

**Outline of CDM/JI study and Global warming measures clean
development mechanism study
Investigation on power generation by the methane capture
from the municipal waste in Vietnam
Nippon Mining Research & Technology Co., Ltd**

(1) Basic factor on project execution

Outline of proposed project and background of planning

Ho Chi Minh City was called Saigon City before and is the largest city in Vietnam, and has the largest harbors, and the center of the commerce and then industry. The main economic activity of Ho Chi Minh City is a commerce and industry. It is forecasted that the service section accounts for 53.1% of GDP in 2005, accounts for 54% in 2010, and the industry and construction section account for 45.7% in 2005, account for 45.3% in 2010. According to statistics in 2003, 20,000 enterprises are acting on the 13 industrial parks(3 export bases and 1 high-tech park are possessed) in Ho Chi Minh City. In addition, there are several thousand of hospital, individual clinic, and health center in Ho Chi Minh City with 5,547,900 residents (2002). A municipal waste of 4,500~5,000 ton of every day, a construction and demolition waste of 1,000~1,100 ton, and industrial waste of 1,000 tons (200 tons are the toxic waste and 7~9 ton are the hospital wastes in among these) have been exhausted from these facilities in 2003. The amount of the exhaust in the future increases 10~15% every year, and garbage from the home is forecasted on 1.0kg/person·day, becoming 6,324 tons in total/day in 2010.

The scale of the landfill in one place becomes full in about ten years. It needs to construct the landfill one after another. Damping the waste keeps increasing in Ho Chi Minh City in suburbs. The organic material is resolved underground because the closed landfill doesn't do special treatment and methane (LFG) has been generated. Especially, because there are no restriction it discharges as it is, and one of the causes of greenhouse effect.

This project is the power generation by using collected LFG (The main component is a methane and carbon dioxide) generated from the Dong Thanh landfill in the Hoc Mon district, northern part of Ho Chi Minh City. The Dong Thanh landfill has divided into three divisions (compartments).

Division -1 is of the reclamation of the municipal waste it place at first operation and is the largest amount of waste of reclamation it, and considered best for the collection of LFG. The Dong Thanh landfill is now used for the construction waste dispersal after the municipal waste is stopped of reclamation it in 2002.

In this project, the LFG collection well is set up for the part of reclamation from comparatively new surface of the earth to the upper part and LFG of division -1 is injected and collected by blower. The gas engine is operated by using collected LFG and electricity is generated. The generated power is connected with the wiring for the vicinity and supplied to the grid. As for excess LFG not used with the gas engine, it is combusted by the flare stack.

Ten years from 2007 to 2016 have been scheduled for the project period based on the amount of the LFG generation.

General Situations of host country

1) General Situations

Name of the country: Socialist Republic of Viet Nam

Population: 79.71 million (2002)

Population increase rate: 1.31% (2002)

Area: 329,200 km² (0.88 of Japan)

Population density: 227 /km²

Capital: Hanoi (Population: 2,841,700 as in June 2002)

Language: Vietnamese and other four rural racial language

Religions: Buddhism 80%, Catholicism, Caodaism and so forth

Ethnic groups: Kinh occupies about 90% of the population, sixty rural minority races consisting mainly in mountain zones

History: A southernmost end country of the Chinese cultural zone experienced control of China for over one thousand years

1976: Reunification of South and North Viet Nam (Socialist Republic)

Policy and situation concerning CDM/JI such as criteria of introducing of CDM/JI in host country and establishment situation of DNA etc.

Vietnam ratified United Nations Framework Convention on Climate Change (UNFCCC) on 16 November 1994 and Kyoto Protocol (KP) on 25 September 2002.

The Ministry of Natural Resources and Environment (MONRE) was assigned by Government of Vietnam as a National Focal Agency for taking part in and implementing the UNFCCC and KP. The International Cooperation Department of MONRE was designated National Authority (CAN) for CDM in Vietnam in March, 2003. It plays functions as the Designated National Authority (DNA) for CDM in Vietnam.

CDM National Executive and Consultative Board (CNECB) was established in April 2003 and chaired by Director General of the International Cooperation Department, MONRE.

CNECB consists of 12 representatives from 10 departments.

Vietnamese government recognizes the influence on the home country by global warming well, and is grappling with the problem of Global warming measures including the international cooperation. Concretely

- (a) Technical study for the productivity continuation in the region for the big climate change and the region with the possibility of going under water.
- (b) Study for protection of ecosystem of coast and various living things
- (c) Research on surface of the sea
- (d) Uplift to people's environments consideration
- (e) Reform of present organization mechanism to promote measures against the climate change and rise in surface of the sea
- (f) Promotion of cooperation with international level, especially Southeast Asian nations

Moreover, 15 items related to energy, 3 items related to agriculture, and the land use change and the forest are examined as the measures of the greenhouse gas reduction.

Execution System of investigation(country, host country, and others)

(country)

Nippon Mining R&T: General investigation, economy evaluation, GHG exhaust examination, baseline, monitor examination, parties concerned hearing, and environmental impact study, etc.

Japan Energy: The financial plan

Kansai Design company : Project site local survey, equipment design, and the construction cost estimate, etc.

Mizuho Research Institute : Making of PDD

(host country)

HCMC Dept. of National Research and Environment:

Local general matter investigation, various legislation degree investigation support, local parties concerned hearing, others various investigation support

Van Lang University Center for Environmental Technology and management :
Analysis and study of waste and LFG

HCMC Environment company : Counter part of project accomplishment
CDM project support

(2) Project Plan

Concrete content of project

The project activity is recovery of landfill gas (The principal component is a methane and carbon dioxide) emitted from Dong Thanh landfill and generation of electric power using the recovered LFG with a view to reducing the emission of greenhouse gases.

The power produced will be supplied to the local power grid. Excess LFG which may not be used for power generation shall be combusted in flare stacks.

1) LFG collection and pre-treating equipment

The usable area in the object area for the LFG collection is 20.88ha. The targeted waste is from here in the part from GL to 23m upper and LFG is collected by setting up the 28 in total of well installation. Moreover, to consider the interference with the well enough and to collect LFG efficiently at well installation intervals, the well installation interval is set up by 50m pitch. The burial depth of the collection tube is assumed from the upper part of the landfill to 20m in depth. The area of innings a well becomes average about 0.25ha. LFG generated from each collection tube is collected with the connected collection tube, sucked in LFG collection Blower after moisture is removed with the dehydrator, and sent to the gas engine generator.

2) Power generator and power supply unit

The power generating system adopts the gas engine generator in consideration of the power generation efficiency and the investment efficiency, etc. The capacity of the power generator sets up 200kW × 2, five years in full operation and accompany the decrease of the amount of the LFG generation, it becomes partial loading after six years. The Siloxane component included in LFG is adsorbed and removed with the activated carbon. Generated electricity (380V) is connected with the existing power line equipment through a low-pressure switchboard.

3) Excess gas combustion unit

When the power generator is stopped and LFG is excess, LFG is combusted by flare stack.

Project boundary, setting baseline and Proof of additionality

1) Project boundary

This project boundary is the boundary of the Dong Thanh landfill and the grid, for electric power supply to it.

2) Setting of baseline

Consider the following three scenarios as alternatives to the proposed project.
Scenario 1: Continuation of the current situation in this alternative, Dong Thanh

landfill keeps the current practice of discharging LFG to the atmosphere without any treatment.

Scenario 2: Collection and flare combustion of the LFG.

Scenario 3: Collection and use of LFG to generate electric power and supply it to the local grid. Excess LFG is flared.

Scenario 1, 2 and 3 are listed as baseline scenario (to the project scenario). Investment and barrier analyses are made after confirming all the scenarios can be realized under the laws and regulations of Vietnam today. The result leads to the conclusion that scenario 2 and 3 can not be the baseline scenario, while scenario 1 can be the baseline scenario.

3) Proving additionality

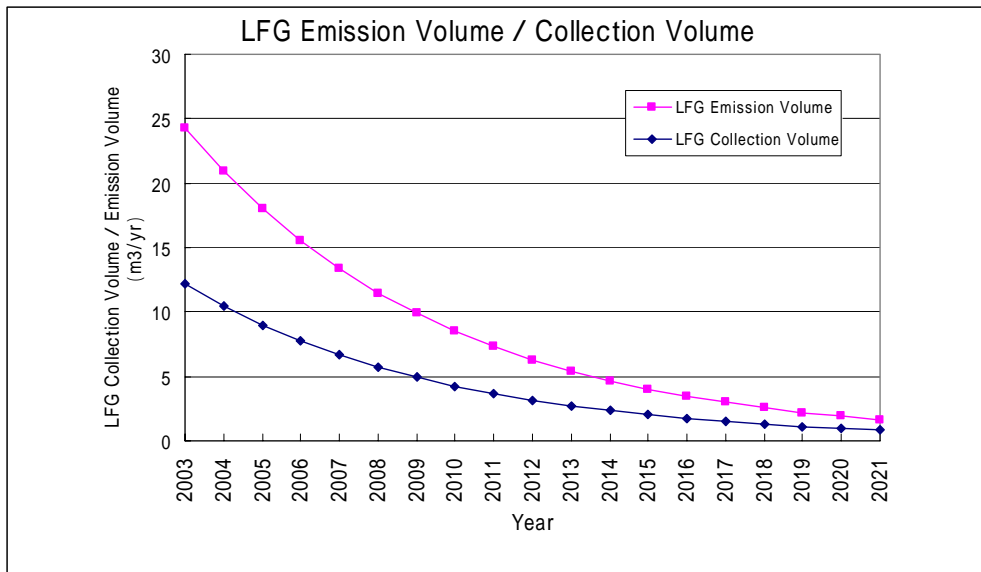
Furthermore, scenario 3, the project scenario can be said to be additional, because it will only be realized when registered as CDM project accompanied by the revenue from CER.

Amount of GHG reduction by project execution and leakage

The amount of the LFG generation and the collection amount calculation condition of compartment-1 of the Dong Thanh Landfill are shown below.

| Item | symbol | Unit | In put value |
|--------------------------------------|--------|-------------------|--------------|
| Annual waste dumping | R | t/年 | 550,000 |
| methane generation constant | k | /年 | 0.15 |
| Methane generation potential | Lo | m ³ /t | 99 |
| start of targeted waste dumping year | - | 年 | 2001 |
| end of targeted waste dumping year | - | 年 | 2002 |
| methane gas content in LFG | F | % | 50 |
| Recovery efficiency | - | % | 50 |
| LFG accuracy | - | % | - 20 |

The amount of the LFG generation and the amount of the collection Volume calculated on the above-mentioned condition are shown below.



Amount of reduced CO₂ exhaust by Power generation use and flared combustion of LFG is

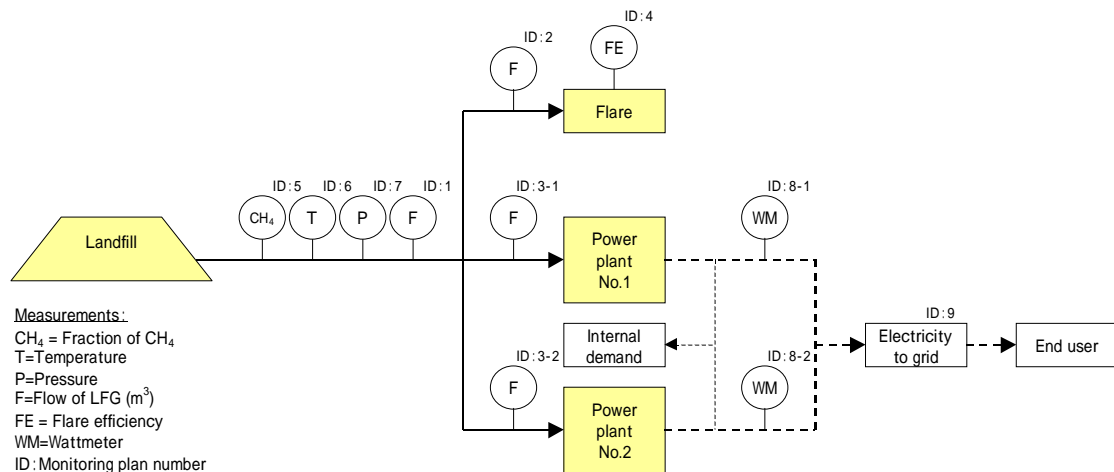
| year | Net LFG generation | Power generation use LFG | flared combustion LFG | Methane recovery | CO ₂ reduction |
|------|--------------------|--------------------------|-----------------------|------------------|---------------------------|
| | m ³ | m ³ | m ³ | tCH ₄ | tCO ₂ |
| 2007 | 5,305,608 | 2,123,820 | 3,181,788 | 1,655 | 34,761 |
| 2008 | 4,565,088 | 2,123,820 | 2,441,268 | 1,427 | 29,968 |
| 2009 | 3,929,112 | 2,123,820 | 1,805,292 | 1,231 | 25,853 |
| 2010 | 3,380,256 | 2,123,820 | 1,256,436 | 1,062 | 22,301 |
| 2011 | 2,909,808 | 2,123,820 | 785,988 | 917 | 19,256 |
| 2012 | 2,509,056 | 2,038,867 | 470,189 | 793 | 16,646 |
| 2013 | 2,160,576 | 1,950,768 | 209,808 | 684 | 14,373 |
| 2014 | 1,855,656 | 1,675,458 | 180,198 | 588 | 12,344 |
| 2015 | 1,594,296 | 1,439,478 | 154,818 | 505 | 10,606 |
| 2016 | 1,376,496 | 1,242,828 | 133,668 | 436 | 9,157 |
| 合計 | 29,585,952 | 18,966,499 | 10,619,453 | 9,298 | 195,263 |

The amount of the reduced CO₂ exhaust and the amount of the total reduction when the generated power is supplied to the grid.

| year | Annual power generation | Grid CO ₂ reduction coefficient | Grid CO ₂ reduction | Total CO ₂ reduction |
|------|-------------------------|--|---|---------------------------------|
| | EG _y | CEF _{electricity,y} | EG _y *CEF _{electricity,y} | |
| | kWh | kgCO ₂ /kWh | tCO ₂ 相当 | tCO ₂ |
| 2007 | 2,663,270 | 0.391 | 1,042 | 35,802 |
| 2008 | 2,663,270 | 0.391 | 1,042 | 31,010 |
| 2009 | 2,663,270 | 0.391 | 1,042 | 26,894 |
| 2010 | 2,663,270 | 0.391 | 1,042 | 23,342 |
| 2011 | 2,663,270 | 0.391 | 1,042 | 20,298 |
| 2012 | 2,556,739 | 0.391 | 1,000 | 17,645 |
| 2013 | 2,447,249 | 0.391 | 957 | 15,330 |
| 2014 | 2,101,024 | 0.391 | 822 | 13,166 |
| 2015 | 1,805,105 | 0.391 | 706 | 11,312 |
| 2016 | 1,559,493 | 0.391 | 610 | 9,767 |
| 合計 | 23,785,963 | | 9,302 | 204,565 |

Monitoring plan

The monitor plan of this project is held based on ACM0001 Approved Consolidated Baseline Methodology (integration baseline methodology of the LFG project activity) that is approved and registered by UNFCCC Execution Board. Thermal energy is not included in the part of the use of thermal energy in this project because it doesn't use it. The monitoring plan of this project (monitor item etc.) is shown below.



Environmental impact/other indirect influence(Include it in the risk investigation)

result at a forestation.)

1) Environmental favor

- (a) When LFG is collected, the leachate is collected at the same time. Therefore, it contributes to the health enhancement of the resident in the surrounding being expected the water quality improvement because the amount into which the poisonous substance is taken while draining it decreases, too.
- (b) The problem of the stench can be reduced by the LFG collection.
- (c) It can be reduced the danger of the autogenous ignition and the explosion around the landfill.
- (d) The risk of the health damage of people (20,000 people or more) who are called Scavenger that hunts the having value thing in the landfill it place decreases.

2) Economy and social favor

- (a) It is expected an employment increase that relates to the management of facilities introduced into the project site, Dong Thanh landfill.
- (b) The demand such as the lubricants and sub-materials is generated by the project execution, and it contributes on the economic front.
- (c) It contributes to the power supply in the city where the electric power supply and demand is stringent.

3) Effect of technology transfer

- (a) The methane collection technology, the flare combustion, and power generation technology using the LFG has been hardly introduced in the landfill in Vietnam now. Those operation control technology, equipment maintenance technology, etc. are transferred to the site of this project, Dong Thanh landfill, through the operator education given by local parties concerned when this project is executed. The transfer of an advanced waste management technology not only connects of the whereabouts region of Dong Thanh landfill with the bottom up of technology but also is expected for other regions of Vietnam the effects that a concerned technology spreads in future.

Stakeholder Comments

Concrete comments such as of the local populace, the local administration, Ho Chi Minh City the natural resources environment divisions, and Van Lang universities on this project are as follows.

1) Comment of the resident neighboring Landfill

The residents do not pay attention on what is the meaning of CDM Projects. They just simply think that if any environmental incident or polluted environment

phenomenon occurs in the neighboring areas, they will strongly protest the activities inside landfill and ask for environmental improvement and compensation.

2) Comment of the local government

Lower local authorities strictly execute and enthusiastically support CDM Projects if this project is approved by higher authority level.

Most of them do not like the landfill located in their competence territories. However, investments for improving environmental safety or preventing risk of environmental incidents for existing landfills such as CMD Projects are welcomed. They promised that they will assist and support investors in implementing process through guiding local residents to strictly execute legislations and regulations relating these projects.

3) Comment of the HCMC government

People's Committee of HCMC encouraged foreign investment on environment projects, especially CDM Projects. The Budget of HCMC is limited, so it is mainly paid for urgent demands such as safely disposal. They will direct Functional Departments on guiding and assisting implementation of CDM Projects

4) Comment of Environmental management Agency (Natural Resources and Environment Department)

According to "Strategy of Environment Management of HCMC until 2010", DONRE considers that this CDM Project conforms to Development Orientation of Solid Waste Management. Advanced Technology for Solid Waste Management such as waste-to-energy is not priority solution in short-list of projects using local government budget in the time being. DONRE encourages CDM-investment into this field and promises to assist and guide implementation of the project, desires to carry out the program of CMD as soon as possible.

5) Comment of Van Lang University

Van Lang University especially staffs of department of environmental technology and management have researched on landfills for years, so they respect CDM program. developing this program not only brings good chance to improve waste treatment conditions in Ho Chi Minh city but also helps them access to new technology. Dong

Thanh landfill emitted offensive smell ten years ago, but it is much better now. In latest investigation they drill 9 holes and Methane fired on flare could be clearly observed, so Dong Thanh landfill should be a significant objective in CDM project.

(3) Toward the project execution

System of project execution (country, host country, and others)

(country)

Nippon Mining R&T : Detailed investigation, Technical guidance, operation and maintenance worker training, Equipment procurement, government negotiation, CDM promotion, and business verification, etc.

Japan Energy: The financing plan

Kansai Design company: Equipment design, field erection work, test operation, performance confirmation, and technical assistance

Mizuho Research Institute : CDM promotion support

(host country)

HCMC Dept. of National Research and Environment:

Negotiation with Vietnamese government, various legislation degree procedure, and local construction support

Van Lang University Center for Environmental Technology and management :

Analysis of LFG and Environment

HCMC Environment Company : Local construction support, waste reclamation disposal place management, and LFG collection equipment operation management

The financing plan for project execution

1) Amount of budget (construction cost): 123.5 million yen

2) Choices of procurement of the finance

(a) A necessary capital collection plan is settled on in Japan on the assumption of the debt from the Vietnamese side city bank. Japan guarantees if necessary.

(b) Japan leases equipment to Vietnam, and Japan receives the rental revenue from the profit after equipment operates.

(c) Equipment is exported from Japan, and the Japanese side enterprise treats the capital of the export finance etc.

(d) Japan raises the capital as a carbon credit, and Japan secures the amount of the CO2 exhaust reduction reduced as CDM project.

Regarding above, case (a) is difficult as long as the policy that peels off and is borrowed as CDM business in an advantageous interest rate Vietnam domestically is planned. Because it is difficult to produce equipment in Vietnam, case (c) is possible. When the profit of the project is high, the lease from the leasing company is also possible in Japan (case (b)). It will be expected that the enterprise in Japan donates the capital if the scheme of CDM becomes clear in the future.

Cost-effectiveness

IRR becomes -5.99% when power generation activities are done and cannot collect the investment without the CDM business.

IRR became + when the unit price of the carbon credit was comparatively low 3\$ when there was power generation with the CDM business. IRR improves to 8.38% when the credit unit price is 5\$ and as the influence of the credit unit price is large. Moreover, does IRR becomes - for not being power generation (Only flared) at the time of 5\$ or less in credit unit price because it cannot expect the incomes other than credit. However, because the equipment cost becomes below the half compared with the case with power generation when the credit unit price becomes 7.5\$ or more, IRR is improved. It can be said that the influence of the credit unit price is larger than the case with power generation when there is no power generation. Moreover, the influence of the cost of construction is about 5% even if it is a change of 20%, electricity is generated, it exists, and it is not it against IRR.

The profitability deteriorates further when there is no power generation, considering having to pay a part of the carbon credit to the locale when the CDM business is executed. Moreover, the income of the whole project in the case with power generation, considering voluntarily secure the electric power of the Dong Thanh Landfill, the advantage of the exhaust reduction in the grid in Vietnam, selling of electricity to a power company income the locale, can be an attractive project.

IRR result by each credit unit price and presence of power generation

| Credit unit price US\$/ t CO ₂ | 0 | 3 | 5 | 7.5 | 10 |
|---|-------|------|------|-------|-------|
| power generation. IRR(%) | -5.99 | 3.58 | 8.38 | 13.97 | 19.35 |
| No power generation IRR(%) | - | - | - | 7.07 | 19.82 |

Influence of IRR by equipment cost change by credit unit price 7.5\$

| Change of the construction cost (%) | -10 | -5 | 0 | +5 | +10 |
|-------------------------------------|-------|-------|-------|-------|-------|
| power generation IRR(%) | 16.58 | 15.22 | 13.97 | 13.19 | 11.77 |
| No power generation IRR(%) | 9.66 | 8.31 | 7.07 | 5.90 | 4.81 |

Expectations and problems for realization

This project is the collection of LFG from the landfill, combustion with flare or the gas engine. As for the landfill, a lot of stink complaints are being sent by the vicinity resident. The LFG collection is thought to be an effective method as a means of the stink prevention. If the methane in LFG makes this CDM project possible there is greenhouse effect 21 times of CO₂, a lot of carbon credits are obtained with the reduced methane. The LFG collection equipment is expected to make this an income source because it is difficult to manage to raise these cost in Vietnam.

It is First Order Decay as the method of forecasting the amount of generation of LFG from the landfill. Proving LFG like the calculation actually result it is generated cannot request an accurate amount of the CO₂ reduction because it is difficult though Model was used. It is necessary to examine data like amount of generation and chemical composition (silica etc.) analyses etc. of LFG closely as a small-scale local test is executed. In addition, it is thought that the capacity bldg. in which it centered on the local government is necessary for the CDM business .

(4) Validation/Determination(When you do this process.)

Outline of Validation (Determination) or desk review

Passage of communication with OE