

Feasibility Study on CH₄ Gas Extraction and Utilization from Landfill in Romania

Final Report
Summary

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Objective and Outline of Survey

In the Kyoto Protocol adopted at the third session of the Conference of the Parties (COP3) to the United Nations Framework Convention on Climate Change held in December 1997, it was stipulated that Japan should cut emissions by 6% from 1990 levels on average during the 2008 - 2012 period (5% reduction on average for advanced countries from 1990 levels) to prevent global warming by Greenhouse Gas (GHG), most notably carbon dioxide. Emissions Trading, the Clean Development Mechanism (CDM) and Joint Implementation (JI) were incorporated as Flexibility Mechanisms (Kyoto Mechanism) to aim at achievement of this reduction objective in international cooperation.

A broad agreement on the operational rulebook for the Kyoto Protocol including the Kyoto Mechanism was reached at COP6 held in Bonn, Germany in July 2002, and the final agreement was reached at COP7 held in Marrakech, Turkey in October - November 2002. Following this, Japan ratified the Kyoto Protocol on June 4, 2003 and became the 74th signatory.

The Government of Japan has formulated the New Climate Change Policy Programme as measures to achieve the reduction target and is promoting measures centering on the Programme. Under such circumstances, the importance of positively utilizing the Kyoto Mechanism is increasingly high.

In CDM/JI projects, emission control and utilization of methane (CH₄) gas are expected to be promoted due to the fact that methane gas has 21 times more greenhouse effect than carbon dioxide, and that the cost of countermeasures is relatively low. It is very significant for Japan, where the cost of achieving the GHG reduction target is higher than other foreign countries, to deepen the knowledge concerning utilization of methane gas.

In Romania, methane gas accounts for approximately 19% of GHG emissions next to carbon dioxide. Of methane gas emissions, those from solid waste account for no less than approximately 25%, thus, the reduction of methane gas emissions is required.

This study investigated the basic situation of Romanian efforts to cope with global warming measures and waste disposal systems as well as studying the system of effectively utilizing landfill gas (LFG) focusing on the Parta-Sag Landfill located in the suburb of Timisoara City, a major city in the west of Romania, as the project implementation site.

The feature of this study is a precondition that the local municipality implements closure of the subject landfill and LFG collecting and flare burning facilities using EU funds. Project developers implement the LFG utilization business following the closure, etc. by the local municipality.

As a result of the study on LFG utilization, the plan to supply collected LFG to heat generating boilers to be newly installed at a nearby thermal power plant as combustion gas was judged adequate. Therefore, the feasibility of this proposal as a JI project was studied.

1. Outline of Romania

1) Efforts to cope with global warming measures

Romania ratified the United Nations Framework Convention on Climate Control in 1994, and the Kyoto Protocol thereto in 2001. Romania's reduction target of GHG emissions in the Kyoto Protocol is 8% from the base year level of 1989. The base year differs for each Party to the Convention (normally 1990), and the base year for Romania was set as 1989 because its GDP drastically declined from the following year of 1990. Romania's assigned amount for the first commitment period from 2008 to 2012 is 24.4 million tons CO₂ equivalent (CO₂-eq) per year. Meanwhile the climate change measures in Romania are mainly promoted by the National Commission on Climate Change (NCCC) established by the Ministry of Agriculture, Forests, Waters and Environmental Protection and the Joint Implementation Unit that manages activities concerning the JI Project in cooperation with the said Ministry.

2) GHG emissions of Romania

According to the National Inventory Report 2001 of Romania issued in 2003, the total GHG emissions in Romania in 2001 was approximately 148 million tons CO₂-eq, of which the energy section accounted for 79% followed by the agricultural section accounting for 8% and the waste section accounting for 7%.

The largest emission source of methane in that year was the production process (mining, treatment, transportation and supply) of oil/natural gas/coal (39.4%) followed by solid waste disposed by landfill (24.8%).

Thus in Romania, methane from solid waste makes up a large proportion of GHG emissions, and in a future forecast of methane emissions, emissions from the waste disposal is forecasted to account for approximately 40% of methane emissions in the entire country in 2010. Therefore, in reducing GHG emissions, reduction of methane emissions from landfills is required.

3) Situation of LFG utilization in Romania

(1) Efforts toward utilization of LFG in Romania

Currently, collection of LFG from landfills is not conducted in Romania for the following reasons.

- There is no law that makes utilization of LFG obligatory.
- Local municipalities that are direct or indirect owners of landfills cannot afford to make a capital investment for collection and utilization of LFG.
- There is no one in Romania who can provide technologies of collecting and effectively utilizing LFG.

From 2010, however, according to the Government Decision on the landfill of waste 162/2002, it is made obligatory for landfills to collect LFG for either flare burning or utilization from the operation stage.

It is predicted that collection and utilization of LFG will be steadily promoted in Romania in the future.

(2) Measures and aid system

In Romania, the presence of landfills has caused serious regional, environmental problems. Namely, there are concerns regarding groundwater pollution in addition to ignition and explosion, scattering and offensive odor of garbage, impairment of the landscape and outbreak of pests, which currently threatens the safety of the entire region.

The current standards Technical Normative on landfills 1147/2002, which controls the management of landfills, require that landfills release LFG at the closing stage for safety reasons, but flare burning and utilization are not made obligatory. The closure of landfills, which will reach capacity in the future, by setting water resistant layers and using technologies of collecting and utilizing LFG is desirable.

As an international aid system, the Instrument for Structural Policies for Pre-Accession (ISPA) has been implemented by the EU in the environmental field for central and eastern European countries that are negotiating to join the EU. Romania has its own financial aid program, the National Environmental Fund, which is scheduled to start in 2004. For the future, national aid to projects for improving the environment will be implemented.

With regard to the Parta-Sag Landfill, an object of this project, the local municipalities have applied for EU ISPA funding and are planning to close the landfill site and install LFG collecting facilities and flare burning facilities using the ISPA funds.

2. LFG utilization project at Parta-Sag Landfill

1) Outline of Project

This project plans to transport LFG, which is collected at the Parta-Sag Landfill (total area of 17 ha, as waster of approximately 1.5 million tons has been dumped so far, the landfill is already nearly full), to the Termocet South Thermal Power Plant (hereinafter referred to as "Termocet"), use it as fuel of heat generation boilers to be newly installed in the site of Termocet and supply generated heat to Termocet at wholesale.

This enables Termocet to reduce the amount of fossil fuels (lignite) to be used.

2) Project schedule and CO₂ crediting period

The installation work for gas transportation and facilities for utilization will be implemented at the same time as the local municipality closes the Parta-Sag Landfill and implement the closing work and installation work for LFG collecting facilities in 2005.

The project implementing schedule was made on the assumption that the operation of the facilities will start in January 2007 and continue until the end of 2017.

The Emission Reduction Unit (ERU) acquisition period was assumed to be 10 years from January 2008 to December 2017, namely the first commitment period (2008 - 2012) and the second commitment period (2013 - 2017) stipulated by the Kyoto Protocol.

The outline of the schedule for implementing the project is shown below.

2005 Jun.	Finish of landfill operation
2005 Jul. ~ 2006 Dec.	Closing work, installation work for LFG collection facilities and LFG utilizing facilities
2007 Jan.	Start of operation
2008, Jan. ~ 2017 Dec.	ERU acquisition period (1st and 2nd commitment period of Kyoto Protocol)
2017 Dec.	End of operation

3) Estimated generation and collection amounts of LFG

The LFG generation amount was calculated using the LandGem E-PLUS model.

The amount is estimated to be approximately 4.1 billion m³/year in 2007, the starting year for the project, and to reduce over time to approximately 2.7 billion m³/year in 2017, the final year for the project.

The collectible amount was assumed to be 75% of the generation amount.

The LFG generation amount and LFG collectible amount during the project period are shown in Figure 1.

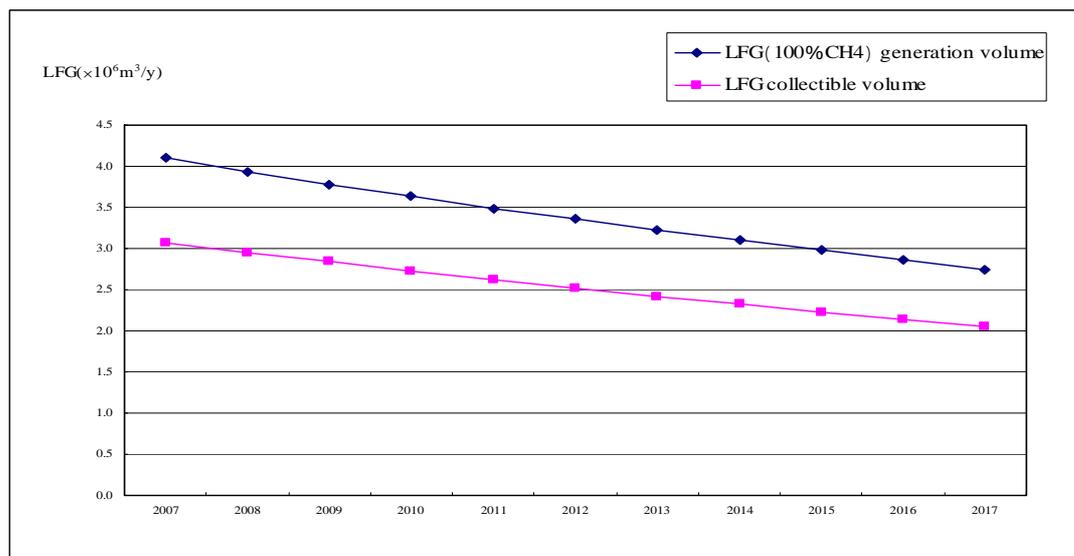


Fig. 1 Generation and collectible amounts of LFG

4) System of utilizing LFG

The capacity of the facility for utilizing LFG was set to be a heat generating boiler 1.3 Gcal/h x 2 units, in consideration of the collection amount of LFG during the project period and flexibility of operation.

The operating condition of the facility for utilization is that all of the LFG collected is burned at heat generating boilers and that Termocet takes in all of the hot water generated.

5) Project flowchart and system boundary

This project plans to utilize collected LFG at heat generating boilers to be newly installed in the site of Termocet nearby. The system boundary covers the gas purification facility, gas boost up facility, gas pipeline of approximately 4.5 km from the landfill to Termocet, burning of LFG at newly installed heat generating boilers in the site of Termocet and supply of hot water to Termocet at wholesale.

The project flowchart and the system boundary are shown in Figure 2.

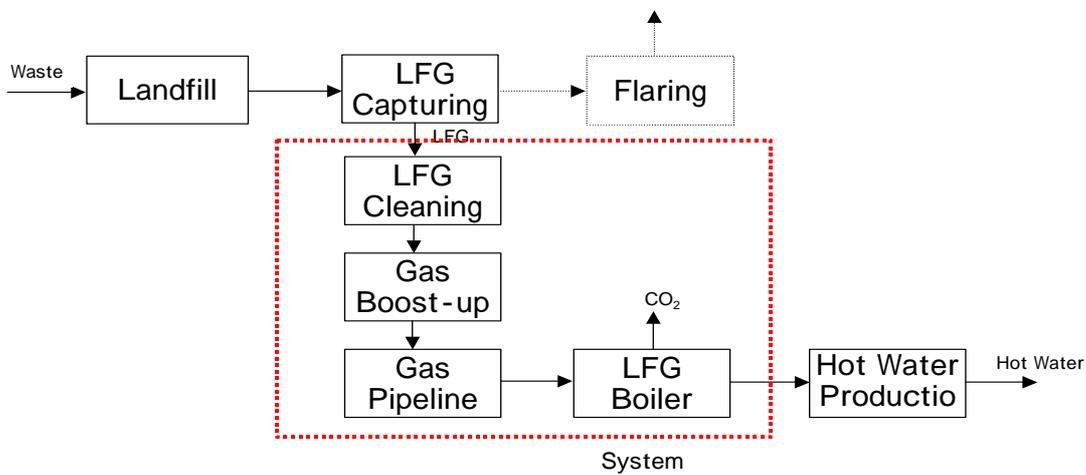


Fig. 2 Project flowchart and system boundary

6) Baseline study

Of the following five scenarios conceivable as a baseline scenario, Scenario 2 was selected as a baseline.

- Scenario 1: Continuation of current situation
- Scenario 2: Closure of landfill, installation of LFG collecting facility and flare burning of LFG by local municipality using ISPA funds
- Scenario 3: Implementation of this project
- Scenario 4: Implementation of this project after a lapse of several years
- Scenario 5: Implementation of the project using other technology

Reasons for making Scenario 2 a baseline are shown below.

- (1) In consideration of Romanian accession to EU in 2007, it is highly probable that this landfill causing high environmental load would be closed and that collection of LFG and flare burning would be implemented based on EU laws and regulations.
- (2) This project proposal cannot obtain cost effectiveness that can attract private investment without the income from ERU and improvement of cost effectiveness will not be made even after a lapse of several

years.

- (3) Implementation of the project using other technology is not realistic because this project proposal is the best from the social, environmental, institutional, and economic aspects. Neither of the projects can obtain cost effectiveness that can attract private investment without the income from ERU.

3. Evaluation of feasibility

1) Calculation of GHG emission reduction amount

The calculation result of GHG emission reduction is shown in the table below.

The GHG emission reduction is expected to be approximately 86,000 tons CO₂-eq for the project period of 11 years, of which the GHG emission reduction for the first commitment period is approximately 43,000 tons CO₂-eq and that for the second commitment period is approximately 34,000 tons CO₂-eq.

Year	Volume of LFG Recovery (m ³ /y)	Emission on Baseline	Emission on LFG Utilization		Emission Reduction on LFG Utilization (t-CO ₂ /y) R1=b-(p1+p2)	Emission Reduction on Termocet Co. (Decrease of Coal Consumption) (t-CO ₂ /y) (R2)	Emission Reduction of the Project (t-CO ₂ /y) Rt=R1+R2
		Emission on LFG flared (t-CO ₂ /y) (b) (Note)	Emission on Heat Boiler LFG fired (t-CO ₂ /y) (p1) (Note)	Emission on LFG Booster driven (t-CO ₂ /y) (p 2)			
2007	3,072,750	0	0	900	-900	10,594	9,694
2008	2,952,000	0	0	900	-900	10,178	9,278
2009	2,836,500	0	0	900	-900	9,780	8,880
2010	2,725,500	0	0	900	-900	9,397	8,497
2011	2,618,250	0	0	900	-900	9,027	8,127
2012	2,515,500	0	0	900	-900	8,673	7,773
2013	2,417,250	0	0	900	-900	8,334	7,434
2014	2,322,000	0	0	900	-900	8,006	7,106
2015	2,231,250	0	0	900	-900	7,693	6,793
2016	2,143,500	0	0	900	-900	7,390	6,490
2017	2,059,500	0	0	900	-900	7,101	6,201
合計	27,894,000	0	0	9,900	-9,900	96,174	86,274

(Note) The CO₂ emissions resulting from the flaring and burning of the methane are not accounted according to IPCC inventory guidelines.

2007	9,694
2008 ~ 2012 (1st Commitment Period)	42,555
2013 ~ 2017 (2nd Commitment Period)	34,024
Total (CO₂-ton)	86,274

[Factors for GHG emission reduction]

- (1) The methane emission reduction by collection of LFG is zero because the baseline is for the local municipality to close the Parta-Sag Landfill and to implement LFG collecting and flare burning facilities.
- (2) The GHG emission reduction by replace of fossil fuel (lignite) used at the Termocet, which is accompanied by reduction of the heat generating amount at the Termocet brought about by wholesale supply to the Termocet of hot water produced by burning of LFG at heat generating boilers, is

approximately 96,000 tons CO₂-eq.

[Factor for GHG emission increase]

The GHG emission increase accompanied by operation of incidental facilities in relation to utilization is approximately 10,000 tons CO₂-eq.

2) Economic evaluation of the project

As this project is based on the assumption that the local municipalities will close the landfill and develop LFG collecting and flare burning facilities using the EU ISPA funds, the investment amount is approximately 1.3 million Euro, being limited to facilities (refining, transportation, boilers, etc.) in relation to utilization. On the other hand, the GHG emission reduction is reduced to a great extent, resulting in a small amount of ERU income.

The expense related to the closure and LFG collection and flare burning is estimated to be approximately 5 million Euro.

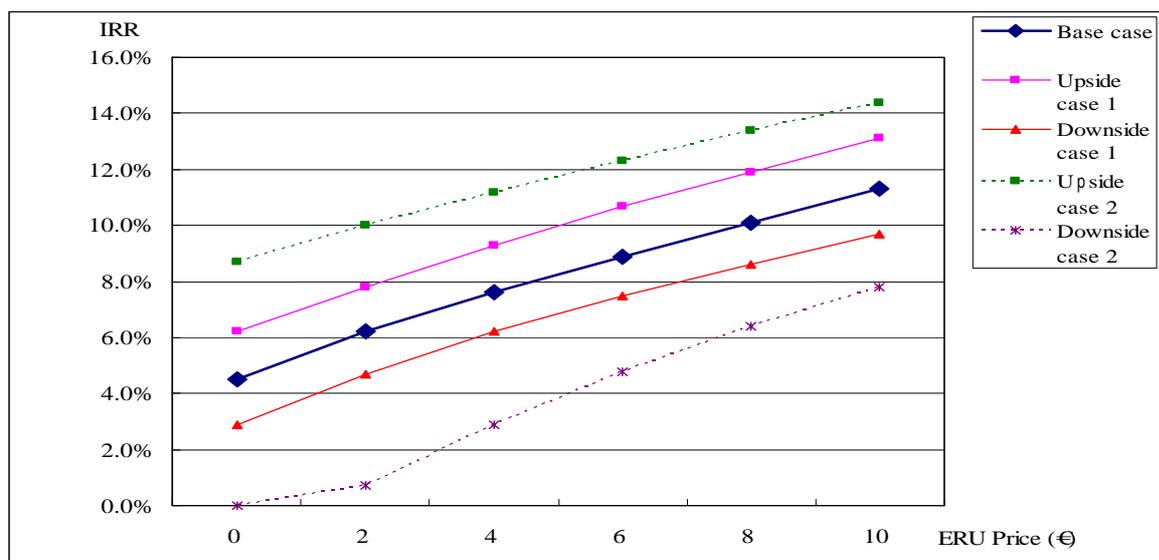
With regard to the cost effectiveness of this project, a sensitivity analysis was conducted for the ERU income between Euro 2/ERU and Euro 10/ERU.

The project IRR without ERU income is 4.5%, the project IRR with Euro 10/ERU is 11.3%.

The result shows that the project is not feasible if there is no ERU income. In addition, considering the guaranteed rate of a 10-year Rumanian-government bond for 0.7 million Euro is 8.5% (redeemed in August 2012), project IRR with Euro 10/ERU which is only close to the bond rate implies that investment of private firms for long-term business might be difficult.

When heat sales price increase of 10%, a project IRR is 14.4% with Euro 10/ERU, and the project has a possibility to be economically feasible (upside case 2).

Therefore, increase of heat sales price through the negotiation with Timisoara City is indispensable to form this project.



3) Issues toward commercialization of utilization of LFG

Issues clarified through this study are summarized as follows.

(1) Detailed study and design of generation and collection amounts of LFG

The estimated generation and collection amounts of LFG at the Parta-Sag Landfill are shown in 2.3). As the generation and collection amounts of LFG are the most basic and important information for the implementation of the project, a detailed study involving drilling must be conducted, based on the result of which a detailed design for utilization is required.

(2) EU funds

This project is based on the assumption that the local municipalities will close the landfill and develop LFG collecting and flare burning facilities using the EU ISPA funds. The expense related to the closure and LFG collection and flare burning is estimated to be approximately 5 million Euro.

As a result, the investment amount in relation to the project development is reduced to approximately 1.3 million Euro, which facilitates investment in the project.

On the other hand, because the baseline is set to be the LFG collection and flare burning, the GHG emission reduction is reduced to a great extent and the income from ERU becomes small as compared to the baseline being set to be a situation where LFG is released into the atmosphere. Therefore, the determination of the feasibility must be made with extreme discretion.

(3) Tender procedure of ISPA

In order to start operation of the project in 2007, a tender procedure must be taken for closing work, and installation work for LFG collecting and flare burning facilities immediately after the provision of ISPA funds is decided, and cooperation from local municipalities (Timis County and Timisoara City) as an enterprising body and from the EU department in charge of funds provision is indispensable.

As utilization of LFG must be considered for design in preparing a tender specification, it is necessary for project developers to secure coordination with local municipalities and the responsible EU department in advance.

Project developers will conduct a detailed study including a drilling survey and design from now on, and in consideration of the above situation, they must implement them in a very short period of time.

(4) Selling price and condition of heat

As both the Part-Sag Landfill and the Termocet are owned by Timisoara City, it is necessary to obtain cooperation from and to hold close consultations with Timisoara City. Items for consultations include use of the landfill/the site in the Termocet, sales quantity of heat, selling price of heat, supply condition of heat, O&M expense and purchase expense of LFG.

(5) Management of landfill

If project developers operate and manage the landfill after its closure, a substantial burden such as pollution prevention and danger prevention in the neighboring environment would be imposed. Therefore, when considering the commercialization, it is necessary to grasp the current situation and to fully study the risk that may arise in the future.

(6) Intergovernmental Minutes of Understanding

At the present time (March 2004), the Minutes of Understanding in relation to JI has not been concluded between the Japanese government, an investment country, and the Romanian government, a host country. The intergovernmental Minutes of Understanding is essential for the implementation of the JI project in Romania.

4) Ripple effect on other regions

Realization of this project will be the first of its kind as utilization of LFG in Romania. Effective utilization of energy in addition to improvement of the regional environment responds to the regional shortage of natural gas resources and to an increase in domestic energy demand. As this is an epoch-making result of utilization of LFG, which has so far adversely affected the environment, its ripple effect will be considerable.

5) Evaluation of feasibility

In consideration of the investment size, utilization of LFG is attractive to JI. And for the host country, this is a useful project in terms of utilization of energy.

When an overall evaluation of this project is made including a small size of GHG emission reduction and issues toward the implementation, it may be difficult to persuade private enterprises to participate in this project.

Therefore, it is necessary to make efforts to solve the issues clarified through this study. It is especially important to deepen the knowledge concerning the generation amount and collection ratio of LFG.