平成16年度環境省委託事業

平成１６年度ＣＤＭ／ＪＩ事業調査

カザフスタンにおける下水汚泥等を活用した

バイオガス発電事業調査

報 告 書

(添付資料)

平成１７年3月

東北電力株式会社

[添 付 資 料 一 覧]

添付資料Ⅰ-1　PROJECT DESIGN DOCUMENT　（英文）

CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>>

Biogas Power Generation utilizing Organic Wastes and Sewage Sludge in Astana

A.2. Description of the project activity:

>>

In Astana City, where the capital of the Republic of Kazakhstan was relocated, environmental problems such as waste disposal are arising with a rapid population influx into the city.

This project is, as a JI project, to introduce an anaerobic cofermentation system into a sewage plant in Astana City and set up a power generation unit which makes use of biogas produced from the system, aiming to ease the environmental problems and realize GHG reductions.

Specifically, at the sewage plant in Astana City, the anaerobiotec cofermentation system is to be created by putting separately collected organic wastes into the existing anaerobiotec digester chamber which has been used to dispose sewage sludge and new digester chambers which are to be installed additionally. Biogas generated from the anaerobiotec cofermentation system is to be introduced to a gas engine to generate electricity.

Currently, two fermentation tanks are being installed at the sewage plant in Astana City. One of them is out of operation while temperature control for the other has not been properly carried out as planned. A project in which rehabilitation of tanks is included has been presently planned by JBIC. Meanwhile, the system to be used in this project is an established technology in Japan.

The followings are measures and policies on GHG and biomass in the Republic of Kazakhstan, which indicates that this project will surely attract the attention from the nation.

- The policy of Ministry of Environmental Protection of the Republic of Kazakhstan, "Concept of the Ecological Security of the Republic of Kazakhstan was approved. In the Concept, the nation's commitment to stabilization of the emissions of pollutants including GHG has been stated.
- The Donor Conference was held in Kazakhstan in 2004 where a project for biogas utilization, along with one for renewable energy, has been proposed.
- Renewable energy has been referred to as a policy in the energy sector and utilization of biomass has been included in the reference. (According to an interview with Astanaenergo that has supplied electricity to Astana City)

Based on the situations above, this project can be placed as the one which can contribute to the nation's energy and environmental policies.

Expected merits for the Republic of Kazakhstan by implementing this project are as follows;

- Sludge treatment at the sewage plant is expected to be upgraded, which can lead to environmental improvement in the region.
- Biomass-fired power generation is expected to reduce the use of fossil fuels, which can improve the atmospheric environment in the region and prevent global warming.
- Effective utilization of wastes can contribute to alleviation of problems of city hygiene and environment through sewage treatment and waste disposal in Astana City.

- This project is expected to make a contribution to the nation's policy to improve the energy self-efficiency ratio stated in "Electric Energy Development Program up to 2030", an electricity development plan of Kazakhstan.
- New employment of local personnel is expected with establishment and operation of new facilities.

＊１：GHG(greenhouse gas): greenhouse effect gas, heat-trapping gas

A.3. Project participants:

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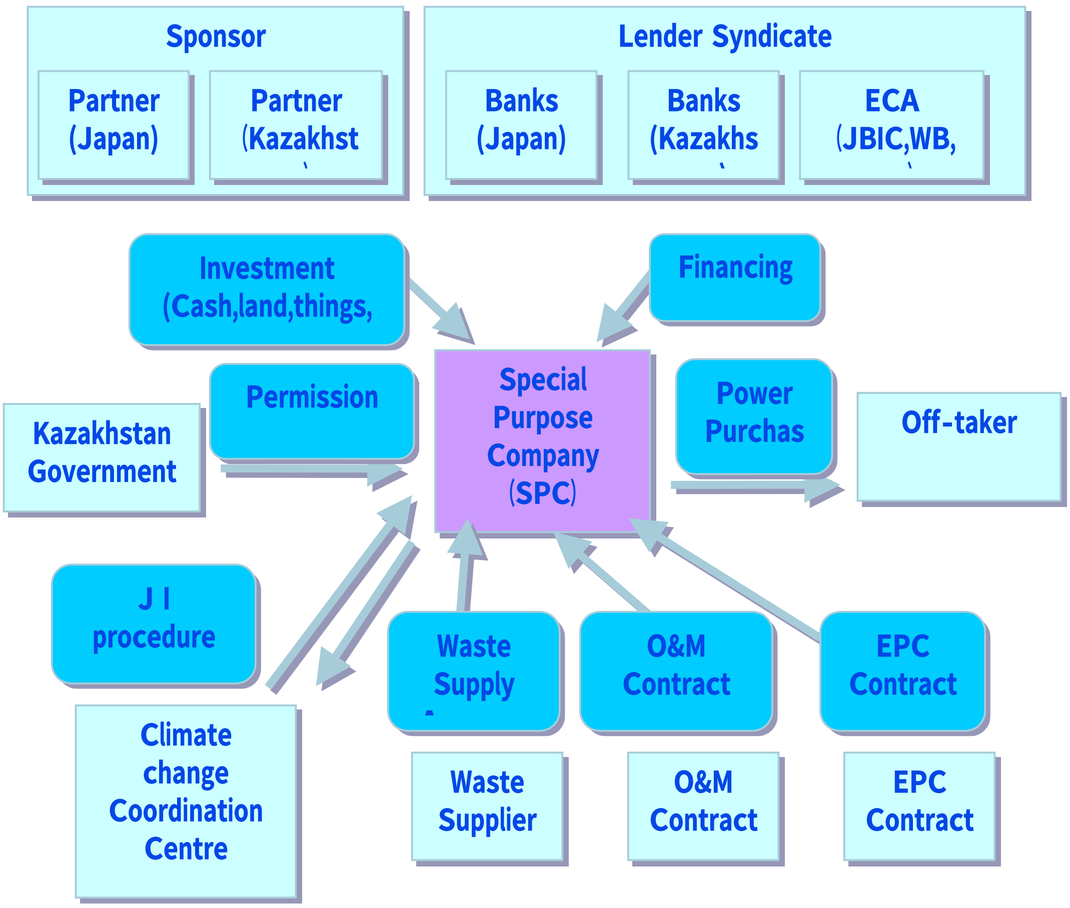
This project is to be implemented by a special purpose corporation jointly set up by Japanese companies, Astana city in the Republic of Kazakhstan and companies in Kazakhstan.

The climate change coordination centre, a secretariat of Kazakhstan for Global Warming Convention, is in charge of matters related to credits as JI.

Tohoku Electric Power Co. is included in the Japanese companies. As to supply of wastes and O&M, the following Kazakhstan companies are to join; Astana Su Arnasy that has administered sewage plants and Gorkommunhoz that has managed solid wastes.



A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

>> The Republic of Kazakhstan

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

>> Akmola Province

A.4.1.3. City/Town/Community etc:

>> Astana City

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

>> Astana City

Astana City is the new capital of the Republic of Kazakhstan. The capital was transferred from Almaty to Astana City in 1997 as the nation became independent. In Astana City, which is currently home to approximately 500,000 inhabitants, the construction of the President's Office, an administrative district and business centres are underway. The city is expecting to be a mega city with a population of one million in 2030 eventually. With problems such as air pollution, water contamination and disposal of urban wastes arising, the city is faced with the challenges to expand and modernize sewage plants as well as to improve waste disposal sites.

A.4.2. Category(ies) of project activity:

>>

１. The Energy Industry (Renewable/Non-renewable)

13. Waste Disposal and Treatment

A.4.3. Technology to be employed by the project activity:

>>

Through the implementation of the project activity to create the anaerobic cofermentation system by installing additional anaerobic digester chambers and use biogas produced from the system for power generation, technologies are to be transferred to the host country as follows.

Working Item	Content	Transfer Method	Remark
Equipment Installation	Installation of project equipment on site	ＯＪＴ＋On-site Instruction	
Trial Run, Performance Testing	Methods of trial run and performance testing	ＯＪＴ＋On-site Instruction	
Designing, Production, Procurement and Transport of Peripheral Facilities	Designing, production, procurement and transport of the project equipment which are built on site	Advice and Instruction	
Methods of Operation, Management and Maintenance	Methods of operation, management and maintenance of the project equipment	Training in Japan	
Monitoring	Monitoring for reduction of CO2 emissions after the launch of operation	Manual	
Data Management	Management of data on CO2 after the launch of operation	Manual	

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

>>

This project is to create the anaerobic cofermentation system by putting separately collected organic wastes into the existing and newly installed anaerobic digester chambers which dispose sewage sludge at a sewage plant in Astana City. Biogas generated from the anaerobiotec cofermentation system is to be introduced into a gas engine as motive energy to generate electricity.

Through this project, GHG emissions can be reduced for the following two reasons.

- By cofermentation of organic wastes and sewage sludge at the anaerobic fermenters, methane gas which is uncollectible as landfill gas (hereinafter referred to as LFG) at the landfill site will be collected instead of being released into the atmosphere.
- By the introduction of the power generation system fuelled by methane gas produced from the anaerobic cofermentation system, this project will be able to replace a part of the grid electricity and contribute to reduction of GHG emitted from fossil fuel-fired generation units of the grid.

This project does not serve as baseline because of technical barriers to adopt a new technology that has never been used in the country as well as investment barriers to newly construct facilities. These barriers can be eliminated by carrying out this project as JI.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

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The crediting period is 21 years. Estimated amount of emission reductions is 73,923 per year. ［t-CO2/year］

Total amount of GHG emission reductions for 21 years is estimated to be 1.55million tons.

A.4.5. Public funding of the project activity:

>>

This project is planned to be carried out as an IPP project and ODA funds are not to be diverted to the project.

SECTION B. Application of a baseline methodology

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

>>

Biogas Power Generation by Cofermentation of Sewage Sludge and Organic Wastes

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

>>

The project, "Biogas Power Generation utilizing Organic Wastes and Sewage Sludge in Astana" fulfils applicable conditions of the methodology of "Biogas Power Generation Utilizing Sewage Sludge" for the following reasons.

- Astana City has no power generation plant utilizing methane gas at a sewage plant.
- Even though policies to develop or prioritise renewable energy are being stated in the governmental energy plan, there is no concrete support system.
- Astana City has sewage sludge disposal facilities at the sewage plant available to this project.
- The landfill site is planning to carry out LFG flaring, however no plan for LFG-fired power generation is being envisioned at present as well as for the future.
- There is no legislation to enforce LFG flaring.
- Sorted collection of organic wastes are planned to be in place in the future.
- There is a coal-fired power plant near the project site from which all electricity is being supplied and no large-scale gas-fired power plant using gas nearby.
- The amount of wastes transported to the landfill site will be gauged with truck scales from 2005.
- The population of Astana City is 500,000 at present and is expected to rise to 1 million in 2030.
- Administrative sections in charge of solid wastes and sewage treatment are being separated.

B.2. Description of how the methodology is applied in the context of the project activity:

>>

With regard to the projects in this methodology, the validity of the baseline scenario shall be judged and the additionality of the project scenario shall be confirmed based on the following barriers.

- Legislation/Institutions, Technical barriers, Investment barriers, Environmental impacts, Regional trend, Market barriers

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

>>

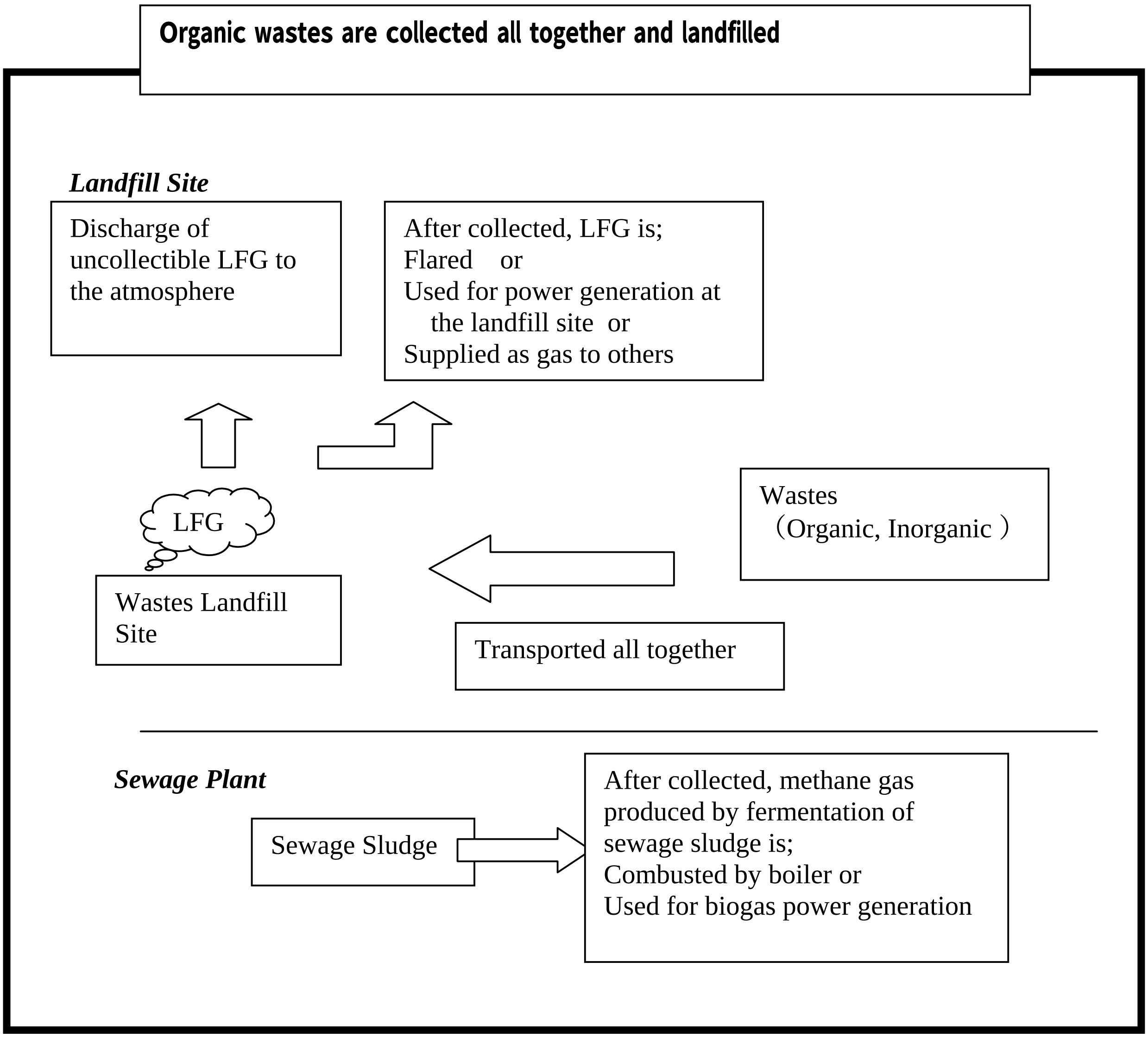
Baseline scenario indicates possible situations which would occur in the region in the absence of a certain project.

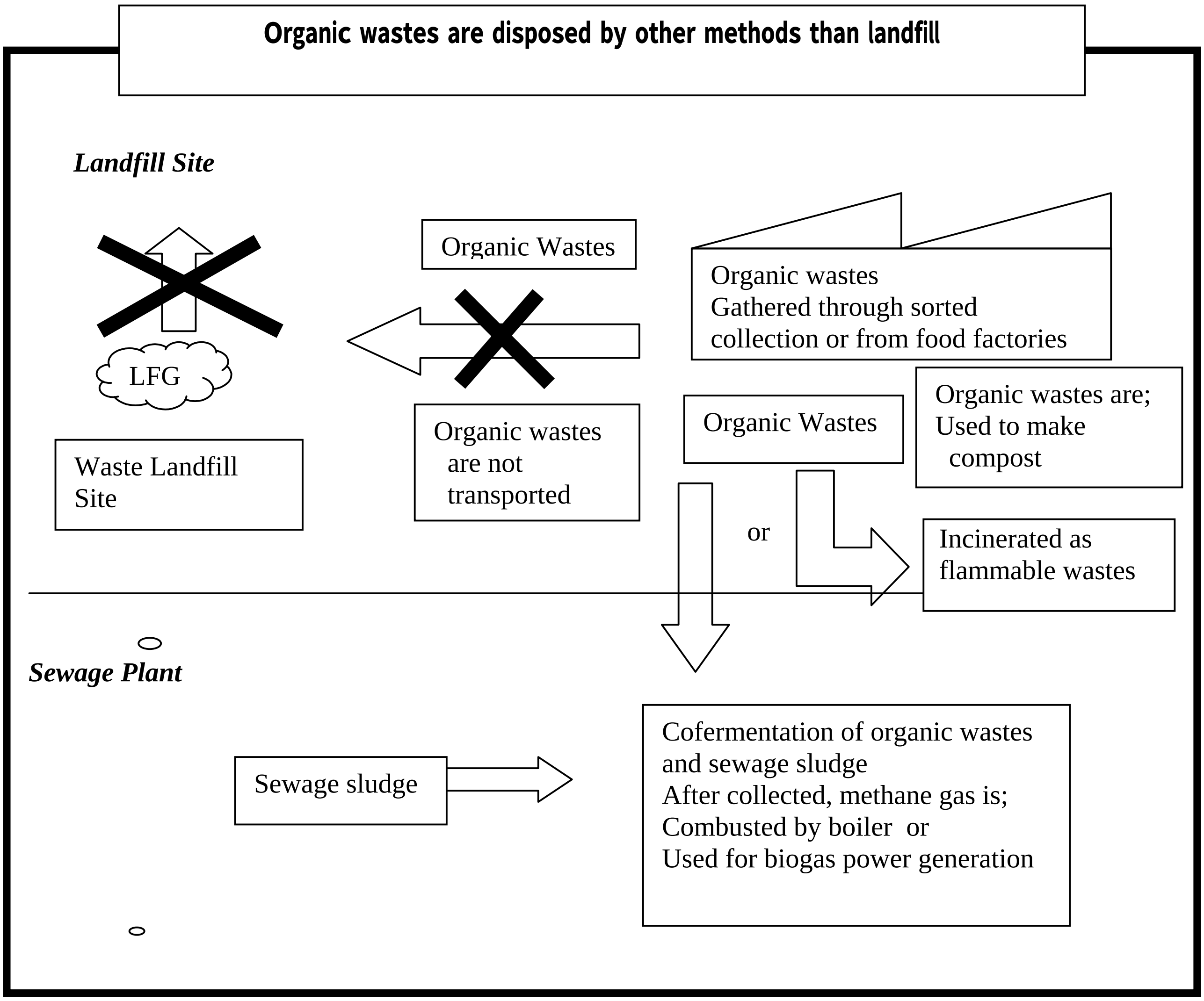
In Astana City, all wastes are being collected together, both organic and inorganic wastes are being transported to the landfill site and, after sanitary landfill, LFG flaring is being carried out at present. Meanwhile, sewage sludge at the sewage plant is being anaerobically fermented at a digester chamber and biogas produced from the fermentation is being used to fuel boiler during the winter season.

Based on the situations above, the following 12 scenarios are conceivable.

Idea	Collected Wastes		Sewage Plant	
1	After collected all together, landfilled	Wastes are landfilled and produced LFG is flared	Methane fermentation by sewage sludge	Combusted by boiler
2				Used for power generation by generator
3		Wastes are landfilled and produced LFG is utilized for power generation at the landfill site	Methane fermentation by sewage sludge	Combusted by boiler
4				Used for power generation by generator
5		Wastes are landfilled and produced LFG is supplied to other facilities than the landfill site	Methane fermentation by sewage sludge	Combusted by boiler
6				Used for power generation by generator
7	Disposed by other methods than landfill	Organic wastes gathered through sorted collection or from factories are used to produce compost	Methane fermentation by sewage sludge	Combusted by boiler
8				Used for power generation by generator
9		Flammable wastes are incinerated.	Methane fermentation by sewage sludge	Combusted by boiler
10				Used for power generation by generator
11		Organic wastes gathered through sorted collection or from factories are transported to the sewage plant	Methane fermentation by sewage sludge and organic wastes	Combusted by boiler
12				Used for power generation by generator

Schematic overviews of the above conceivable scenarios are shown below.


Organic wastes are collected all together and landfilled
Landfill Site
Discharge of uncollectible LFG to the atmosphere
After collected, LFG is;
Flared or
Used for power generation at the landfill site or
Supplied as gas to others
Wastes
（Organic, Inorganic ）
LFG
Wastes Landfill Site
Transported all together
Sewage Plant
Sewage Sludge
After collected, methane gas produced by fermentation of sewage sludge is;
Combusted by boiler or
Used for biogas power generation


Organic wastes are disposed by other methods than landfill
Landfill Site
LFG
Waste Landfill Site
Organic Wastes
Organic wastes are not transported
Organic wastes Gathered through sorted collection or from food factories
Organic Wastes
Organic wastes are; Used to make compost
or
Incinerated as flammable wastes
Sewage Plant
Sewage sludge
Cofermentation of organic wastes and sewage sludge
After collected, methane gas is;
Combusted by boiler or
Used for biogas power generation

To define whether the applicable conditions are met or not, an interview about the environmental sector, the energy sector and the technical level of the region or on-site survey on existing facilities should be carried out in the region where the implementation of the project is being examined.

An appropriate baseline scenario shall be chosen from these 12 scenarios based on the applicable conditions set in A.3 of this application, with various barriers taken into consideration.
”Y” as yes, “N” as no and “－” as being neutral are given for each scenario on each question.
After the scenarios are assessed on all the question items, assesment”2” is given for the scenarios which have all “Y” s for the questions, assessment “1” for the scenarios which have one “Y”, and assessment ”0” for the scenarios which have more than two “N”s.

After the above assessment process is conducted for all the barriers, the scenario that has the highest mark shall be chosen as the baseline project.

ｉ）Legislation･Institution

Question	1	2	3	4	5	6	7	8	9	10	11	12
Consistent with the governmental energy policy?	N	Y	N	Y	Y	Y	N	Y	N	Y	N	Y
Consultations or coordination with relevant organizations unnecessary?	Y	Y	Y	Y	N	N	N	N	N	N	N	N
Assessment	1	2	1	2	1	1	0	1	0	1	0	1

- “Y” is given to the following scenarios as they conform to what are stated in the energy policy of Kazakhstan government, “Electric Energy Development Program up to 2030” on the following point: Scenarios 2,4,6,8,10 and12 as they generate electricity utilizing biogas, and Scenario 5 as biogas is possibly used at power generation facilities.
- In Scenarios 7～12, among solid wastes, only organic wastes should be carried to the sewage plant. Because, in Kazakhstan, ASA (Astana Su Arnasy) has administered sewage plant while Gorkommunhoz has managed solid wastes, consultation and coordination with several governing bodies would be required.
- “Y” is given to Scenarios 1～4 as they would not require consultation and coordination with relevant organizations because they would not span several existing administrative sections.
- Scenarios 5 and 6, in which biogas is supplied to other facilities, would require consultation with such governing bodies as the energy sector.

ii） Technical Barriers

Question	1	2	3	4	5	6	7	8	9	10	11	12
１）Risks in technology development and practical use small?	Y	N	N	N	N	N	N	N	N	N	N	N
２）Risks in construction small?	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y
３）Technical risks in operation small?	Y	N	Y	N	N	N	N	N	N	N	Y	N
Assessment	2	0	1	0	0	0	0	0	0	0	1	0

- As Scenario 1 has a past record of operation, technical risks would be small.
- Scenarios 2, 4, 6,8,10 and12, utilize a system which uses methane gas produced by fermentation of sewage sludge or organic wastes to generate electricity. This system is a common technology in Japan, however it would entail risks of technology development in the Republic of Kazakhstan as it would be the first time for this technology to be used in the nation. Meanwhile, the technology to utilize LFG in Scenarios 3 and 5 as well as the technology to dispose organic wastes colleted separately in Scenarios 7 and 9 would be also adopted first time ever in Kazakhstan. Accordingly they would entail risks in technology development.
- Scenarios 9 and 10 use large-scale combustion equipment and, therefore would have risks in quality control due to lack of experience.
- Scenarios 2, 4, 6,8,10 and 12 are considered to entail technology risks in operation to generate electricity, given the possibility that the property and amount of methane gas, which are forcibly fermented, could be unstable. "N" is given to Scenarios 5 and 6 as a continuous monitoring of the propriety of gas and communication with the recipient would be necessary in transporting produced LFG to the other facilities. "N" is given to Scenarios 7 and 8 as, in producing the compost, control of temperature and moisture content is difficult. "N" is given to Scenarios 9 and 10, in which wastes are incinerated, as they would entail technology risk in operation, considering the difficulty to control the incineration temperature when wastes are moist.

  Meanwhile, currently, two fermentation tanks are being installed at the sewage plant in Astana City. One of them is out of operation while temperature control for the other has not been properly carried out as planned. A project in which rehabilitation of tanks is included has been presently planned by JBIC.

iii) Investment Barriers

Question	1	2	3	4	5	6	7	8	9	10	11	12
New investment unnecessary or investment efficiency high?	Y	N	N	N	N	N	N	N	N	N	N	N
Low operational cost?	Y	Y	Y	Y	Y	Y	N	N	N	N	Y	Y
Assessment	2	1	1	1	1	1	0	0	0	0	1	1

- Scenario 1 is the same as the status quo, and, thus, no new investment would be required.
- As to Scenarios 2, 3,4,10 and12, even though the governmental policy on renewable energy exists, there is no support policy and, as a result, no incentive to invest in power generation facilities. For that reason, investment efficiency is not considered high and, therefore, "N" is given to the scenarios.
- In Scenarios 5 and 6, a piping would be needed to supply LFG to other facilities, which would require hefty initial investment. Therefore "N" is given to them.
- In Scenarios 7 and 8, investment efficiency is not considered high because, given lack of purchasing power in the domestic agricultural sector, incomes from sales of compost could not be expected.
- Scenarios 9 and 10 would require the construction of new incineration facilities, which would need hefty initial investment. Therefore, "N" is given to them.
- With regard to operational costs in Scenario 7 and 8, considering the possibility that the management cost for making compost and also, in case that sales of the compost are slow due to lack of purchasing power in the domestic agricultural sector, the carrying cost of the compost would arise. Therefore, "N" is given to the scenarios. Meanwhile, as to incineration of wastes in Scenarios 9 and 10, maintenance costs would be high because the boiler would be damaged more severely than other

types of boilers such as a coal boiler, considering that incineration gas contains various components. Therefore, "N" is given to them.

- In Scenarios 1, 2,3,4,5,6,11 and 12, maintenance costs are considered most costly among operational costs. As machine maintenance available on the site would be basically provided, the cost would be smaller than Scenarios 7 – 10. Therefore, "Y" is given to them.

iv）Environmental Impacts

Question	1	2	3	4	5	6	7	8	9	10	11	12
Suitable to solve environmental problems?	N	N	N	N	―	―	N	Y	N	N	N	Y
Assessment	0	0	0	0	―	―	0	1	0	0	0	1

- Environmental impacts shall be judged from the following two points; i.e., whether a scenario can reduce greenhouse gases, and whether it is suitable for environmental improvement in the region.
- "N" is given to Scenarios 9 and 10, in which wastes are incinerated, because they would entail risks to cause problems of dioxin and so forth if the incineration temperature is not controlled.
- Scenarios1, 5,6,7, and 11, in which power generation is not carried out, could not replace coal combustion and reduce dust through power generation. For that reason, they are unlikely to contribute to solving the problem of air quality and, thus, "N" is given to them.
- In Scenarios 2, 3 and 4, LFG would not be completely collected and, therefore, methane gas would be released to the atmosphere. Accordingly they are not suitable for solving the environmental problem of global warming.

v）Regional Trend

Question	1	2	3	4	5	6	7	8	9	10	11	12
Meet the needs of the region?	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
Assessment	0	0	0	0	0	0	1	1	1	1	1	1

- In accordance with Master Plan for the comprehensive development of Astana, Astana city has been making efforts to raise the quality of collection method of solid wastes from households and factories to the international level. As Scenarios 7 to 12 carry out sorted collection and could contribute to extending a life of a landfill site, they are considered to meet the needs of the region. Therefore, "Y" is given to them.

vi）Market Barriers

Question	1	2	3	4	5	6	7	8	9	10	11	12
Possible to spread in the region?	Y	Y	N	N	N	N	N	N	N	N	Y	Y
Assessment	1	1	0	0	0	0	0	0	0	0	1	1

- "Y" is given to Scenario 1 and 2 since LFG flaring at the landfill site stated in the scenarios is expected to spread in the region as it applies a simple system and has shown an actual performance.
- "N" is given to Scenarios 3 and 4, in which power generation is carried out at the landfill site using LFG, as they have never been carried out in Kazakhstan and, thus, would require time to spread in the region.
- "N" is also given to Scenarios 5 and 6 , in which LFG is supplied to other facilities than the landfill site, as they have never been implemented in Kazakhstan and, therefore, would require time to spread in the region.

・"N" is given to Scenarios 7 and 8, in which organic wastes are used to make compost, as it would be difficult to manage such a vast amount of compost to be produced.
・"N" is given to Scenarios 9 and 10, in which wastes are incinerated, as it has been found out through interviews that incineration of wastes is not allowed under the law of the country.
・"Y" is given to Scenarios 11 and 12 as the system used in the scenarios has shown an actual performance of operation and can possibly spread in the nation if such conditions as collection of organic wastes are met, though some operational problems exist in reality.

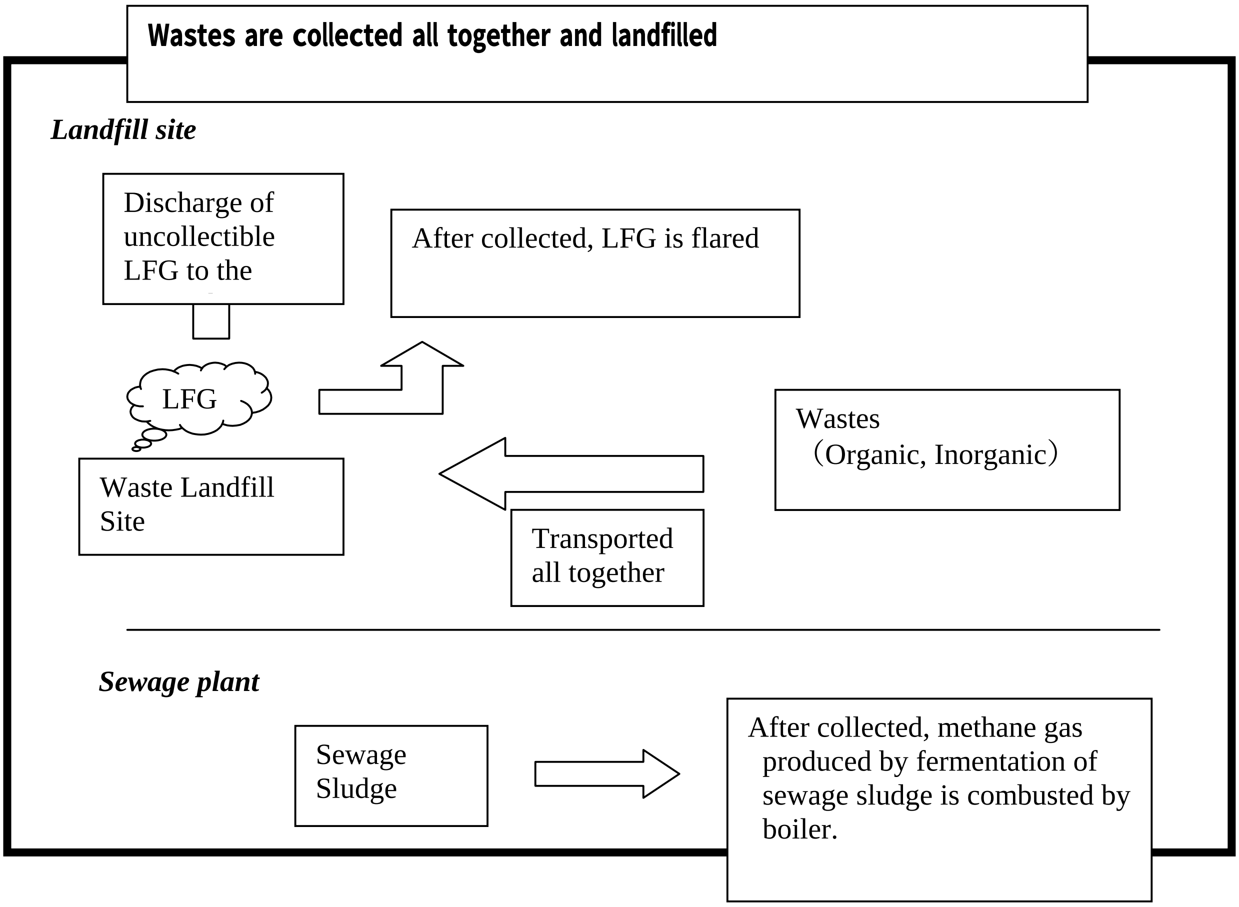
Selection of Baseline

The following table sums up the examination results.

Examination Item	Idea 1	Idea 2	Idea 3	Idea 4	Idea 5	Idea 6	Idea 7	Idea 8	Idea 9	Idea 10	Idea 11	Idea 12
Legislation/Institution	1	2	1	2	1	1	0	1	0	1	0	1
Technical Barriers	2	0	1	0	0	0	0	0	0	0	1	0
Investment Barriers	2	1	1	1	1	1	0	0	0	0	1	1
Environmental Impacts	0	0	0	0	–	–	0	1	0	0	0	1
Regional Trend	0	0	0	0	0	0	1	1	1	1	1	1
Market Barriers	1	1	0	0	0	0	0	0	0	0	1	1
Comprehensive Assessment	6	4	3	3	2	2	1	3	1	2	4	5

Based on the above, with all the examination items; i.e., legislation/institution, technical barriers, investment barriers, environmental impacts, regional trend and market barriers, taken into account, Scenario 1, which has the highest mark, is chosen as the baseline scenario.

Scenario 1 is; all wastes are collected together, then landfilled with produced methane gas (hereinafter referred to as LFG) being flared. Sewage sludge is anaerobically fermented with produced methane gas being combusted at a boiler. Below is the schematic overview of Scenario 1.



The project scenario is fixed as Scenario 12 which marks the second highest in the comprehensive assessment. The scenario is; among all wastes, organic wastes collected through sorted collection or from factories are transported to the sewage plant, the organic wastes are put into anaerobic fermenters together with sewage sludge, and produced methane gas is utilized for power generation.

This project scenario is inferior to the baseline scenario in technical barriers and investment barriers. However, by carrying out the project as JI, the technical barriers can be overcome with technical guidance and the investment barriers can be lowered with CO2 credits.

Looking at economic effects with and without the credits as to the investment barriers, NPV of the project will improve by around USD2, 700 with them compared to without them.

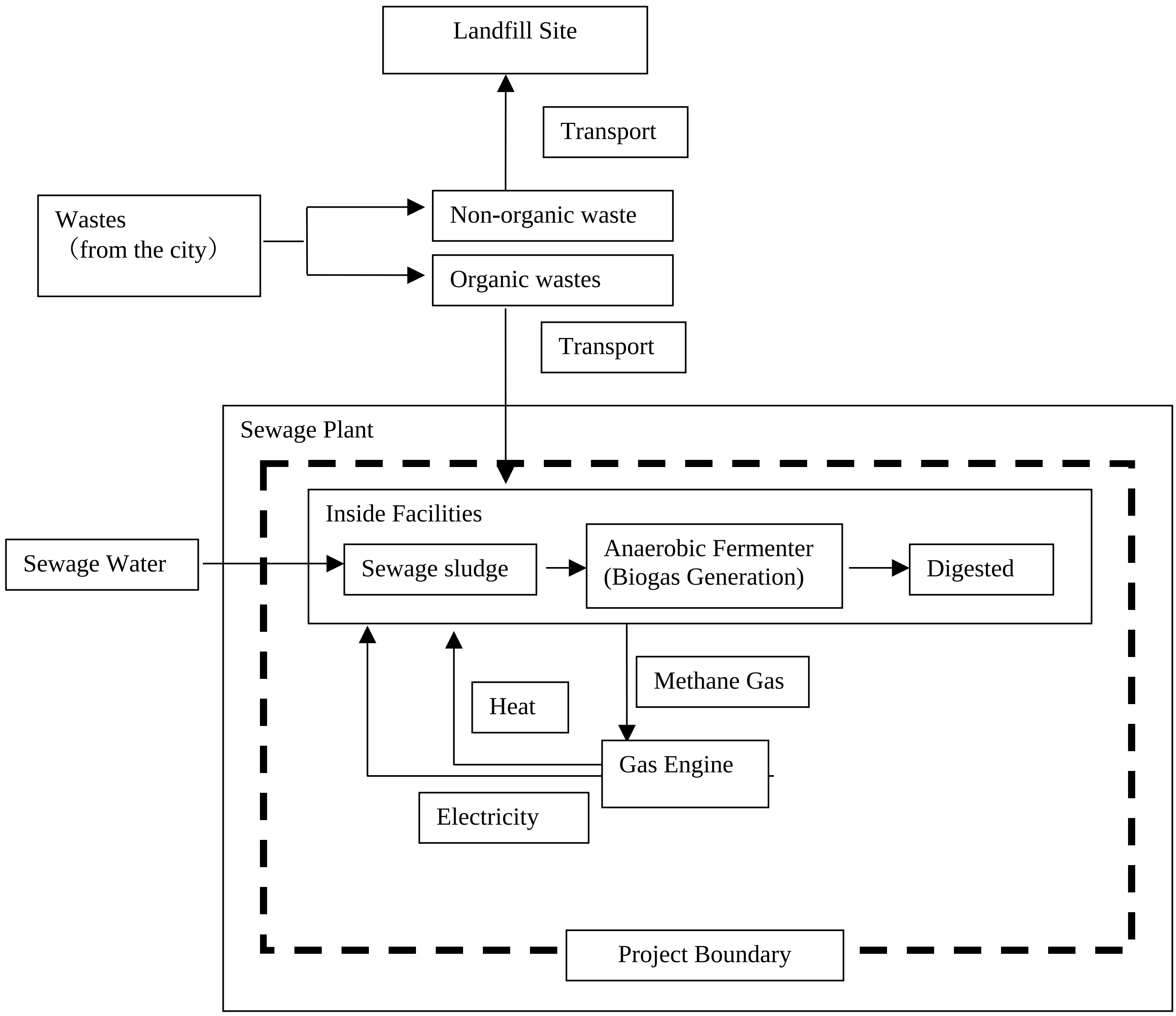
B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

>>

The project boundary is anaerobic fermenters and a power generation unit at the sewage plant.

Separating wastes and carrying them into the anaerobic fermenters at the sewage plant are the tasks the administration is responsible for. Therefore, they are not included in the project boundary of this project.

Meanwhile, potential leakage would be GHG from transport machines which carry organic wastes to the project boundary. As the distances to the landfill site in the outskirts of the city and to the sewage plant are almost equal, GHG emissions would not increase by carrying out the project. Accordingly, the leakage is negligible.



The system flow at the sewage plant is shown below.

Meanwhile, the project on water and sewerage is currently underway at the sewage plant by Japan Bank for International Cooperation(hereinafter referred to as JBIC). Consistency with the project can be also found out in the system flow.

System Flow

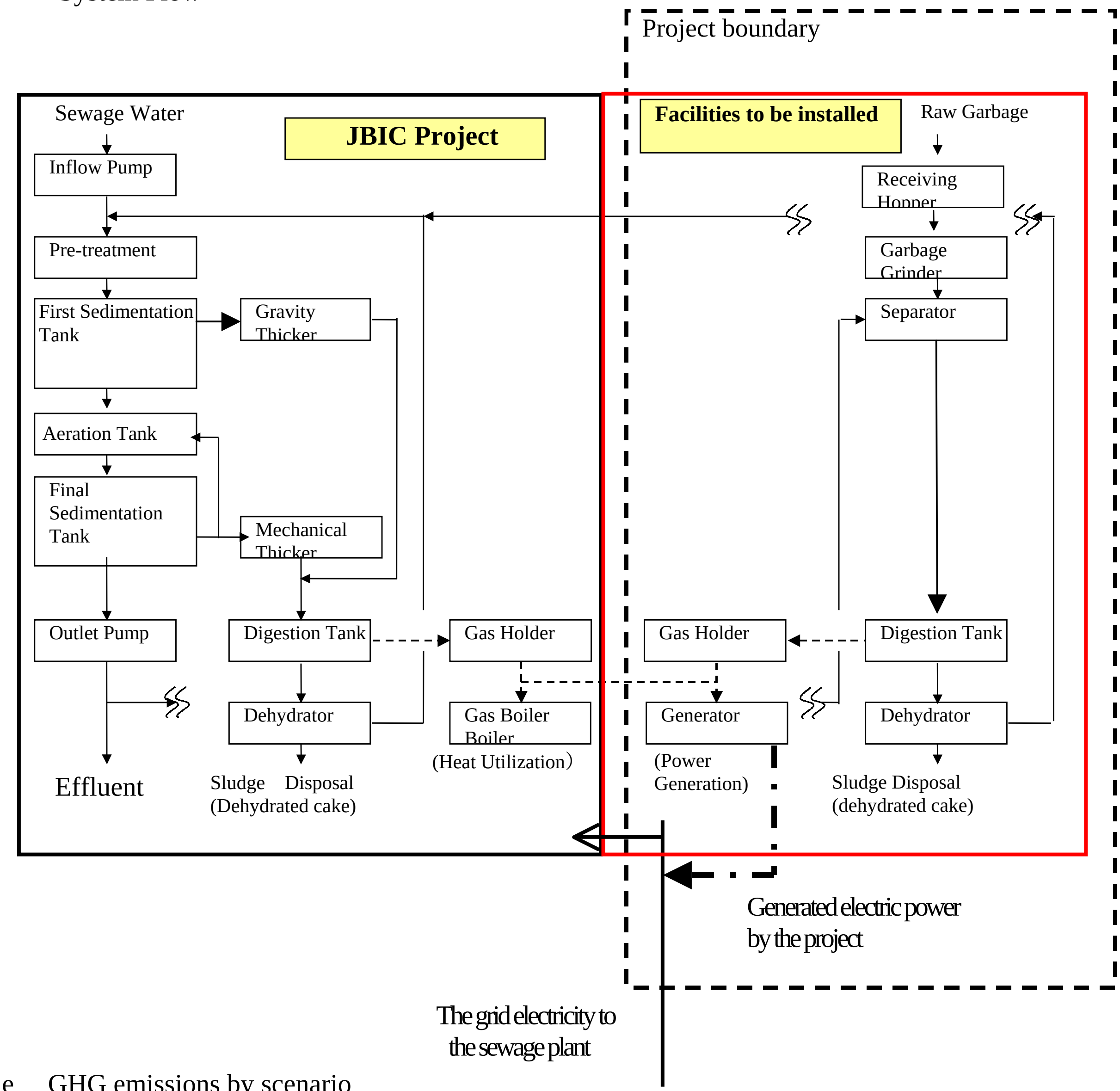


Table GHG emissions by scenario

	Within the boundary	Outside the boundary
Baseline Scenario	CO2 emissions by the grid electricity used at the sewage plant	Methane gas emissions from the landfill site
Project Scenario	CO2 emissions by the grid electricity at the sewage plant – CO2 emissions from biogas power generation	CO2 emissions from transport vehicles of organic wastes

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

>>

Tohoku Electric Power Co., Inc.
7-1, Honcho 1-chome, Aoba-ku, Sendai, Miyagi 980-8550 JAPAN
Tel +81-22-799-6281
Fax +81-22-213-5190

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

2008.11

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

>>

In conformity with THE MODEL PROJECT FOR INCREASING THE EFFICIENT USE OF ENERGY USING A GAS TURBINE COGENERATION SYSTEM, which was the first JI project by the Japanese Government, the first phase of the crediting period shall be set as 7 years. The period shall be automatically extended if no consultation is made among the parties concerned. The project period shall be 21 years.

Generally, the equipment of this project can operate for more than 20 years by carrying out proper maintenance.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>

November 2008

Presently, the yen-loan-financed project of water and sewerage by JBIC is underway in Astana City. Its facilities are planned to come into operation in November 2008. In order to ensure consistency with the yen-loan-financed project, the starting date of this project shall be fixed as November 2008.

C.2.1.2. Length of the first crediting period:

>>

The first crediting period 7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

C.2.2.2. Length:

>>

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

>>

Monitoring methodology of biogas power generation by cofermentation of sewage sludge and organic wastes

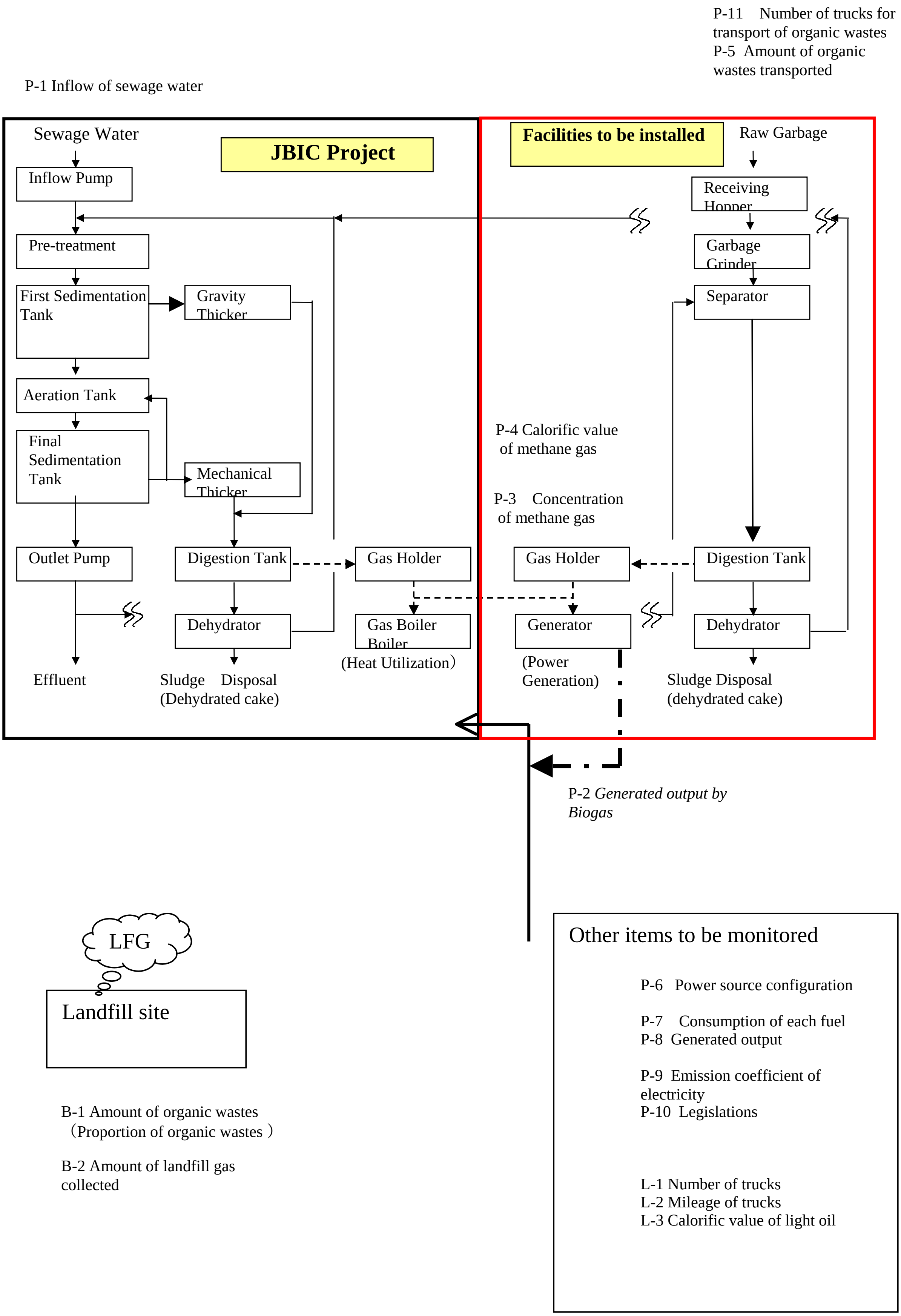
D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

>>

” Monitoring methodology of biogas power generation by cofermentation of sewage sludge and organic wastes” is applicable to projects which adopt “the baseline methodology of biogas power generation by cofermentation of sewage sludge and organic wastes.” In other words, this methodology can be applied to project activities which replace the grid electricity and reduce methane gas released from organic wastes transported to landfill sites.

This methodology is applicable to this project, “Biogas Power Generation utilizing Organic Wastes and Sewage Sludge in Astana” for the following reasons.

- Astana City has no power generation plant utilizing methane gas at a sewage plant.
- Even though policies to develop or prioritise renewable energy are being stated in the governmental energy plan, there is no concrete support system.
- Astana City has sewage sludge disposal facilities at the sewage plant available to this project.
- The landfill site is planning to carry out LFG flaring, however no plan for LFG-fired power generation is being envisioned at present as well as for the future.
- There is no legislation to enforce LFG flaring.
- Sorted collection of organic wastes are planned to be in place in the future.
- There is a coal-fired power plant near the project site from which all electricity is being supplied and no large-scale gas-fired power plant using gas nearby.
- The amount of wastes transported to the landfill site will be gauged with truck scales from January 2005.
- The population of Astana City is 500,000 at present and is expected to rise to 1 million in 2030.
- Administrative sections in charge of solid wastes and sewage treatment are being separated.


P-11 Number of trucks for transport of organic wastes
P-5 Amount of organic wastes transported
P-1 Inflow of sewage water
Sewage Water
JBIC Project
Inflow Pump
Pre-treatment
First Sedimentation Tank
Gravity Thicker
Aeration Tank
Final Sedimentation Tank
Mechanical Thicker
Outlet Pump
Digestion Tank
Gas Holder
Dehydrator
Gas Boiler
Effluent
Sludge Disposal (Dehydrated cake)
(Heat Utilization)
Facilities to be installed
Raw Garbage
Receiving Hopper
Garbage Grinder
Separator
P-4 Calorific value of methane gas
P-3 Concentration of methane gas
Gas Holder
Digestion Tank
Generator
Dehydrator
(Power Generation)
Sludge Disposal (dehydrated cake)
P-2 Generated output by Biogas
LFG
Landfill site
B-1 Amount of organic wastes (Proportion of organic wastes)
B-2 Amount of landfill gas collected
Other items to be monitored
P-6 Power source configuration
P-7 Consumption of each fuel
P-8 Generated output
P-9 Emission coefficient of electricity
P-10 Legislations
L-1 Number of trucks
L-2 Mileage of trucks
L-3 Calorific value of light oil

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P-1	*Inflow of sewage water*	*Measurement by flowmeter*	*M3/day*	*m*	*Everyday*	*100%*	electronic/ paper	
P-2	*Generated output by Biogas*	Measurement by watt-hour meter	kWh */day*	*m*	*Everyday*	*100%*	electronic/ paper	
P-3	*Concentration of Methane gas from fermenter*	*Measurement by concentration meter*	*%*	*m*	*Weekly*	*100%*	electronic/ paper	
P-4	*Calorific value of Methane gas*	*Measurement by calorific value meter*	*MJ/m3*	*m*	*Weekly*	*Sample*	electronic/ paper	
P-5	*The amount of organic wastes transported*	*Truck scale*	*t/day*	*m*	*Everyday*	*100%*	electronic/ paper	
P-6	*Power source configuration in Kazakhstan*	*Interview*		*m,c*	*Year*	*Sample*	paper	*The data will be monitored for calculation of the average carbon emission coefficient of all electricity*
A-7	*Consumption of each fuel used for thermal power*	*Interview*	*t/year*	*e*	*Year*	*Sample*	paper	*The data will be monitored for calculation of the average carbon emission coefficient of all electricity*

	generation in Kazakhstan							
P-8	*Total generated output in Kazakhstan*	*Interview*	*MW/year*	*e*	*Year*	*Sample*	paper	*The data will be monitored for calculation of the average carbon emission coefficient of all electricity.*
P-9	*CO2 emission coefficient of electricity*	*Interview and calculation*	*t-co2MWh*	*c*	*Year*	*Sample*	paper	
P-10	*The number of trucks for transport of organic wastes*	*Counting with eyes*	*Amount/day*	*m*	*Everyday*	*100%*	electronic/ paper	
P -11	*Legislations*	*Interview*			*Year*		paper	Revision and establishment of legislations on wastes and energy will be monitored.

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

CO2 emissions in the project scenario

PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε_METH

PEy ：Project CO2 reductions(t-CO2/year)

BE_SW_EL_GRIDy ：Power consumption at the sewage plant(KWh)

P_EL_GENy ：Generated output by biogas（kWh）

EF_GRID ：CO2 emission coefficient in the grid（t-CO2/kWh）

PE_METH_NWy ：The amount of methane gas generated through cofermentation of organic wastes and sewage sludge which are put into fermenters(t-CH4/year)

ε _METH ：Global warming coefficient of Methane(=21 IPCCGuideline)

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B- 1	*The amount of organic wastes*	*Measurement by weight meter*	*t /year*	*m，c*	*Biannual*	*Sample*	electronic/ paper	*The composition of pre-separated wastes will be checked.*
B-2	*The amount of landfill gas collected*	*Flowmeter Calculation*	*t/year*	*m,c*	*Everyday*	*Sample*	electronic/ paper	*Fflowmeters will be installed on LFG collection piping. The amount of LFG collected will be determined by multiplying the inflow by the number of pipes.*

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

The formula to calculate GHG emissions in the baseline scenario is as follows.

BEy＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH

BEy	：Baseline CO2 emissions (t-CO2/year)
BE_SW_EL_GRIDy	：Power consumption at the sewage plant (KWh)
EF_GRID	：CO2 emission coefficient in the grid（t-CO2/KWh）
BE_METH_Wy	： The amount of methane gas which is uncollectible as LFG and is released to the atmosphere from the landfill site. (t-CH4/year) IPCC will be used for calculation. In this regard, however, the smaller value in comparison with the monitoring result shall be used to be conservative.
ε_METH	：Global warming coefficient of Methane (=21 IPCC Guideline))(t-CO2/t-CH4)

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
L-1	*The number of trucks*	*Counting with eyes*	*Unit/year*	*m*	*Everyday*	*100%*	electronic/ paper	
L-2	*Mileage of trucks*	*Interview*	*Km/l*	*m,c*	*Half year*	*Sample*	electronic/ paper	
L-3	*Calorific value of light oil*	*Interview*	*Kcal/kg*	*e*	*Hafyear*	*Sample*	electronic/ paper	

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

Ｌ１＝EF_TR×TR_ AM

L1 ：CO2 emissions by leakage(t-CO2/year)
EF_TR ：CO2 emissions which would be generated from a truck which transports organic wastes from the city to the sewage plant(t-CO2/unit)
TR_AM ：The number of trucks The number counted when the trucks transport the wastes shall be used.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>>>

CO2 emission reductions are as follows.

GHG reductions＝Baseline GHG emissions－Project GHG emissions－Leakage

＝BEy－Pey－L1

＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH－（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID－L1

＝BE_METH_Wy × ε_METH＋ P_EL_GENy ×EF_GRID－L1

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data (Indicate table and ID number e.g. 3.-1.; 3.2.)	*Uncertainty level of data (High/Medium/Low)*	*Explain QA/QC procedures planned for these data, or why such procedures are not necessary.*
P-1	*Low*	*QA is undertaken. Inflow of sewage water will be measured by a flowmeter at the sewage plant. The flowmeter shall be based on the standard on calibration of measuring devices in the nation, however if such standard does not exist, calibration recommended by the manufacturer will be regularly carried out.*
P-2	*Low*	*Generated output by Biogas shall be based on the standard on calibration of measuring devices in the nation, however if such standard does not exist, calibration recommended by the manufacturer will be regularly carried out.*
P-3	*Low*	*Concentration of methane gas from the fermenters shall be based on the standard on calibration of measuring devices in the nation, however if such standard does not exist, calibration recommended by the manufacturer will be regularly carried out.*
P-4	*Low*	*Calorific value of methane gas shall be based on the standard on calibration of measuring devices in the nation, however if such standard does not exist, calibration recommended by the manufacturer will be regularly carried out.*
P-5	*Low*	*The amount of organic wastes transported will be measured by truck scales. The scales shall be based on the standard on calibration of measuring devices in the nation, however if such standard does not exist, calibration recommended by the manufacturer will be regularly carried out.*
P-6	*Low*	*An interview will be held with a national organization to find out power source configuration.*
P-7	*Low*	*An interview will be held with a national organization to find out consumption of each fuel.*

P-8	*Low*	*An interview will be held with a national organization to find out generated output.*
P-9	*Low*	*CO2 emission coefficient of electricity will be determined with generated output and coal consumption. This figure can be found out by calculation, therefore attention shall be paid to the calculation.*
P-10	*Low*	*The number of trucks for transport of organic wastes and the weight of organic wastes transported will be measured.*
P-11	*Low*	*Revision and establishment of legislations on wastes and energy will be checked.*
B-1	*Low*	*Separation of organic wastes from inorganic wastes and measurement of the composition of organic wastes will be done by hand. Workers shall be directed to separate wastes properly. A calibrated weight meter shall be used to measure the mount of organic wastes.*
B-2	*Medium*	*Flowmeters will be installed on LFG collection piping and the amount of landfill gas collected will be determined by multiplying the inflow by the number of pipes. Therefore, calibrated measuring devices shall be used for the measurement.*
L-1	*Medium*	*The number of trucks*
L-2	*Medium*	*Mileage of trucks*
L-3	*Medium*	*Calorific value of light oil*

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>

D.5 Name of person/entity determining the monitoring methodology:

>>

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>

The project scenario is to coferment organic wastes and sewage sludge at the anaerobic fermenters and generate electricity utilizing biogas to be produced. CDM " AM0012 " is referred to for this calculation.

GHG emissions in the case that the project is carried out are determined by the following formula.
GHG emissions in the project scenario
PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε _METH

PEy ：Project CO2 reductions(t-CO2/year)
BE_SW_EL_GRIDy ：Power consumption at the sewage plant(KWh)
P_EL_GENy ：Generated output by biogas（kWh）
EF_GRID ：CO2 emission coefficient in the grid（t-CO2/kWh）

PE_METH_NWy ：The amount of methane gas generated from cofermentation of organic wastes and sewage sludge which are put into fermenters(t-CH4/year)
ε _METH ：Global warming coefficient of Methane(=21 IPCC Guideline)
PE_METH_Nwy will not be released into the atmosphere as GHG because all of them are used for biogas power generation.

Accordingly, CO2 emissions in the project scenario are;
PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε _METH＝（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID

CO2 emissions by the grid electricity in the case that the project is carried out shall be calculated.
Firstly, CO2 emissions in the grid will be found out through an interview.
Next, generated output by biogas shall be found out.

The amount of sewage sludge and organic wastes which are put into the methane fermenters are as follows;
Sewage sludge ： 562m3 of sewage sludge is generated per day from 136,000m３of daily disposed sewage water.
Organic wastes： 279m3of organic wastes are generated per day through close checking the contents of wastes of 60,130m３/year.

When the organic wastes are put into the anaerobic fermenters, the organic wastes-produced biogas generated from the project equipment to be installed amounts to 18,360m3/day.
Given that concentration of methane gas generated from the equipment is 60 – 65 % according to the guideline and explanation for designing by Japan Sewage Works Association，60% is chosen as a conservative value.

Accordingly, the generation of methane gas amounts to 11,016m3/day.

Based on the above, generated output utilizing methane gas can be determined as follows, assuming that the efficiency of methane gas generator is 27.45％, calorific value of methane gas 35.8MJ/m3 and conversion factor between kWh and MJ 3.6kWh/MJ,
Daily generated output＝the amount of methane gas×calorific value of methane gas×Generating efficiency／3.6
＝11016 × 35.8 × 0.2745 / 3.6
＝30.07MWh/day

Given that yearly operating rate of the methane gas power plant is 97.28％considering that gas production during the maintenance period(10 days a year) is down to 40% and auxiliary power of the plant is 4,540 ｋWh/day,

Yearly power supply from the plant is;
（30.07-4,540/1000）MWh ×365×0.9728＝9,064MWh

Next, CO2 emission coefficient in the grid shall be determined.
Electricity in Astana City is being supplied from a coal fired power plant in the city, therefore CO2 emission coefficient can be calculated with the data on the power plant.
However, as the grid in Astana City is not isolated but linked to other regions, the weighted average emission coefficient of all power sources in Kazakhstan shall be adopted to be conservative.

Annual generated output in Kazakhstan is 61,000GWh with the power source configuration of 88% of thermal and 12% of hydropower. Fuel configuration of thermal power generation represents 75% of coal, 23% of gas and 2% of oil.
The weighted average emission coefficient is determined with the following conditions.
・For generating efficiencies of gas-fired and oil-fired power plants, Japan’s average values for the 1990s are adopted to be conservative.
・For calorific value of gas, the value of Uralsk TETS in Kazakhstan is used.
・ For calorific value of oil, the average value in Japan is used to be conservative.
・

		Generated output	CO2 emissions
		GWh	×10^3 t-CO_2/年
Thermal	Coal	40,260.0	38,947.03
	Gas	12,346.4	6,391.07
	Oil	1,073.6	730.72
Hydro		7,320.0	0.00
Total		61,000.0	46,068.82

As a result of calculation using the above values, the weighted average emission coefficient comes to 0.75t-CO2/MWh.

Given that generated output by methane gas is 8,617MWh/year,
P_EL_GENy ×EF_GRID
＝ 9,064MWh ×0.75［ｔ-CO2/MWh］
＝ 6,798 ［ｔ-CO2］

Based on the above, GHG emissions in this project are as follows.
PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε _METH＝（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID
＝BE_SW_EL_GRIDy ×EF_GRID－6,798 ［ｔ-CO2］

E.2. Estimated leakage:

>>

In this project, potential leakage is transport equipment such as trucks which transport electricity, heat and organic wastes relating to the operation of the project equipment to the fermenters at the sewage plant. Considering that electricity and heat used for the project equipment are the ones generated from the project equipment, there is no leakage that would newly occur by carrying out the project.
Leakage in transporting organic wastes to the sewage plant is calculated as follows.
Ｌ１＝EF_TR×TR_ AM

L1 ：CO2 emissions by leakage(t-CO2/year)
EF_TR ：CO2 emissions which would be generated from a truck which transports organic wastes from the city to the sewage plant(t-CO2/unit)
TR_AM ：The number of trucks The number counted when the trucks transport the wastes shall be used.

EF_TR shall be determined.
Given that gasoline mileage of a normal 5t truck in Kazakhstan is 5km/L and the distance to transport organic wastes is about 15km, the distance to cross Astana City, the amount of fuels consumed is 3L.

Based on the IPCC guideline,
Carbon oxidation proportion coefficient 0.99
CO2 unit conversion coefficient 44/12＝3.7
Carbon equivalent emission factor 19.6 ［ｔ-c/TJ］
Calorific value 0.043TJ/ｔ (10,300kcal/kg) the average value of Japan’s light oil is adopted.
Fuel consumption 28.908 m3/year
Specific gravity 0.84

EF_TR＝Light oil consumption[m3]×Specific gravity×Calorific value×Carbon oxidation proportion coefficient×CO2 unit conversion coefficient ×Carbon equivalent emission factor ［ｔ-c/TJ］
＝3×0.84×0.043×0.99×3.7×19.6 ［ｔ-CO2/unit］
＝0.00778 ［ｔ-CO2/unit］

Next, the number of trucks shall be found out.
As yearly production of organic wastes is 48.18Ｇｇ, if 5-ton trucks are used for transport of the wastes, the number of trucks necessary per year can be found out as follows.
TR_AM＝48.18[Gｇ/year]×1,000[t/Gg]／５[ｔ]＝9,636units

Based on the above, CO2 emissions by leakage are;
L1＝EF_TR×TR_ AM＝ 9,636×0.00778
＝75 ［ｔ-CO2/year］

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>>
GHG emissions by the project activity are as follows.

E1+E2＝PEｙ＋L1

＝BE_SW_EL_GRIDy ×EF_GRID－6,798＋75
＝BE_SW_EL_GRIDy ×EF_GRID－6,723 ［ｔ-CO2］

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>>
The formula to determine GHG emissions in the baseline scenario is shown below.
GHG emissions in the baseline scenario＝
LFG emissions from the landfill site in the baseline
＋CO2 emissions from the grid electricity in the baseline

BEy＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Ｗy × ε_METH

BEy ： Baseline CO2 emissions(t-CO2/year)
BE_SW_EL_GRIDy ： Power consumption(KWｈ) at the sewage plant.
EF_GRID ： CO2 emission coefficient in the grid （t-CO2/KWh）
BE_METH_Wy ：The amount of methane gas which is uncollectible as LFG and is released to the atmosphere from the landfill site. IPCC shall be used for calculation. In this regard, however, the smaller value between the IPCC and the monitoring result will be used to be conservative.
ε_METH ：Global warming coefficient of Methane(=21 IPCC Guideline)

Firstly, the amount of methane gas which is uncollectible as landfill gas and is released from the landfill site to the atmosphere shall be calculated.

In conformity with the formula of IPCC Guideline, methane gas emissions are;
BE_METH_Wy (Gg/year)
= (MSWT ×MSWF ×MCF ×DOC×DOCF× F×16/12 – R)×(1-OX)
＝(MSWT ×MSWF ×MCF ×DOC×DOCF× F×16/12) （１ – R）×(1-OX)

Please note that the followings stand for;
MSWT = total MSW generated (G/yr)
MSWF = fraction of MSW disposed to solid waste disposal sites
MCF = methane correction factor (fraction)
DOC = degradable organic carbon (fraction)
DOCF = fraction DOC similated

F = fraction of CH_4 in landfill gas
R = recovered CH_4 (Gg/yr)
OX = oxidation factor

MCF ：Based on IPCC, 1.0 is adopted as the waste landfill site in Astana City is management-type.
DOCF：the IPCC default value is 0.77, however, given the effects of winter temperature on DOCF, the value is defined as 0.68.

An interview with researchers engaged in management and research of waste disposal sites has found out that, even in a cold region, the temperature of organic wastes landfilled in the soil is said to be kept around 40 - 60℃ and, in some cases, reach 70℃partly because of own self-heating of the wastes by anaerobic fermentation.

The IPCC default value for DOCF has been determined by substituting T=35℃ for the formula 0.014T+0.28. Thus, the value itself can be regarded as conservative.

However, as the wastes landfilled in shallow ground are affected by outside air temperature, the extent to which air temperature affects wastes in a very cold region shall be taken into consideration in examining effects of temperature to generation of methane gas.

In a normal temperate area, frost penetration depth which should be considered for designing of structure is defined as around 0.5m below ground in winter while in Kazakhstan the depth is defined as 2.0m. Meanwhile, some scholars engaged in researches on waste disposal sites in Hokkaido have expressed views that the depth in which disposed wastes start to be affected by air temperature is around 5.0m. To be conservative, the effects observed 5.0m below ground shall be taken into account in this project.

The planned landfill method of wastes in this project is to pile up 2.00m of wastes and 0.5m of sand alternately, with a permeable seat put between the two, seven times, and then land up with sand on the top. Accordingly, the thick of the landfill layer is; (2.00m+0.50m)×7+0.50ｍ＝18.00ｍ

Within the landfill layer, 18.00-0.50＝17.50ｍ is normally free from the effects of air temperature in a temperate region. This part of the layer is provisionally defined as holding the DOCF value corresponding to 35℃ throughout the year.

On the contrary, the part of the layer which is free from the effects of freezing during the winter season is 18.00-5.00＝13.00ｍ. During this period, DOCF is considered to decrease by the amount of decrease in capacity, or in the proportion of 13.00/17.50. Thus, DOCF（in winter）＝0.77×13.00/17.50＝0.572

Practically, the effect is rather small considering the size of the entire layer, however given lowering of temperature around a gas collection piping, DOCF(in winter) is set as 0.56.

In Astana City, monthly mean maximum temperature remains below the freezing point for five months from November to March. Therefore, DOCF in this project is defined as;
DOCF=（0.77×7＋0.56×5）/12＝0.68
In reality, it is unlikely that the effect of low temperature continues to go beyond the frost penetration depth of 2m to reach 5m during the full five months from November to March. Consequently, this assumption is considered as conservative enough.

F ：0.5, an IPCC default value, is used.

In this regard, however, this value will be monitored and the smaller value between the IPCC default value and the monitored one shall be used to be conservative.

R ： According to the handbook on Landfill compiled by U.S. Environmental Protection Agency (hereinafter referred to as EPA), the collection rate of methane gas is considered to be between

50% and 90%. The handbook has also stated that the collection efficiency of methane gas in the case that the operation to collect LFG is carried out is between 60% and 85% of the generated methane gas. The collection efficiency is conservatively set to be 85% with the use of the collection efficiency in operation.

OX ：0.0, a default value from IPCC, is adopted.

MSWT ×MSWF ×MCF ×DOC： This value refers to the amount of organic wastes taken to the landfill site in Astana City. According to the data obtained from Astana City, the value is set to be 48.18Ｇｇ/year.

The above values are substituted as follows.

BE_METH_Wy（Gg/year）

= (MSWT ×MSWF ×MCF ×DOC×DOCF× F×16/12 – R)×(1-OX)

＝(MSWT ×MSWF ×MCF ×DOC×DOCF× F×16/12)（1 – R）×(1-OX)

＝（48.18×1.0×0.68×0.5×16/12)（1－0.85）×(1-0)

=3.20 Gg/year

CO2 emissions generated from the landfill site are as follows.

BE_METH_Wy×ε_METH

＝3.20[Gｇ/year]×1000[t/Gg]×21＝67,200［ｔ-CO2/year］

CO2 emissions in the grid will be found out by an interview.

Based on the above, CO2 emissions in the baseline are as follows.

BEy＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH

＝67,200＋BE_SW_EL_GRIDy ×EF_GRID［ｔ-CO2/年］

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

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CO2 emission reductions are defined as follows.

GHG reductions＝E4－E3

＝Baseline G HG emissions－（Project GHG emissions＋Leakage）

＝BEｙ－（PEｙ＋L1）

＝（67,200＋BE_SW_EL_GRIDy ×EF_GRID）－（BE_SW_EL_GRIDy ×EF_GRID －6,723 ）

＝67,200＋6,723

＝73,923［ｔ-CO2］

E.6. Table providing values obtained when applying formulae above:

>>

Reductions realized in the first Commitment Period（2008－2012）are 308,012［ｔ-CO2］

Year	CO2 emissions generated by disposing organic wastes at	Reductions of the grid power sources	Leakage［ｔ-CO2/year］	GHG reductions［ｔ-CO2/year］

	the landfill site ［t-CO2/year］	by biogas power generation ［t-CO2/year］		
2008	11,200	1,133	13	12,320
2009	67,200	6,798	75	73,923
2010	67,200	6,798	75	73,923
2011	67,200	6,798	75	73,923
2012	67,200	6,798	75	73,923
2013	67,200	6,798	75	73,923
2014	67,200	6,798	75	73,923
Total				455.858

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

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

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SECTION G. Stakeholders' comments

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

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G.2. Summary of the comments received:

>>

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

>>

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

SOURCES OF VARIABLES, PARAMETERS AND DATA ARE ARRANGED IN A TABLE WITH REGARD TO THE MAJOR ITEMS USED FOR SELECTION OF THE BASELINE SCENARIO AND CALCULATION OF EMISSIONS.

Annex 4

MONITORING PLAN

IT IS DESIRABLE THAT THE MAJOR ITEMS ON THE MONITORING PLAN ARE ARRANGED IN A TABLE (SOURCES OF VARIABLES, PARAMETERS AND DATA ARE ARRANGED IN A TABLE WITH REGARD TO THE MAJOR ITEMS USED FOR SELECTION OF THE BASELINE SCENARIO AND CALCULATION OF EMISSIONS.).

添付資料Ⅰ-2　PROPOSED NEW METHODOLOGY : BASELINE　　　（英文）

CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: BASELINE (CDM-NMB)
Version 01 - in effect as of: 1 July 2004

CONTENTS

SECTION A. Identification of methodology

A.1. Proposed methodology title:

>>
Biogas Power Generation by Cofermentation of Sewage Sludge and Organic Wastes

A.2. List of category(ies) of project activity to which the methodology may apply:

>>
Categories of the project activity are as follows.
１. The Energy Industry (Renewable/Non-renewable)
13. Waste Disposal and Treatment

A.3. Conditions under which the methodology is applicable to CDM project activities:

>>
This methodology is applicable to a project which fulfils the following conditions.

- There is no power plant which utilizes methane gas in the region where the project is to be carried out.
- The government has a policy to develop or prioritize renewable energy.
- There is no support system for renewable energy.
- Sewage sludge disposal facilities at a sewage plant are available to the project.
- Landfill gas (hereinafter referred to as LFG)-fired power generation is not being carried out at a landfill site.
- There is no legislation to enforce LFG flaring.
- Sorted collection of organic wastes is expected to be in place in the future.
- There is a coal-fired power plant near the project site from which all electricity is being supplied and no large-scale gas-fired power plant using gas nearby.
- There are some measuring devices to gauge the amount of wastes transported to the landfill site.
- The project site is in a big city where the population is expected to increase going forward.
- Administrative sections in charge of solid wastes and sewage disposal are separated.

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

>>
Strengths
This methodology is applicable to power generation utilizing biogas generated by cofermentation of sewage sludge and organic wastes.
Measuring technologies to gauge the amount of biogas generated and the generated output are common and thus the accuracy of the data can be ensured.

Weaknesses
Measurement of the amount of organic wastes thrown out in a landfill site could be a weakness. This measurement is important for calculation of the amount of biogas released from the landfill site into the atmosphere. In this connection, the number and weight of trucks which transport wastes to the landfill site will be measured while the proportion of organic wastes in all the wastes transported to the landfill site will be annually measured by a public organization. By multiplying the number and weight of trucks by the proportion, the amount of organic wastes can be determined. Accordingly, the accuracy of the data can be ensured.

- In respect of the amount of biogas generated from the landfill site, through the comparison between the IPCC data and the value measured after the launch of operation, the more conservative value will be used.

•

SECTION B. Overall summary description:

>>

The project scenario in this methodology is to coferment sewage sludge and organic wastes at anaerobic fermenters and collect methane gas which is uncollectible as landfill gas (hereinafter referred to as LFG) at a landfill site instead of being released to the atmosphere. Moreover, by introducing the power generation system utilizing methane gas, a part of the grid electricity is to be replaced and GHG emitted from fossil fuel-fired power generation units of the grid is to be reduced.

The baseline scenario in this methodology is defined as the case in which LFG is combusted at a landfill site, sewage sludge is used for methane fermentation and produced methane is used to fuel boiler at a sewage plant.

With regard to the projects in this methodology, the validity of the baseline scenario shall be judged and the additionality of the project scenario shall be confirmed based on the following barriers.

- Legislation/Institution, Technical Barriers, Investment Barriers, Market Barriers, Environmental Impacts, Regional Trend

The formula to calculate GHG emissions in the baseline scenario is as follows.

BEy＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH

BEy ：Baseline CO2 emissions (t-CO2/year)

BE_SW_EL_GRIDy ：Power consumption at the sewage plant (KWh)

EF_GRID ：CO2 emission coefficient in the grid（t-CO2/KWh）

BE_METH_Wy ：The amount of methane gas which is uncollectible as LFG and is released to the atmosphere from the landfill site. (t-CH4/year) IPCC will be used for calculation. In this regard, however, the smaller value in comparison with the monitoring result shall be used to be conservative.

ε_METH ：Global warming coefficient of Methane (=21 IPCC Guideline))(t-CO2/t-CH4)

Leakage by carrying out the project scenario is CO2 emissions by the transportation of organic wastes. Leakage in transporting organic wastes to the sewage plant is defined as the CO2 emissions generated from combustion of light oil that transport trucks would consume in one year, assuming that the distance to transport organic wastes is the one to cross the city.

Ｌ１＝EF_TR×TR_ AM

EF_TR： CO2 emissions which would be generated from a truck which transports organic wastes from the city to the sewage plant(t-CO2/unit)

TR_AM： The number of trucks The number counted when the trucks transport the wastes shall be used.

CO2 emissions in the project scenario

PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε _METH

PEy ：Project CO2 reductions (t-CO2/year)

BE_SW_EL_GRIDy ：Power consumption at the sewage plant(KWh)

P_EL_GENy ：Generated output by Biogas（KWh ）

EF_GRID ：CO2 emission coefficient in the grid（t-CO2/KWh）

PE_METH_NWy ： The amount of methane gas generated from cofermentation of organic wastes and sewage sludge which are put into fermenters(t-CH4/year)

ε_METH ：Global warming coefficient of Methane (=21 IPCC Guideline)

PE_METH_Nwy will not be released into the atmosphere as GHG because all of them is used for biogas power generation.

Accordingly, CO2 emissions in the project scenario is;
PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε _METH＝（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID

Based on the above, CO2 emission reductions are defined as follows.
GHG reductions＝Baseline GHG emissions－Project GHG emissions－Leakage
＝BEy－PEy－L1
＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH－（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID－L1
＝BE_METH_Wy × ε_METH＋ P_EL_GENy ×EF_GRID－L1

SECTION C. Choice of and justification as to why one of the baseline approaches listed in paragraph 48 of CDM modalities and procedures is considered to be the most appropriate:

>>

C.1. General baseline approach:

□ Existing actual or historical emissions, as applicable;

■ Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;

□ The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.

C.2. Justification of why the approach chosen in C.1 above is considered the most appropriate:

>> By the use of an economically optimal technology, the baseline which abides by legislations and requires no investment has been selected.

SECTION D. Explanation and justification of the proposed new baseline methodology:

D.1. Explanation of how the methodology determines the baseline scenario (that is, indicate the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity):

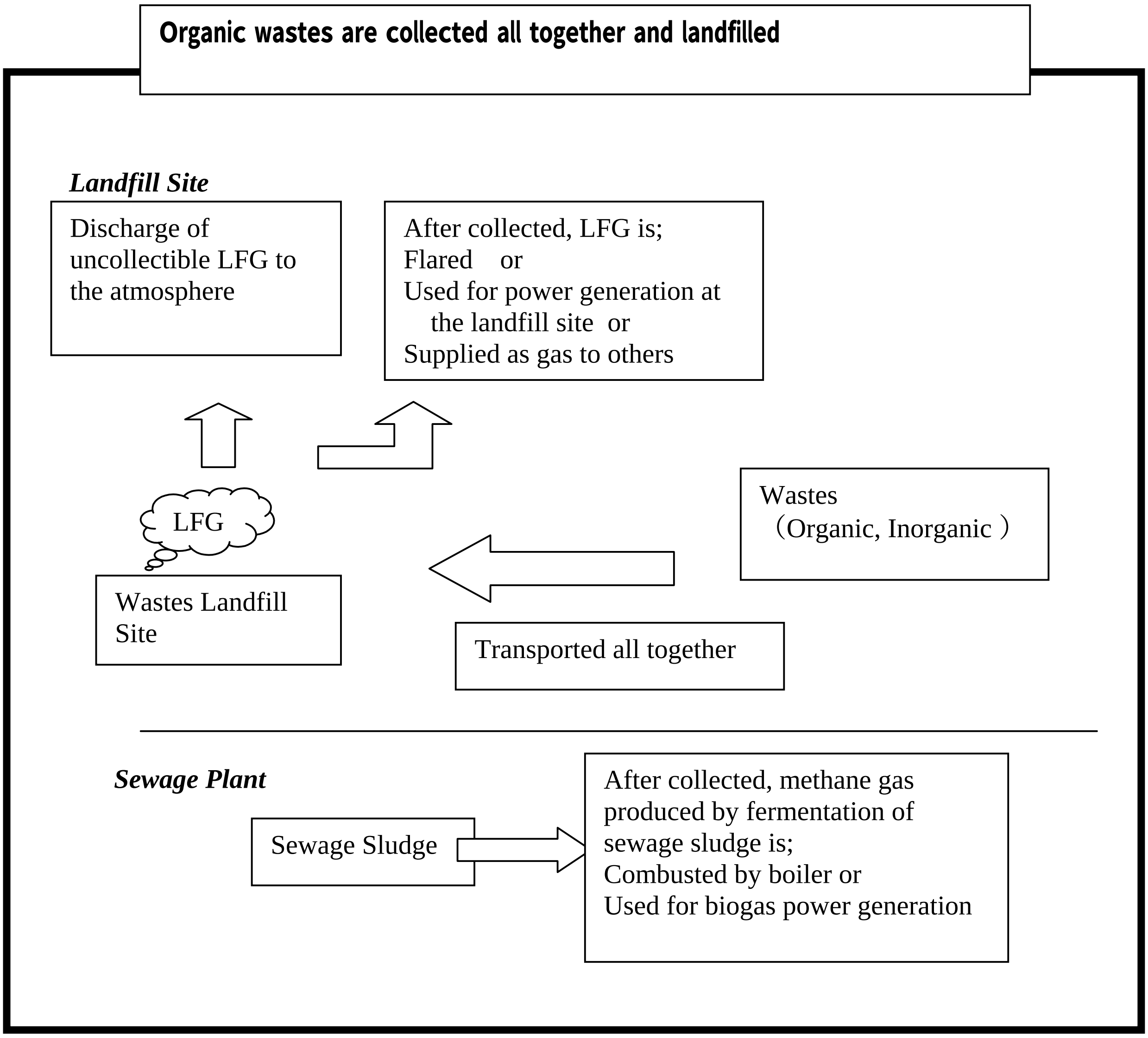
>>Baseline scenario indicates possible situations which would occur in a region in the absence of a certain project.

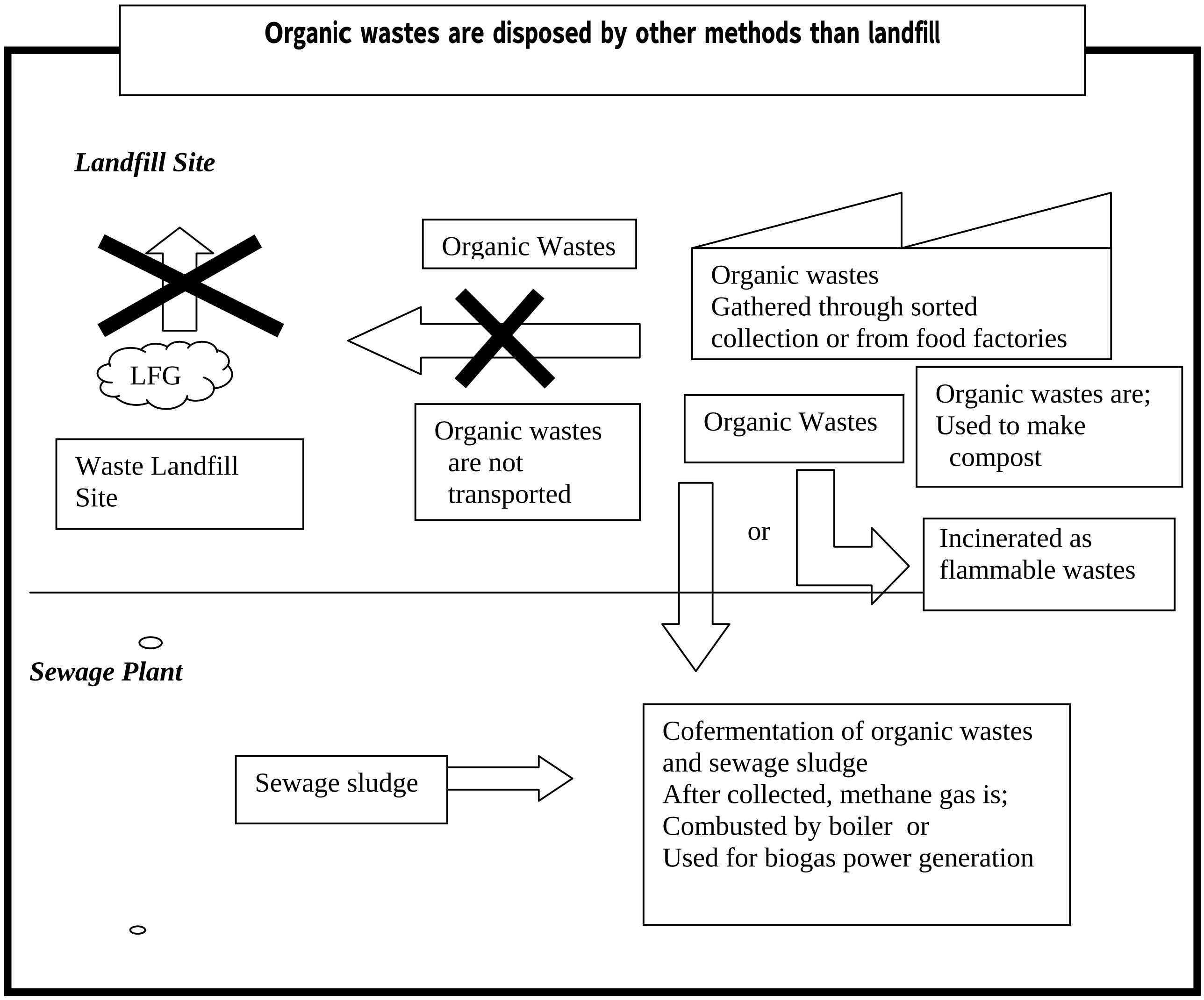
In the envisioned region, it is assumed:
・Both organic and inorganic wastes are being collected together, transported to a landfill site and, after sanitary landfill, LFG flaring is being carried out.
・Sewage sludge at a sewage plant is being anaerobically fermented at digester chambers and biogas produced from the fermentation is being used to fuel boiler during the winter season.

Based on the situations above, the following 12 scenarios are conceivable

Idea	Collected Wastes		Sewage Plant	
1	After collected all together, landfilled	Wastes are landfilled and produced LFG is flared	Methane fermentation by sewage sludge	Combusted by boiler
2				Used for power generation by generator
3		Wastes are landfilled and produced LFG is utilized for power generation at the landfill site	Methane fermentation by sewage sludge	Combusted by boiler
4				Used for power generation by generator
5		Wastes are landfilled and produced LFG is supplied to other facilities than the landfill site	Methane fermentation by sewage sludge	Combusted by boiler
6				Used for power generation by generator
7	Disposed by other methods than landfill	Organic wastes gathered through sorted collection or from factories are used to produce compost	Methane fermentation by sewage sludge	Combusted by boiler
8				Used for power generation by generator
9		Flammable wastes are incinerated.	Methane fermentation by sewage sludge	Combusted by boiler
10				Used for power generation by generator
11		Organic wastes gathered through sorted collection or from factories are transported to the sewage plant	Methane fermentation by sewage sludge and organic wastes	Combusted by boiler
12				Used for power generation by generator

Schematic overviews of the conceivable scenarios are shown below.




Organic wastes are disposed by other methods than landfill
Landfill Site
Organic Wastes
Organic wastes
Gathered through sorted
collection or from food factories
LFG
Organic wastes are not transported
Organic Wastes
Organic wastes are;
Used to make compost
Waste Landfill Site
or
Incinerated as flammable wastes
Sewage Plant
Sewage sludge
Cofermentation of organic wastes
and sewage sludge
After collected, methane gas is;
Combusted by boiler or
Used for biogas power generation

To define whether the applicable conditions are met or not, an interview about the environmental sector, the energy sector and the technical level of the region or on-site survey on existing facilities should be carried out in the region where the implementation of the project is being examined.

An appropriate baseline scenario shall be chosen from these 12 scenarios based on the applicable conditions set in A.3 of this application, with various barriers taken into consideration.
”Y” as yes, “N” as no and “－” as being neutral are given for each scenario on each question.
After the scenarios are assessed on all the question items, assesment”2” is given for the scenarios which have all “Y” s for the questions, assessment “1” for the scenarios which have one “Y”, and assessment ”0” for the scenarios which have more than two “N”s.

After the above assessment process is conducted for all the barriers, the scenario that has the highest mark shall be chosen as the baseline project.

ｉ）Legislation・Institution

Question	1	2	3	4	5	6	7	8	9	10	11	12
Consistent with the governmental energy policy?	N	Y	N	Y	Y	Y	N	Y	N	Y	N	Y
Consultations or coordination with relevant organizations unnecessary?	Y	Y	Y	Y	N	N	N	N	N	N	N	N
Assessment	1	2	1	2	1	1	0	1	0	1	0	1

- “Y” is given to the scenarios which are consistent with the governmental policies to develop or prioritize renewable energy.
- As consultations or coordination with relevant organizations take time and possibly become a huge obstacle to the project, the scenarios that would not require them are given “Y”.
- “Y” is given to Scenarios 2, 4, 6,8,10 and12 as they generate electricity utilizing biogas, and Scenario 5 as biogas is possibly used at power generation facilities, considering that the government in the nation has a policy to develop or prioritise renewable energy.
- In Scenarios 7～12, among solid wastes, only organic wastes should be carried to the sewage plant. Because the governing bodies for solid wastes and for sewage treatment have been separately run in the country, consultation and coordination with several governing bodies would be required.
- “Y” is given to Scenarios 1～4 as they would not span several existing administrative sections.
- Scenarios 5 and 6, in which biogas is supplied to other facilities than the landfill site, would require consultation with such governing bodies as the energy sector.

ii） Technical Barriers

Question	1	2	3	4	5	6	7	8	9	10	11	12
1）Risks in technology development and practical use small?	Y	N	N	N	N	N	N	N	N	N	N	N
2）Risks in construction small?	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y
3）Technical risks in operation small?	Y	N	Y	N	N	N	N	N	N	N	Y	N
Assessment	2	0	1	0	0	0	0	0	0	0	1	0

- As Scenario 1 has a past record of operation, technical risks would be small.

- Scenarios 2, 4, 6,8,10 and12, utilize a system which uses methane gas produced from fermentation of sewage sludge or organic wastes to generate electricity. This system is a common technology in Japan, however it would entail risks of technology development in the nation as it would be the first time for this technology to be used there. Meanwhile, the technology to utilize LFG in Scenarios 3 and 5 as well as the technology to dispose organic wastes colleted separately in Scenarios 7 and 9 would be also adopted first time ever in the nation. Accordingly they would entail risks in technology development.
- Scenarios 9 and 10 use large-scale combustion equipment and, therefore, would have risks in quality control due to lack of experience.
- Scenarios 2, 4, 6,8,10 and 12 are considered to entail technology risks in operation to generate electricity, given the possibility that the property and amount of methane gas, which are forcibly fermented, could be unstable. “N” is given to Scenarios 5 and 6 since a continuous monitoring of the propriety of gas and communication with the recipient would be necessary as produced LFG is transported to other facilities. “N” is given to Scenarios 7 and 8 as, in producing the compost, control of temperature and moisture content is difficult. “N” is given to Scenarios 9 and 10, in which wastes are incinerated, as they would entail technology risk in operation, considering the difficulty to control the incineration temperature when wastes are moist.

iii）Investment Barriers

Question	1	2	3	4	5	6	7	8	9	10	11	12
New investment unnecessary or investment efficiency high?	Y	N	N	N	N	N	N	N	N	N	N	N
Low operational cost?	Y	Y	Y	Y	Y	Y	N	N	N	N	Y	Y
Assessment	2	1	1	1	1	1	0	0	0	0	1	1

- Scenario 1 is the same as the status quo, and, thus, no new investment would be required.
- As to Scenarios 2, 3,4,10 and12, even though the governmental policy on renewable energy exists, there is no support policy and, as a result, no incentive to invest in power generation facilities. For that reason, investment efficiency is not considered high and, therefore, “N” is given to the scenarios.
- In Scenarios 5 and 6, a piping would be needed to supply LFG to other facilities, which would require hefty initial investment. Therefore “N” is given to them.
- In Scenarios 7 and 8, investment efficiency is not considered high because, given lack of purchasing power in the domestic agricultural sector, incomes from sales of compost could not be expected.

・ Scenarios 9 and 10 would require the construction of new incineration facilities, which would need hefty initial investment. Therefore, “N” is given to them.
・ With regard to operational costs in Scenario 7 and 8, considering the possibility that the management cost for making compost and also, in case that sales of the compost are slow due to lack of purchasing power in the domestic agricultural sector, the carrying cost of the compost would arise. Therefore, “N” is given to the scenarios. Meanwhile, as to incineration of wastes in Scenarios 9 and 10, maintenance costs would be high because the boiler would be damaged more severely than other types of boilers such as a coal boiler, considering that incineration gas contains various components. Therefore, “N” is given to them.
・ In Scenarios 1, 2,3,4,5,6,11 and 12, maintenance costs are considered most costly among operational costs. As machine maintenance available on the site would be basically provided, the cost would be smaller than Scenarios 7 – 10. Therefore, “Y” is given to them.

iv）Environmental Impacts

Question	1	2	3	4	5	6	7	8	9	10	11	12
Suitable to solve environmental problems?	N	N	N	N	—	—	N	Y	N	N	N	Y
Assessment	0	0	0	0	—	—	0	1	0	0	0	1

・ Environmental impacts shall be judged from the following two points; i.e., whether a scenario can reduce greenhouse gases, and whether it is suitable for environmental improvement in the region.
・ “N” is given to Scenarios 9 and 10, in which wastes are incinerated, because they would entail risks to cause problems of dioxin and so forth if the incineration temperature is not controlled.
・ Scenarios 1, 7 and 11, in which power generation is not carried out, could not replace coal combustion and reduce dust through power generation. For that reason, they are unlikely to contribute to solving the problem of air quality and, thus, “N” is given to them.
・ In Scenarios 2, 3 and 4, LFG would not be completely collected and, therefore, methane gas would be released to the atmosphere. Accordingly they are not suitable for solving the environmental problem of global warming.

v）Regional Trend

Question	1	2	3	4	5	6	7	8	9	10	11	12
Meet the needs of the region?	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
Assessment	0	0	0	0	0	0	1	1	1	1	1	1

・ The envisioned city is faced with a rapid increase of the population and is urged to examine the waste problem. Moreover, given that sorted collection of garbage has been promoted as a solution of the worldwide garbage issue, Scenarios 7 to 12, which carry out sorted collection and could contribute to extending a life of a landfill site, are considered to meet the needs of the region. Therefore, “Y” is given to them.

vi）Market Barriers

Question	1	2	3	4	5	6	7	8	9	10	11	12
Possible to spread in the region?	Y	Y	N	N	N	N	N	N	N	N	Y	Y
Assessment	1	1	0	0	0	0	0	0	0	0	1	1

・”Y” is given to Scenario 1 and 2 since LFG flaring at the landfill site stated in the scenarios is expected to spread in the region as it applies a simple system and has shown an actual performance.

- ”N” is given to Scenarios 3 and 4, in which power generation is carried out at the landfill site using LFG, as they have never been carried out in Kazakhstan and, thus, would require time to spread in the region.
- ”N” is also given to Scenarios 5 and 6, in which LFG is supplied to other facilities than the landfill site, as they have never been implemented in Kazakhstan and, therefore, would require time to spread in the region.
- ”N” is given to Scenarios 7 and 8, in which organic wastes are used to make compost, as it would be difficult to manage such a vast amount of compost to be produced.
- ”N” is given to Scenarios 9 and 10, in which wastes are incinerated, as it has been found out through interviews that incineration of wastes is not allowed under the law of the country.
- ”Y” is given to Scenarios 11 and 12 as the system used in the scenarios has shown an actual performance of operation and can possibly spread in the nation if such conditions as collection of organic wastes are met, though some operational problems exist in reality.

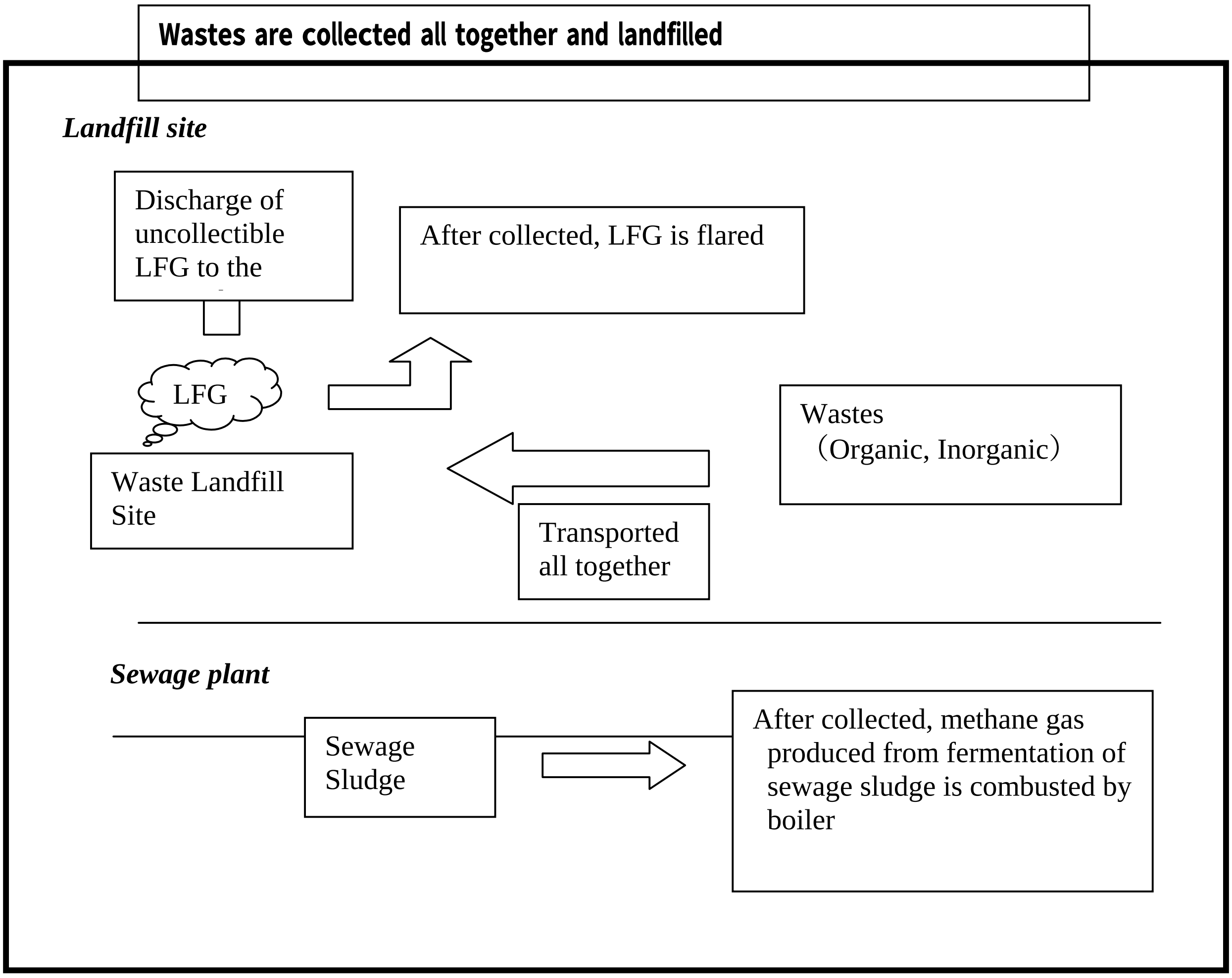
Selection of Baseline

The following table sums up the examination results.

Examination Item	Idea 1	Idea 2	Idea 3	Idea 4	Idea 5	Idea 6	Idea 7	Idea 8	Idea 9	Idea 10	Idea 11	Idea 12
Legislation/Institution	1	2	1	2	1	1	0	1	0	1	0	1
Technical Barriers	2	0	1	0	0	0	0	0	0	0	1	0
Investment Barriers	2	1	1	1	1	1	0	0	0	0	1	1
Environmental Impacts	0	0	0	0	–	–	0	1	0	0	0	1
Regional Trend	0	0	0	0	0	0	1	1	1	1	1	1
Market Barriers	1	1	0	0	0	0	0	0	0	0	1	1
Comprehensive Assessment	6	4	3	3	2	2	1	3	1	2	4	5

Based on the above, with all the examination items; i.e., legislation/institution, technical barriers, investment barriers, environmental impacts, regional trend and market barriers, taken into account, Scenario 1, which has the highest mark, is chosen as the baseline scenario.

Scenario 1 is; all wastes are collected together, then landfilled with produced methane gas (hereinafter referred to as LFG) being flared. Sewage sludge is anaerobically fermented with produced methane gas being combusted at a boiler. Below is the overview of Scenario 1.



GHG emissions in the baseline scenario are the sum of CO2 emissions by the use of the grid electricity at the sewage plant and CO2 equivalent emissions of methane gas which is uncollectible as LFG and is released from the landfill site.

The project scenario is fixed as Scenario 12 which marks the second highest in the comprehensive assessment. The scenario is; wastes are separately collected and organic wastes are put into anaerobic fermenters together with sewage sludge, and produced methane gas is utilized for power generation.

This project scenario is inferior to the baseline scenario in technical barriers and investment barriers. However, by carrying out the project as JI, the technical barriers can be overcome with technical guidance and the investment barriers can be lowered with CO2 credits.

D.2. Criteria used in developing the proposed baseline methodology:

>>

As major standards in developing the baseline methodology, examination has been carried out as to legislation/institution, technical barriers, investment barriers, environmental impacts, regional trend and market barriers. The following items have been also used.

In order to avoid overestimation of GHG emissions, the generated output by methane gas should be precisely measured. As the measuring technology of the data is common, there is little gap between the calculated GHG emission reductions in the baseline scenario and the actual value.

・Measurement of the amount of organic wastes thrown out in a landfill site could be a weakness. This measurement is important for calculation of the amount of biogas released from the landfill site into the atmosphere. In this connection, the number and weight of trucks which transport wastes to the landfill site will be measured while the proportion of organic wastes in all the wastes transported to the landfill site will be annually measured by a public organization. By multiplying the number and weight of trucks by the proportion, the amount of organic wastes can be determined. Accordingly, the accuracy of the data can be ensured.

・In respect of the amount of biogas generated from the landfill site, through the comparison between the IPCC data and the value measured after the launch of operation, the more conservative value will be used.

This methodology is highly versatile as it does not require any particular prerequisites.

D.3. Explanation of how, through the methodology, it can be demonstrated that a project activity is additional and therefore not the baseline scenario (section B.3 of the CDM-PDD):

>>

The project scenario of biogas power generation utilizing sewage sludge has the following additionality and, thus, cannot be the baseline scenario.

- Legislation/Institution
  The project has additionality as it will enable the government's vertical administrative structure to work together to operate the anaerobic fermentation system utilizing wastes.
- Technical Barriers
  The project has additionality as technical barriers on biogas power generation by cofermentation of sewage sludge and organic wastes can be removed through the implementation of the project scenario which enables technology transfer.
- Investment Barriers
  The project scenario has additionality as investment effects will improve by carrying out the project as JI because of the condition where no legislation on LFG handling exists and, thus, no incentive for investment in renewable energy is found.
- Environmental Impacts
  The project has additionality as the implementation of this project is effective to alleviate the environmental problem at a landfill site in the nation as well as the air pollution and global warming problems.
- Regional Trend
  This project meets the needs of the region which is examining a solid waste disposal method.
- Market Barriers
  Market barriers can be removed as the nation has a past record in operating anaerobic fermenters and the technology used in the project scenario can possibly spread by carrying out the project if such conditions as collection of organic wastes are met.

D.4. How national and/or sectoral policies and circumstances can been taken into account by the methodology:

>>

Policies in the host country have important bearings in defining the baseline. Any support systems for renewable energy would have influences on investment barriers while legislation on landfill sites could impose some restrictions on the use of organic wastes. Accordingly, policies and regulations in the host country should be confirmed through interviews with the parties concerned.

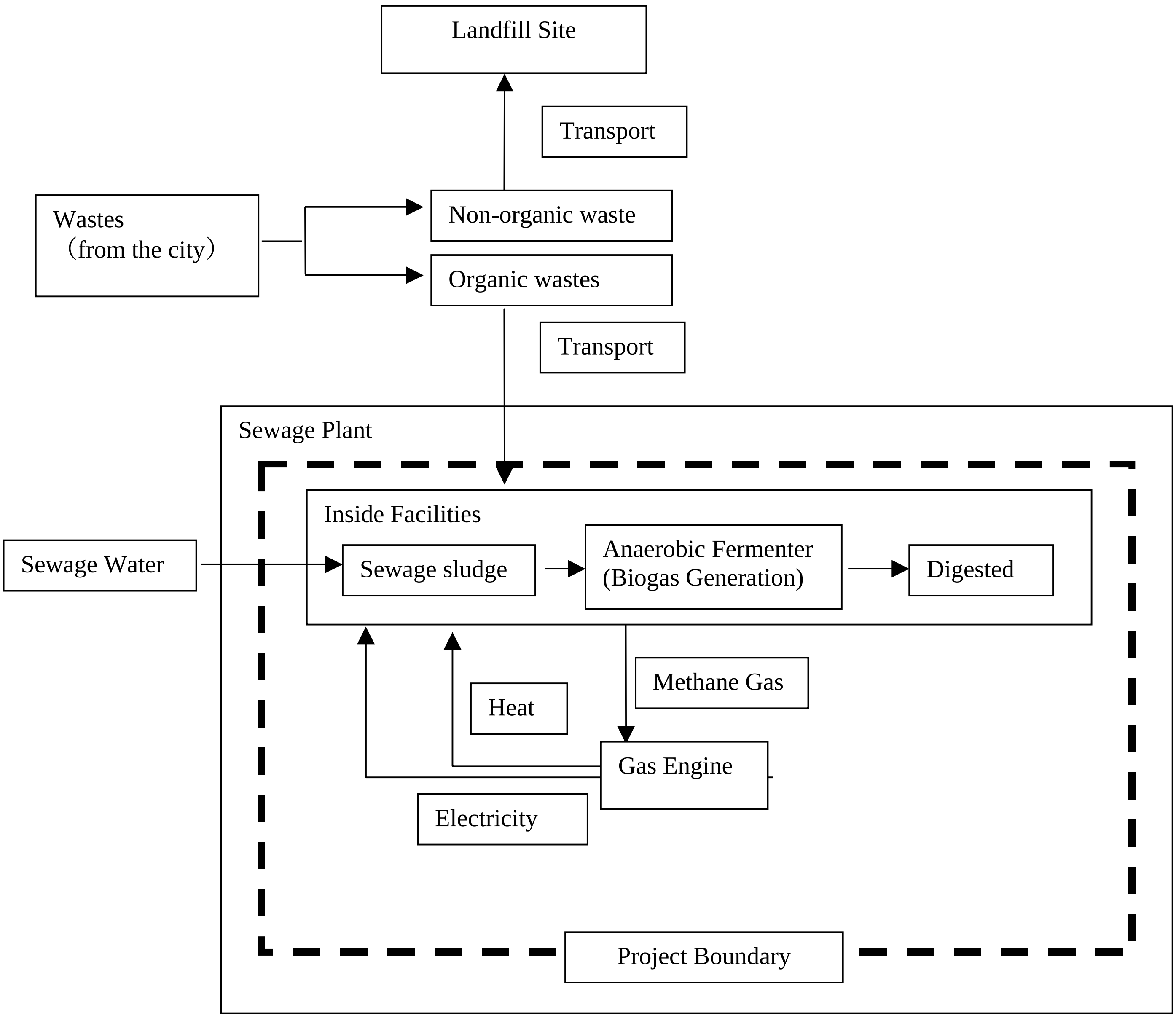
D.5. Project boundary (gases and sources included, physical delineation):

>>

The project boundary is anaerobic fermenters and a power generation unit at the sewage plant.

Separating wastes and carrying them into the anaerobic fermenters at the sewage plant are the tasks the administration is responsible for. Therefore, they are not included in the project boundary of this project.

Potential leakage would be GHG from transport machines which carry organic wastes to the project boundary.



System Flow

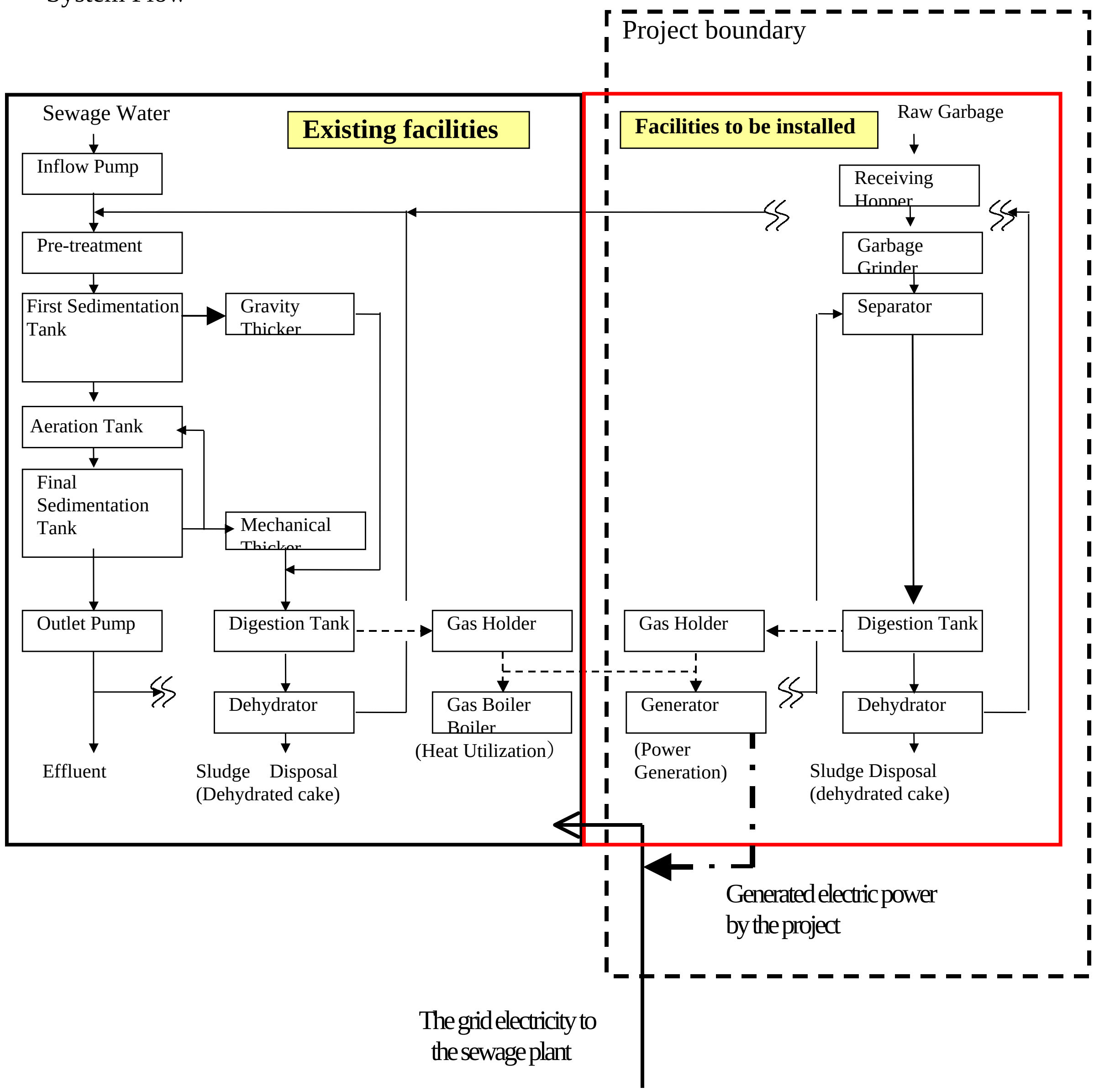


Table GHG emissions by scenario

	Within the boundary	Outside the boundary
Baseline Scenario	CO_2 emissions by the grid electricity used at the sewage plant	Methane gas emissions from the landfill site
Project Scenario	CO_2 emissions by the grid electricity at the sewage plant – CO_2 emissions by biogas power generation	CO_2 emissions by the transport of organic wastes

D.6. Elaborate and justify formulae/algorithms used to determine the baseline scenario. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

>>

The formula to determine GHG emissions in the baseline scenario is shown below.

BEy＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Ｗy × ε_METH

BEy ： Baseline CO2 emissions(t-CO2/year)

BE_SW_EL_GRIDy ： Power consumption(KWｈ) at the sewage plant. It will be measured by a watt-hour meter which can determine grid power consumption.

EF_GRID ： For CO2 emission coefficient in the grid, the average of all electric power is adopted to be conservative.

BE_METH_Wy ： The amount of methane gas which is uncollectible as LFG and is released to the atmosphere from the landfill site. IPCC shall be used for calculation. In this regard, however, the smaller value between the IPCC and the monitoring result will used to be conservative.

ε_METH ：Global warming coefficient of Methane(=21 IPCC Guideline)

D.7. Elaborate and justify formulae/algorithms used to determine the emissions from the project activity. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

>>

CO2 emissions in the project scenario

PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε_METH

PEy ：Project CO2 reductions(t-CO2/year)

BE_SW_EL_GRIDy ：Power consumption at the sewage plant(KWh)

P_EL_GENy ：Generated output by biogas（kWh）

EF_GRID ：CO2 emission coefficient in the grid（t-CO2/kWh）

PE_METH_NWy ： The amount of methane gas generated from cofermentation of organic wastes and sewage sludge which are put into fermenters(t-CH4/year)

ε_METH ：Global warming coefficient of Methane (=21 IPCC Guideline)

PE_METH_Nwy will not be released into the atmosphere as GHG because all of them are used for biogas power generation.

Accordingly, CO2 emissions in the project scenario is;

PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε_METH＝（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID

D.8. Description of how the baseline methodology addresses any potential leakage of the project activity:

>>

Potential leakage is CO2 emissions by the transportation of organic wastes to the project line.

Leakage in transporting organic wastes to the sewage plant is defined as the CO_2 emissions generated from combustion of light oil that transport trucks would consume in one year, assuming that the distance to transport organic wastes is the one to cross the city.

Ｌ１＝EF_TR×TR_ AM

EF_TR： CO_2 emissions which would be generated from a truck which transports organic wastes from the city to the sewage plant(t-CO_2/unit)
TR_AM： The number of trucks The number counted when the trucks transport the wastes shall be used.

D.9. Elaborate and justify formulae/algorithms used to determine the emissions reductions from the project activity. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

>>
GHG emissions are as follows.
GHGreductions＝Baseline GHG emissions－Project GHG emissions－Leakage
＝BEy－PEy
＝（P_EL_GENy×EF_GRID＋×PE_METH_NWy×ε_METH）－０－L1
＝（P_EL_GENy×EF_GRID＋×PE_METH_NWy×ε_METH）－L1

SECTION E. Data sources and assumptions:

E.1. Describe parameters and or assumptions (including emission factors and activity levels):

>>
Local data have been used for emission coefficient. With respect to unavailable data, the average of all electric power is calculated using the thermal efficiency of Japanese plants, which is higher than that of local plants, to be conservative.
The amount of wastes transported to the landfill site can be obtained from the local authorities.
The amount of methane gas at the landfill site can be determined with IPCC.

E.2. List of data used indicating sources (e.g. official statistics, expert judgement, proprietary data, IPCC, commercial and scientific literature) and precise references and justify the appropriateness of the choice of such data:

>>

Item	Data source used	Reason to be used
Conversion coefficient on the amount of methane gas generated	IPCC	With no experiments being held on site, it is difficult to obtain the data. Thus, data from IPCC is used. If local data is available from the monitoring results, the value will be used to be conservative.
Fuel Property	On-site data	Data used on site is adopted.
Efficiency of the power plant	On-site data	Data used on site is adopted.

E.3. Vintage of data (e.g. relative to starting date of the project activity):

>>
Vintage of the data used

- IPCC Guidebook 1996
- For fuel calories, the latest data obtained through an interview on the site has been used. For unavailable data, conservative values have been used.
- For the mount of biomass transported, the latest on-site data has been used.

E.4. Spatial level of data (local, regional, national):

>>
The spatial level of the IPCC data used is the former Soviet Union. With respect to other data, local data have been used.

SECTION F. Assessment of uncertainties (sensitivity to key factors and assumptions):

>>IPCC default values are included in the values used this time. As the values have an effect on the amount of methane fermentation by landfill gas, some errors on CO2 emission reductions may occur. Therefore, on the analogy of data on other nations, a conservative value has been used.

In respect of errors in measuring devices, uncertainty decreases as the accuracy of the devices can be ensured by the use of calibrated ones.

SECTION G. Explanation of how the baseline methodology allows for the development of baselines in a transparent and conservative manner:

>>

In calculating GHG reductions, some uncertainties may arise depending on data on the amount of wastes. Accordingly, on-site values are used to be conservative.

添付資料Ⅰ-3　PROPOSED NEW METHODOLOGY : MONITORING　　（英文）

CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: MONITORING (CDM-NMM)
Version 01 - in effect as of: 1 July 2004

CONTENTS

SECTION A. Identification of methodology

A.1. Title of the proposed methodology:

>>

Monitoring methodology of biogas power generation by cofermentation of sewage sludge and organic wastes

A.2. List of category(ies) of project activity to which the methodology may apply:

>>

Categories of the project activity are as follows.

1 The Energy Industry(Renewable/Non-renewable)

13. Wastes Disposal and Treatment

A.3. Conditions under which the methodology is applicable to CDM project activities:

>>

This monitoring methodology is applicable to project activities that adopt the baseline methodology for biogas power generation utilizing sewage sludge and so forth and that replace the grid electricity and reduce methane gas released from organic wastes transported to a landfill site.

This monitoring methodology is applicable to the projects which fulfil the following conditions.

- There is no power generation plant utilizing methane gas at sewage plants in the region where the project is planned.
- Even though policies to develop or prioritise renewable energy are being stated in the governmental energy plan, there is no concrete support system.
- The region has sewage sludge disposal facilities at sewage plants available to this project.
- The landfill site is planning to carry out LFG flaring, however no plan for LFG-fired power generation is being envisioned at present as well as for the future.
- There is no legislation to enforce LFG flaring.
- Sorted collection of organic wastes are planned to be in place in the future.
- There is a coal-fired power plant near the project site from which all electricity is being supplied and no large-scale gas-fired power plant using gas nearby.
- There are some measuring devices to gauge the amount of wastes transported to the landfill site.
- The project site is in a big city where the population is expected to increase going forward.
- Administrative sections in charge of solid wastes and sewage treatment are being separated.

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

>>

Strengths

This monitoring methodology does not use any special measuring devices, which leads to easy maintenance of the devices, including their calibration. Accordingly, monitoring on site will not be burdensome.

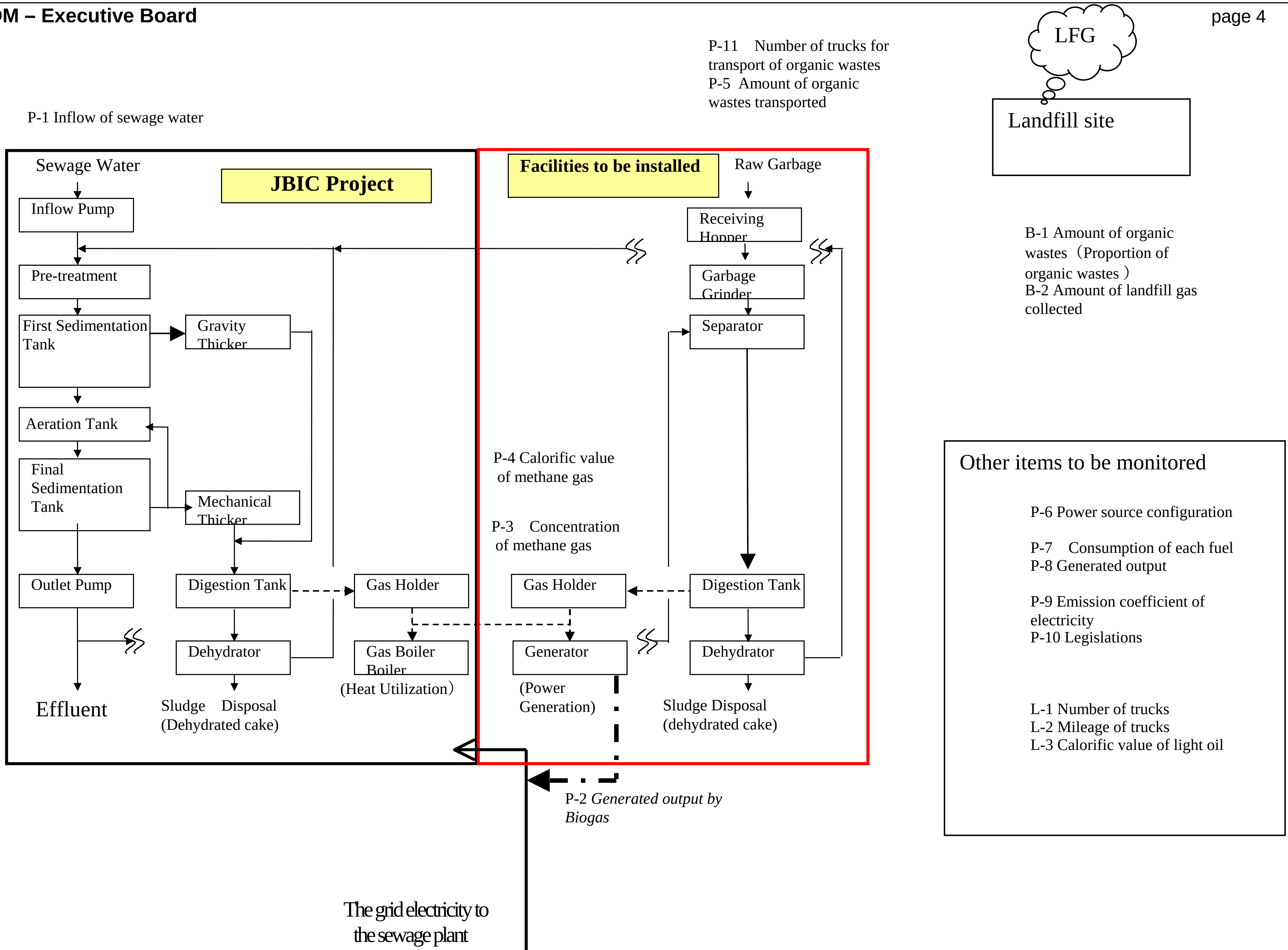
Weaknesses

Data on coal consumption and the generated output will have to be obtained from the power plant. Since this project has no binding power to the plant, a potential weakness is the need to ask them to measure the data. However, their cooperation is expected to be gained easily as this request will not induce any additional work to them because they are controlling these values on a daily basis. Explanation on the monitoring plan will be given to the plant to gain their understanding and cooperation for provision of the records.

SECTION B. Proposed new monitoring methodology

B.1. Brief description of the new methodology:

>>Items to be monitored are as follows.


P-11 Number of trucks for transport of organic wastes
P-5 Amount of organic wastes transported
LFG
Landfill site
P-1 Inflow of sewage water
Sewage Water
JBIC Project
Facilities to be installed
Raw Garbage
Inflow Pump
Receiving Hopper
B-1 Amount of organic wastes（Proportion of organic wastes）
B-2 Amount of landfill gas collected
Pre-treatment
Garbage Grinder
First Sedimentation Tank
Gravity Thicker
Separator
Aeration Tank
Final Sedimentation Tank
Mechanical Thicker
P-4 Calorific value of methane gas
P-3 Concentration of methane gas
Other items to be monitored
P-6 Power source configuration
P-7 Consumption of each fuel
P-8 Generated output
P-9 Emission coefficient of electricity
P-10 Legislations
Outlet Pump
Digestion Tank
Gas Holder
Gas Holder
Digestion Tank
Dehydrator
Gas Boiler Boiler
Generator
Dehydrator
(Heat Utilization)
(Power Generation)
Effluent
Sludge Disposal (Dehydrated cake)
Sludge Disposal (dehydrated cake)
L-1 Number of trucks
L-2 Mileage of trucks
L-3 Calorific value of light oil
P-2 Generated output by Biogas
The grid electricity to the sewage plant

B.2. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario:

>>

B.2.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P-1 P_EL_GENy	*Inflow of sewage water*	*Measurement by flowmeter*	*M3/day*	*m*	*Everyday*	*100%*	electronic/ paper	
P-2 P_EL_GENy	*Generated output by Biogas*	Measurement by watt-hour meter	kWh */day*	*m*	*Everyday*	*100%*	electronic/ paper	
P-3 P_EL_GENy	*Concentration of Methane gas from fermenter*	*Measurement by concentration meter*	*%*	*m*	*Weekly*	*100%*	electronic/ paper	
P-4 P_EL_GENy	*Calorific value of Methane gas*	*Measurement by calorific value meter*	*MJ/m3*	*m*	*Weekly*	*Sample*	electronic/ paper	
P-5 P_EL_GENy	*The amount of organic wastes transported*	*Truck scale*	*t/day*	*m*	*Everyday*	*100%*	electronic/ paper	
P-6 EF_GRID	*Power source configuration in Kazakhstan*	*Interview*		*m,c*	*Year*	*Sample*	paper	*The data will be monitored for calculation of the average carbon emission coefficient of all electricity*
P-7 EF_GRID	*Consumption of each*	*Interview*	*t/year*	*e*	*Year*	*Sample*	paper	*The data will be monitored for calculation of the average*

	fuel used for thermal power generation in Kazakhstan							*carbon emission coefficient of all electricity*
P-8 EF_GRID	*Total generated output in Kazakhstan*	*Interview*	*MW/ year*	*e*	*Year*	*Sample*	paper	*The data will be monitored for calculation of the average carbon emission coefficient of all electricity.*
P-9 EF_GRID	*CO2 emission coefficient of electricity*	*Interview and calculation*	*t-co2MWh*	*c*	*Year*	*Sample*	paper	
P-10 EF_GRID	*The number of trucks for transport of organic wastes*	*Counting with eyes*	*Amount/day*	*m*	*Everyday*	*100%*	electronic/ paper	
P -11	*Legislations*	*Interview*			*Year*		paper	Revision and establishment of legislations on wastes and energy will be monitored.

B.2.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε_METH

PEy ：Project CO2 reductions(t-CO2/year)
BE_SW_EL_GRIDy ：Power consumption at the sewage plant(KWh)
P_EL_GENy ：Generated output by biogas（kWh）
EF_GRID ：CO2 emission coefficient in the grid（t-CO2/KWh）

PE_METH_NWy ：The amount of methane gas generated through cofermentation of organic wastes and sewage sludge which are put into fermenters(t-CH4/year)
ε_METH ：Global warming coefficient of Methane(=21 IPCC Guideline

B.2.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary and how such data will be collected and archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B-1 B_LFG_METHy	*The amount of organic wastes*	*Measurement by weight meter*	*t /year*	*m，c*	*Biannual*	*Sample*	electronic/ paper	*The composition of pre-separated wastes will be checked.*
B-2 B_LFG_METHy	*The amount of landfill gas collected*	*Flowmeter Calculation*	*t/year*	*m,c*	*Everyday*	*Sample*	electronic/ paper	*Fflowmeters will be installed on LFG collection piping. The amount of LFG collected will be determined by multiplying the inflow by the number of pipes.*

B.2.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

The formula to calculate GHG emissions in the baseline scenario is as follows.

GHG emissions in the baseline scenario＝
LFG emissions from the landfill site in the baseline
＋CO2 emissions from the grid in the baseline

BEy＝BE_METH_Wy × ε_METH ＋ BE_SW_EL_GRIDy ×EF_GRID

BEy	：Baseline CO2 emissions (t-CO2/year)
BE_SW_EL_GRIDy	：Power consumption at the sewage plant (KWh)
EF_GRID	：CO2 emission coefficient in the grid（t-CO2/KWh）
BE_METH_Wy	： The amount of methane gas which is uncollectible as LFG and is released to the atmosphere from the landfill site. (t-CH4/year) IPCC will be used for calculation. In this regard, however, the smaller value in comparison with the monitoring result shall be used to be conservative.
ε_METH	：Global warming coefficient of Methane (=21 IPCC Guideline))(t-CO2/t-CH4)

B.3. Option 2: Direct monitoring of emission reductions from the project activity:

>>

B.3.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

B.3.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

B.4. Treatment of leakage in the monitoring plan:

B.4.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
L-1 TR_AM	*The number of trucks*	*Counting with eyes*	*Unit/year*	*m*	*Everyday*	*100%*	electronic/ paper	
L-2 EF_TR	*Mileage of trucks*	*Interview*	*Km/l*	*m,c*	*Half year*	*Sample*	electronic/ paper	
L-3	*Calorific value of light oil*	*Interview*	*Kcal/kg*	*e*	*Hafyear*	*Sample*	electronic/ paper	

B.4.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

Ｌ１＝EF_TR×TR_ AM

L1 ：CO2 emissions by leakage(t-CO2/year)

EF_TR ：CO2 emissions which would be generated from a truck which transports organic wastes from the city to the sewage plant(t-CO2/unit)

TR_AM ：The number of trucks The number counted when the trucks transport the wastes shall be used.

B.5. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

CO2 emission reductions are as follows.

GHG reductions＝Baseline GHG emissions－Project GHG emissions－Leakage

＝BEy－Pey－L1

＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH－（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID－L1

＝BE_METH_Wy × ε_METH＋ P_EL_GENy ×EF_GRID－L1

B.6. Assumptions used in elaborating the new methodology:

>>

In calculation of methane gas emissions by LFG, the following values are used.

MCF = methane correction factor (fraction) Based on IPCC, 1.0 is adopted as the waste landfill site in Astana City is management-type.

DOCF = fraction DOC similated With regional features of this region taken into account, the value is set to be 0.68 to be conservative.

F = fraction of CH4 in landfill gas 0.5, the IPCC default value, is used to be conservative though various values have been reported. In this regard, however, this value will be monitored and, in comparison with the IPCC default value, the smaller one shall be used to be conservative.

R ： According to the handbook on Landfill compiled by U.S. Environmental Protection Agency (hereinafter referred to as EPA), the collection rate of methane gas is considered to be between 50% and 90%. The handbook has also stated that the collection efficiency of methane gas in the case that the operation to collect LFG is carried out is between 60% and 85% of the generated methane gas. The collection efficiency is conservatively set to be 85% with the use of the collection efficiency in operation.

OX = oxidation factor 0.0, the IPCC default value, is adopted.

MSWT = total MSW generated (G/yr)

MSWF = fraction of MSW disposed to solid waste disposal sites

DOC = degradable organic carbon (fraction)

MSWT ×MSWF ×MCF ×DOC：As this data refers to the amount of organic wastes thrown out in the landfill site, the waste data of the landfill site is obtained from the municipal authorities.

The amount of sewage sludge put into methane fermenters can be determined by calculation with the data on the amount of sewage water disposed.

The amount of organic wastes landfilled at the waste disposal site will be gauged by truck scales.

The amount of biogas generated from the project equipment to be installed, concentration of methane gas, calorific value of methane gas and the generated output will be found out by actual measurement.

Electricity has been supplied from a nearby coal-fired power plant to the region. However, as it has been linked to other grid, the weighted average emission coefficient of all power sources is used to be conservative.

The IPCC Guideline is used for the following values to be conservative.
Carbon oxidization proportion coefficient 0.995
CO2 unit conversion coefficient 44/12＝3.7
Carbon equivalent emission factor 25.8 ［ｔ-c/TJ］

B.7. Please indicate whether quality control (QC) and quality assurance (QA) procedures are being undertaken for the items monitored:		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
P-1	*Low*	*QA is undertaken. Inflow of sewage water will be measured by a flowmeter at the sewage plant. The flowmeter shall be based on the standard on calibration of measuring devices in the nation, however if such standard does not exist, calibration recommended by the manufacturer will be regularly carried out.*
P-2	*Low*	*Generated output by Biogas shall be based on the standard on calibration of measuring devices in the nation, however if such standard does not exist, calibration recommended by the manufacturer will be regularly carried out.*
P-3	*Low*	*Concentration of methane gas from the fermenters shall be based on the standard on calibration of measuring devices in the nation, however if such standard does not exist, calibration recommended by the manufacturer will be regularly carried out.*
P-4	*Low*	*Calorific value of methane gas shall be based on the standard on calibration of measuring devices in the nation, however if such standard does not exist, calibration recommended by the manufacturer will be regularly carried out.*
P-5	*Low*	*The amount of organic wastes transported will be measured by truck scales. The scales shall be based on the standard on calibration of measuring devices in the nation, however if such standard does not exist, calibration recommended by the manufacturer will be regularly carried out.*
P-6	*Low*	*An interview will be held with a national organization to find out power source configuration.*
P-7	*Low*	*An interview will be held with a national organization to find out consumption of each fuel.*
P-8	*Low*	*An interview will be held with a national organization to find out generated output.*
P-9	*Low*	*CO2 emission coefficient of electricity will be determined with generated output and coal consumption. This figure can be found out by calculation, therefore attention shall be paid to the calculation.*
P-10	*Low*	*The number of trucks for transport of organic wastes and the weight of organic wastes transported will be measured.*

P-11	*Low*	*Revision and establishment of legislations on wastes and energy will be checked.*
B-1	*Low*	*Separation of organic wastes from inorganic wastes and measurement of the composition of organic wastes will be done by hand. Workers shall be directed to separate wastes properly. A calibrated weight meter shall be used to measure the mount of organic wastes.*
B-2	*Medium*	*Flowmeters will be installed on LFG collection piping and the amount of landfill gas collected will be determined by multiplying the inflow by the number of pipes. Therefore, calibrated measuring devices shall be used for the measurement.*
L-1	*Medium*	*The number of trucks*
L-2	*Medium*	*Mileage of trucks*
L-3	*Medium*	*Calorific value of light oil*

B.8. Has the methodology been applied successfully elsewhere and, if so, in which circumstances?

>>

none

添付資料Ⅱ-1　PROJECT DESIGN DOCUMENT　（和文）

CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>>
Biogas Power Generation utilizing Organic Wastes and Sewage Sludge in Astana

A.2. Description of the project activity:

>>
カザフスタン共和国の首都アスタナ市においては，遷都による急激な人口流入に伴い，廃棄物処理等の環境問題が発生している。
本プロジェクトは，アスタナ市の下水処理場に嫌気性共発酵システムを導入し，発生するバイオガスを利用する発電設備を設置し，環境問題の緩和ならびにＧＨＧ削減を実現する JI プロジェクトを実施するものである。
具体的なシステムとしては，アスタナ市の下水処理場において汚泥処理に使用されている嫌気性消化槽と新規に追加設置する嫌気性消化槽を利用し，これに分別回収された有機性廃棄物を加えて嫌気性共発酵システムを形成する。嫌気性共発酵システムより発生したバイオガスは，ガスエンジンへと導入し，発電を実施する。
現状，アスタナ市の下水処理場には下水汚泥を発酵させるタンクが 2 台あるが，そのうち 1 台は運用を停止しており，もう一台は設計どおりの温度管理をされていない。また，JBIC によるプロジェクトが計画されておりその中でタンクも含めたリハビリテーションを行うことになっている。なお，本プロジェクトに利用されるシステムは，日本では確立された技術である。
カザフスタン共和国の GHG＊[1]およびバイオマスに対する対策，施策は以下のとおりであり，本プロジェクトへの関心が存在すると考える。

- カザフスタン共和国の環境保護省の施策｢2015 年までのカザフスタン共和国の生態学的安全のコンセプト｣が承認された。この中には，GHG を含む汚染物質の排出の安定化に向けての努力がうたわれている。
- ２００４年，カザフスタン共和国でドナー会議が開催され，その中でバイオガス利用プロジェクトもエネルギー回帰プロジェクトとともに提案されている。
- エネルギーセクターにおける政策として，再生可能エネルギーについても言及されており，その中でバイオマスの利用についても記載がある。（アスタナ市内に電力を供給しているアスタナエネルゴ聞き取りによる）

これらの状況から，本プロジェクトは，同国のエネルギー・環境政策に寄与するものと位置づけられる。
本プロジェクト実現により期待されるカザフスタン共和国のメリットは以下のとおりである。

- 下水処理場の汚泥処理の高度化を図ることができ，地域の環境改善が図れる。
- バイオマス利用発電により，化石燃料を削減し，大気環境の改善，地球温暖化防止が図られる。
- 廃棄物の有効活用により，アスタナ市の下水処理・廃棄物処理を通じて都市衛生・環境問題の緩和に寄与する。
- カザフスタンの電力開発計画プログラムの｢2030 年までの電力開発計画｣の電力自給率向上という国策に寄与できる。

・　施設の新設・運転に伴う現地雇用の創出が期待できる。

＊１：GHG(greenhouse gas): 温室効果ガス，温暖化ガス

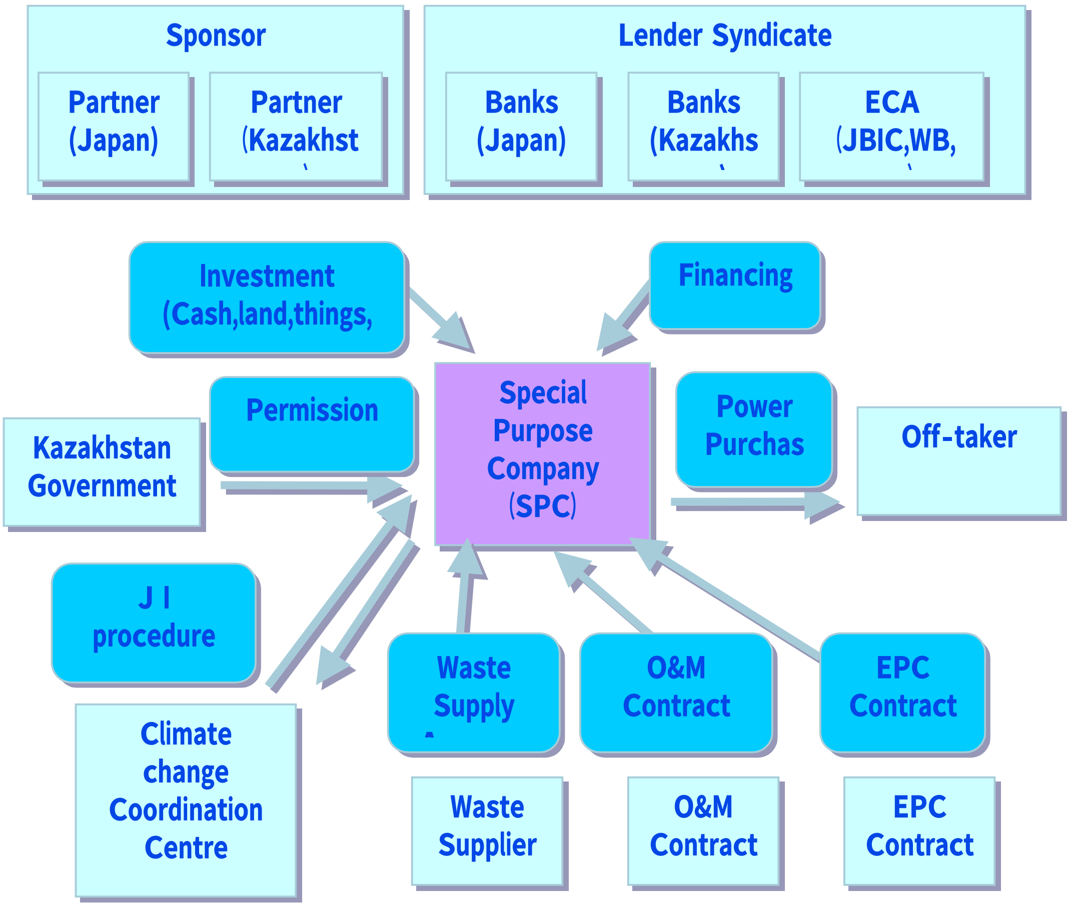
A.3. Project participants:

>>

本プロジェクトは，日本企業ならびにカザフスタン共和国アスタナ市および同国企業の共同出資により設立する特別目的会社により実施される。

JI としてのクレジットに関する事については，地球温暖化防止条約の同国事務局である climate change coordination centre が担当となる。

なお，日本企業には東北電力株式会社を含む。また，廃棄物の供給，O&M については，同国企業の下水処理場を管理している ASA (Astana Su Arnasy)社ならびに固形廃棄物を管理しているゴルコムホース社(Gorkommunhoz)が参加する。



A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

>>カザフスタン共和国

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

>>アクモラ州

A.4.1.3. City/Town/Community etc:

>>アスタナ市

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

>>アスタナ市

カザフスタン共和国の首都であり，1997年にアルマトゥイから遷都され現在の人口は約50万人である。国家独立により移転した新首都アスタナは現在大統領府を始め、官庁街、ビジネスセンターなどが建設されている。最終的には2030年に100万人都市を目指しており，大気汚染，水質汚濁，都市廃棄物処理等の問題が顕在化しつつあり，下水処理場の拡大・近代化，廃棄物処理施設の充実等が課題となっている。

A.4.2. Category(ies) of project activity:

>>
１.エネルギー産業（再生可能/非再生可能）
13.廃棄物処理及び処分

A.4.3. Technology to be employed by the project activity: ホスト国への技術移転

>>
嫌気性消化槽を追加設置し嫌気性共発酵システムより発生したバイオガスによって，発電を行うこのプロジェクト活動を実施することにより，ホスト国へは以下のとおり技術移転がなされる。

項目	内容	移転方法	備考
機器据付	プロジェクト機器の現場据付	ＯＪＴ＋現場指導	
試運転，性能試験	試運転方法，性能試験方法	ＯＪＴ＋現場指導	
周辺設備の設計・製作・調達・輸送	プロジェクト機器の現地側工事部分の設計，準備，製作，輸送	助言指導	
運転及び管理，保守方法	プロジェクト機器の運転，管理，保守の方法	日本における研修	
モニタリング	運用開始後，CO2 削減のためのモニタリング	マニュアル	
データ管理	運用後の CO2 にかかるデータの管理	マニュアル	

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

>>
本プロジェクトは，アスタナ市の下水処理場において汚泥処理に使用される嫌気性消化槽（既設＋新設）を利用し，これに分別回収した有機性廃棄物を加えて嫌気性共発酵システムを形成する。嫌気性共発酵システムより発生したバイオガスは，ガスエンジンへと導入し，動力として発電を実施する。

このプロジェクトにより，以下の 2 つのことから地球温暖化ガス排出量が削減できる。

・ 有機廃棄物を下水汚泥および有機性廃棄物を嫌気性発酵槽で共発酵させることにより，ランドフィルガス（以下 LFG）として回収できない埋立て処分場メタンガスを大気に放出せずに回収する。
・ 共発酵により発生したメタンガスによる発電システムを導入することによりグリッド電力の一部を代替し，グリッドの化石燃料発電設備より排出される GHG を削減する。

本プロジェクトがベースラインにならない理由は，当該国において導入されたことのない技術を採用することによる技術的なバリヤがあること，新規に設備を建設するために投資バリヤがあるためであり，そのバリヤはＪＩ化することによりクリアすることが可能である。

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

>>
クレジット期間は２１年，1年当たりは，73,923 ［ｔ-CO2/年］。
21年間の総GHG排出量は，155万ｔ

A.4.5. Public funding of the project activity:

>>
本プロジェクトはIPP事業としての実施を計画しており，ODAの流用ではない。

SECTION B. Application of a baseline methodology

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

>>

下水汚泥と有機性廃棄物の共発酵によるバイオガス発電

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

>>

Biogas Power Generation utilizing Organic Wastes and Sewage Sludge in Astana　プロジェクトは，方法論「下水汚泥を活用したバイオガス発電」の適用条件を満たす。

- アスタナ市は，下水処理場にメタンガスを利用した発電プラントがない。
- 政府エネルギープランに再生可能エネルギーを開発するあるいは，優先する政策が記載されているが，具体的な補助制度が無い。
- アスタナ市には下水処理場の下水汚泥処理施設があり，利用できること。
- 埋め立て処分場はＬＦＧのフレア処理を実施する予定であるが，ＬＦＧ発電を行う予定は，現在，また将来的にも想定されていないこと。
- ＬＦＧフレア処理について，これを強制する法律はない。
- 有機廃棄物について将来的に分別回収が実施される予定である。
- プロジェクト近郊には石炭火力発電所があり，電力はすべてこの発電所から供給されて折り，ガスを利用した大きなガス火力発電所がない。
- 2005 年 1 月以降，埋立地に運搬される廃棄物量はトラックスケールを用いて測定される。
- アスタナ市は，現在人口 50 万人である。2030 年には 100 万人になることが想定されている。
- 固形廃棄物と下水処理を管轄する行政部門が別である。

B.2. Description of how the methodology is applied in the context of the project activity:

>>

本方法論におけるプロジェクトは以下のバリヤにより，ベースラインシナリオの正当性が判断され，プロジェクトシナリオの追加性が認められる。

- 法律・制度，技術的バリヤ，投資バリヤ，環境影響，地域性

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

>>

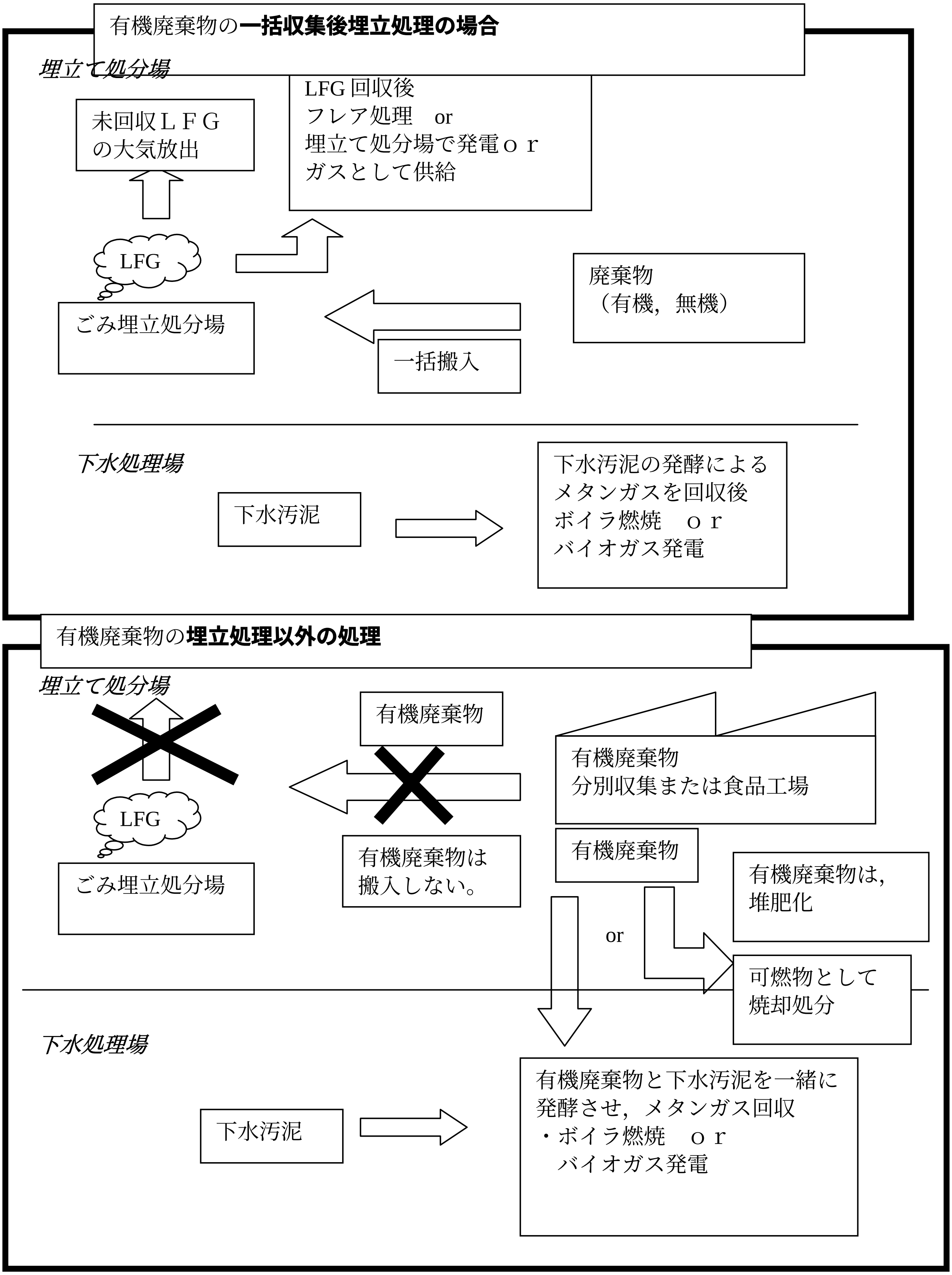
ベースラインシナリオは，何らかのプロジェクトが実施されない場合に想定されるその地域の状況を表したものである。

現在アスタナ市は，廃棄物は一括収集され，有機廃棄物も無機廃棄物も一緒に埋立地に搬入され，衛生埋立後にＬＦＧフレア処理が行われている。また，下水処理場の下水汚泥は，消化槽にて嫌気性発酵され，そのバイオガスはボイラの燃料として冬の期間に利用されている。

この状況をふまえ，シナリオとして考えられるのは，次の１２のシナリオである。

ケース	収集されたごみ		下水処理場	
1	一括収集後埋立処理	埋立て処分を行い，発生した LFG をフレア処理	下水汚泥によるメタン発酵	ボイラによる燃焼
2				発電機による発電
3		埋立て処分を行い，発生した LFG は埋立て処分場内で発電に利用される。	下水汚泥によるメタン発酵	ボイラによる燃焼
4				発電機による発電
5		埋立て処分を行い，発生した LFG の処分場以外への提供	下水汚泥によるメタン発酵	ボイラによる燃焼
6				発電機による発電
7	埋立処理以外の処理	廃棄物のうち，分別回収または工場からの有機物を用いて，**有機物の堆肥化**	下水汚泥によるメタン発酵	ボイラによる燃焼
8				発電機による発電
9		可燃物の焼却処分	下水汚泥によるメタン発酵	ボイラによる燃焼
10				発電機による発電
11		廃棄物のうち，分別回収または工場からの有機物を用いて，**下水処理場への有機物の搬入**	下水汚泥＋有機廃棄物によるメタン発酵	ボイラによる燃焼
12				発電機による発電

想定されるシナリオの概略図を以下に示す。


有機廃棄物の**一括収集後埋立処理の場合**
埋立て処分場
未回収ＬＦＧの大気放出
LFG回収後
フレア処理　or
埋立て処分場で発電ｏｒ
ガスとして供給
LFG
ごみ埋立処分場
廃棄物
（有機，無機）
一括搬入
下水処理場
下水汚泥
下水汚泥の発酵による
メタンガスを回収後
ボイラ燃焼　ｏｒ
バイオガス発電
有機廃棄物の**埋立処理以外の処理**
埋立て処分場
有機廃棄物
有機廃棄物
分別収集または食品工場
LFG
ごみ埋立処分場
有機廃棄物は
搬入しない。
有機廃棄物
有機廃棄物は，
堆肥化
or
可燃物として
焼却処分
下水処理場
下水汚泥
有機廃棄物と下水汚泥を一緒に
発酵させ，メタンガス回収
・ボイラ燃焼　ｏｒ
バイオガス発電

適用条件については，プロジェクトを検討している地域において，環境部門，エネルギー部門，当該地域の技術レベル等を聞き取り,あるいは既設設備の現地調査する必要がある。

ベースラインシナリオはこのシナリオの中から，この申請書 A．3 項において規定した適用条件に基づき，さまざまなバリヤを考慮し適切なベースラインを選択していく。
検討項目に合致するものには「Yes」（以下略して N）を，合致しないものに「No」（以下略して N），どちらともいえないものに「－」を記載した。
検討項目を評価した後，その項目による全項目「Y」の場合は評価「２」，1 項目「Y」の場合は評価「１」，２項目以上「N」の場合は「０」とした。

以上の評価を各項目について実施し，最終的に数字の大きなものがベースラインプロジェクトになるものとした。

ｉ）法律・制度

検討項目	1	2	3	4	5	6	7	8	9	10	11	12
政府のエネルギー政策に合致している	N	Y	N	Y	Y	Y	N	Y	N	Y	N	Y
関係機関との協議・調整を必要としない。	Y	Y	Y	Y	N	N	N	N	N	N	N	N
評価	1	2	1	2	1	1	0	1	0	1	0	1

・ カザフスタン政府のエネルギー政策｢2030 年までの電力開発計画｣の再生可能エネルギーの利用について記載されている事項に適合するため，案 2,4,6,8,10,12 はバイオガスを用いて発電を行うこと，案 5 は，バイオガスが発電設備にて利用される可能性もあるため，｢Y｣をつけた。

案 7～12 までは，固形廃棄物のうち，有機廃棄物を下水処理場へ搬入しなければならず，カザフスタンにおいては，同国企業の下水処理場を管理している ASA (Astana Su Arnasy)社ならびに固形廃棄物を管理しているゴルコムホース社(Gorkommunhoz)によって，管理されていることから，複数の管理機関と協議調整が必要である。

・ 案 1~4 は，現状の処理行政区分をまたがないことから，関係機関との協議・調整を必要としないため「Y」とした。
・ 案 5,6 は，バイオガスをどこかに供給するものであり，そのためにエネルギーセクター等管理機関との協議が発生する。

ii）技術的バリヤ

検討項目	1	2	3	4	5	6	7	8	9	10	11	12
技術開発・実用に伴うリスクが小さい。	Y	N	N	N	N	N	N	N	N	N	N	N
建設に関する技術リスクが小さい。	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y
運用の技術リスクが小さい。	Y	N	Y	N	N	N	N	N	N	N	Y	N
評価	2	0	1	0	0	0	0	0	0	0	1	0

・ 案 1 は運用実績があり，技術的バリヤは小さい。

・案 2,4,6,8,10,12 は，下水汚泥あるいは下水汚泥と有機物を発酵させ発生したメタンガスを発電に利用するシステムを用いるが，この設備は日本では一般的な技術であるが，カザフスタン共和国で初めて適用される技術であるため技術開発リスクがある。また，案 3,5 の LFG を利用する技術，案 7,9 の分別回収された後の有機物の処理も同様にカザフで始めて適用される技術のため，技術開発リスクがある。
・案 9,10 は大型の燃焼設備であり，建設には経験不足による品質管理にリスクがある。
・案 2,4,6,8,10,12 は，強制発酵させたメタンガスの性状，量が安定しない可能性があるため，発電を行う場合には運用の技術リスクがあるものとした。案 5,6 は，発生した LFG を他の場所に送るため，ガスの性状について連続してモニタリングし相手先に連絡する必要があるため「N」とした。案 7,8 は堆肥の製造は温度管理，水分量管理など難しいため「N」とした。案 9,案 10 は廃棄物を焼却処分する案であるが，有機物に水分が多い場合には焼却温度の管理が難しなり運用の技術リスクがあるため，「N」とした。
　なお，現状，アスタナ市の下水処理場には下水汚泥を発酵させるタンクが 2 台あるが，そのうち 1 台は運用を停止しており，もう一台は設計どおりの温度管理をされていない。また，JBIC によるプロジェクトが計画されておりその中でタンクも含めたリハビリテーションを行うことになっている。

iii）投資バリヤ

検討項目	1	2	3	4	5	6	7	8	9	10	11	12
新規投資が不要または投資効率が良い	Y	N	N	N	N	N	N	N	N	N	N	N
運用コストが低い	Y	Y	Y	Y	Y	Y	N	N	N	N	Y	Y
評価	2	1	1	1	1	1	0	0	0	0	1	1

・ 案１は，現状のままであり新規投資は不要である。
・ 案 2,3,4,10,12 に関して，再生可能エネルギーに関する政府の政策はあるが補助政策は無いことから，発電設備を投資するインセンティブがなく，投資効率が良いとはいえないことから「N」とした。
・ 案 5,6 のＬＦＧ供給は供給先までの配管が必要となり，初期投資が多額となるため，「N」とした。
・ 案 7,8 は現在，カザフ国内の農業セクターに購買力がないことから肥料の販売による収入が考えにくく，投資効率が良いとはいえないことから，「N」とした。
・ 案 9,10 は焼却場設備の新設が必要となり，その初期投資は大きいため，「N」とした。
・ 運用コストについては，案 7,8 は堆肥化するための管理費用やカザフ国内は農業セクターに購買力がないことから堆肥販売が進まない場合，堆肥の保管費用も発生する可能性があるため，「N」とした。また，案 9,10 の廃棄物の焼却処分は，焼却ガスにはさまざまな成分が含まれ，石炭ボイラなどよりもボイラへの損傷が大きく保守コストが割高となるため「N」とした。
・ 案 1,2,3,4,5,6,11,12 の運用コストで一番高価と考えられるのはメンテナンス費用であり，基本的に現地で可能な機械メンテナンスを実施するので，7～10 に比べて安価であることから「Y」とした。

iv）環境影響

検討項目	1	2	3	4	5	6	7	8	9	10	11	12
環境問題解決に適している。	N	N	N	N	－	－	N	Y	N	N	N	Y
評価	0	0	0	0	－	－	0	1	0	0	0	1

・ 環境影響として，地球温暖化ガスを削減できること，地域の環境向上に適していること，この 2 点から判断した。
・ 案 9，案 10 は廃棄物を焼却処分する案であるが，焼却温度の管理をしなければダイオキシン問題等の発生するリスクがあるため，「N」とした。
・ 案 1, 5,6,7,11 は，発電を実施しない案であるが，発電により石炭燃焼を代替し煤塵等の削減をすることができないことから，大気環境問題解決に寄与しないと考え，「N」とした。
・
・ 案 2,3,4 は，LFG を 100％回収できないことから，メタンガスが大気中に放出されるため，地球温暖化という環境問題に適していない。

v）地域性

検討項目	1	2	3	4	5	6	7	8	9	10	11	12
地域のニーズに合っている。	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
評価	0	0	0	0	0	0	1	1	1	1	1	1

アスタナ市は，首都アスタナ市開発マスタープランにしたがい，家庭や工場から発生する固形廃棄物収集方法の質を国際レベルにまで高める取組みがなされており，案 7 から 12 は分別回収を行うこと，埋立て処分場の延命を図ることができることが地域のニーズに合っていることから「Y」とした。

vi）市場障壁

検討項目	1	2	3	4	5	6	7	8	9	10	11	12
地域に普及する可能性がある。	Y	Y	N	N	N	N	N	N	N	N	Y	Y
評価	1	1	0	0	0	0	0	0	0	0	1	1

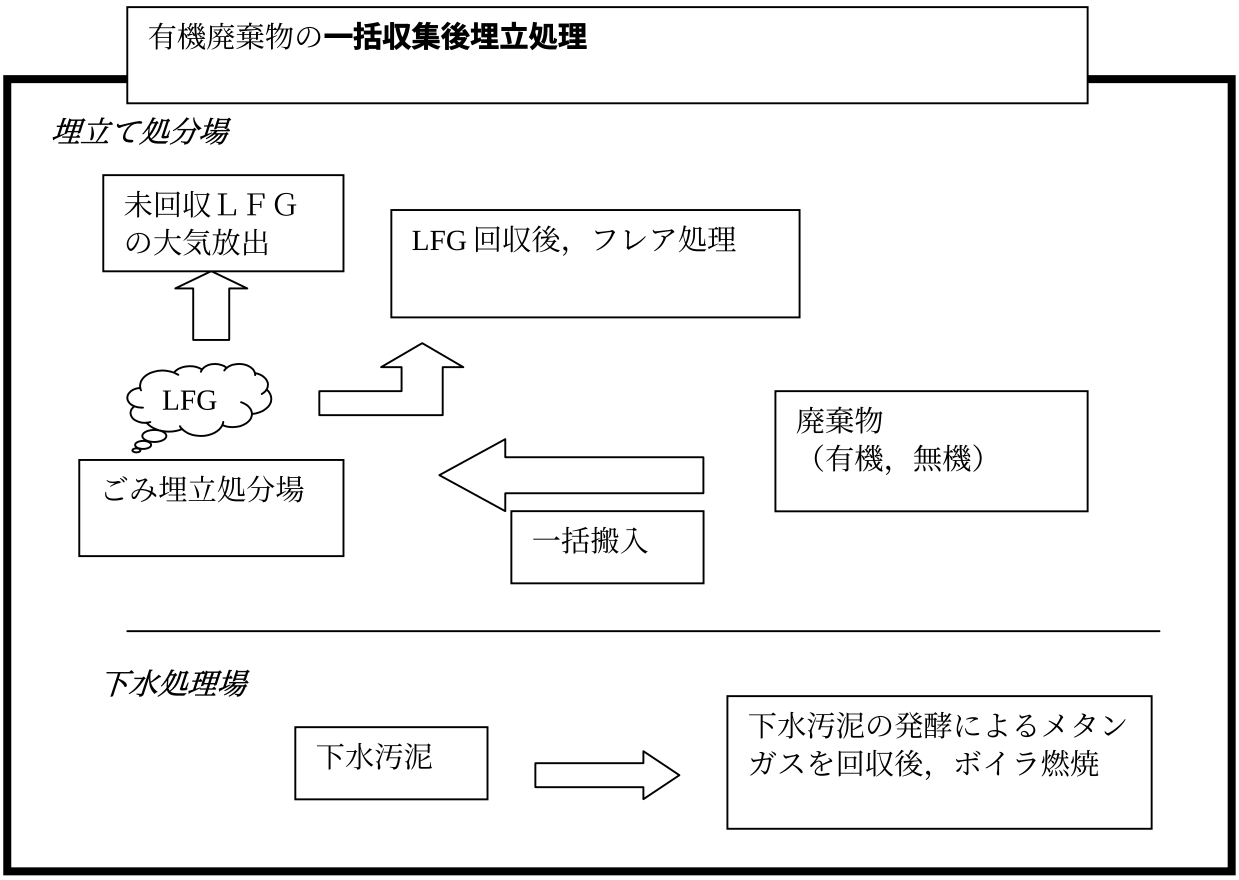
案 1,2 の埋め立て処分場における LFG のフレア処理は，簡易なシステムを用いること，実際に開始され実績ができることから普及が見込まれるため,「Y」とした。
案 3,4 の LFG による処分場での発電はカザフ国において実績がないことから，普及まで時間が必要と考えられることから「N」とした。
案 5,6 の LFG を埋立処分場以外に提供する案も，カザフ国において実績がないことから，普及まで時間が必要と考えられることから「N」とした。
案 7,8 の有機物の堆肥化は製造により堆肥が大量に発生するため，その扱いが難しいことから,「N」とした。
案 9,10 の焼却処分については，聞き取り調査によって，焼却処分が国の法律で認められていないことから「N」とした。
案 11，12 は，現実には運用等の問題はあるものの，運用実績があり有機廃棄物の収集など条件がそろえば普及する可能性があるため，「Y」とした。

ベースラインの選択
現在まで，検討した内容を次の表にまとめた。

検討項目	案１	案２	案３	案４	案５	案６	案７	案８	案９	案１０	案１１	案１２
法律・制度	1	2	1	2	1	1	0	1	0	1	0	1
技術的バリヤ	2	0	1	0	0	0	0	0	0	0	1	0
投資バリヤ	2	1	1	1	1	1	0	0	0	0	1	1
環境影響	0	0	0	0	―	―	0	1	0	0	0	1
地域性	0	0	0	0	0	0	1	1	1	1	1	1
市場障壁	1	1	0	0	0	0	0	0	0	0	1	1
総合評価	6	4	3	3	2	2	1	3	1	2	4	5

以上のことから，法律・制度，技術的バリヤ，投資バリヤ，環境影響，地域性を考慮し，各項目を検討した結果として案１が一番点数が高いことから，ベースラインシナリオとした。

案１のシナリオは「廃棄物は一括収集後，埋立て処分され，発生したメタンガス（以下ＬＦＧ）はフレア処理される。また，下水汚泥は嫌気性発酵させ，発生したメタンガスはボイラにて燃焼される。」であり，いかに概略図を記載する。



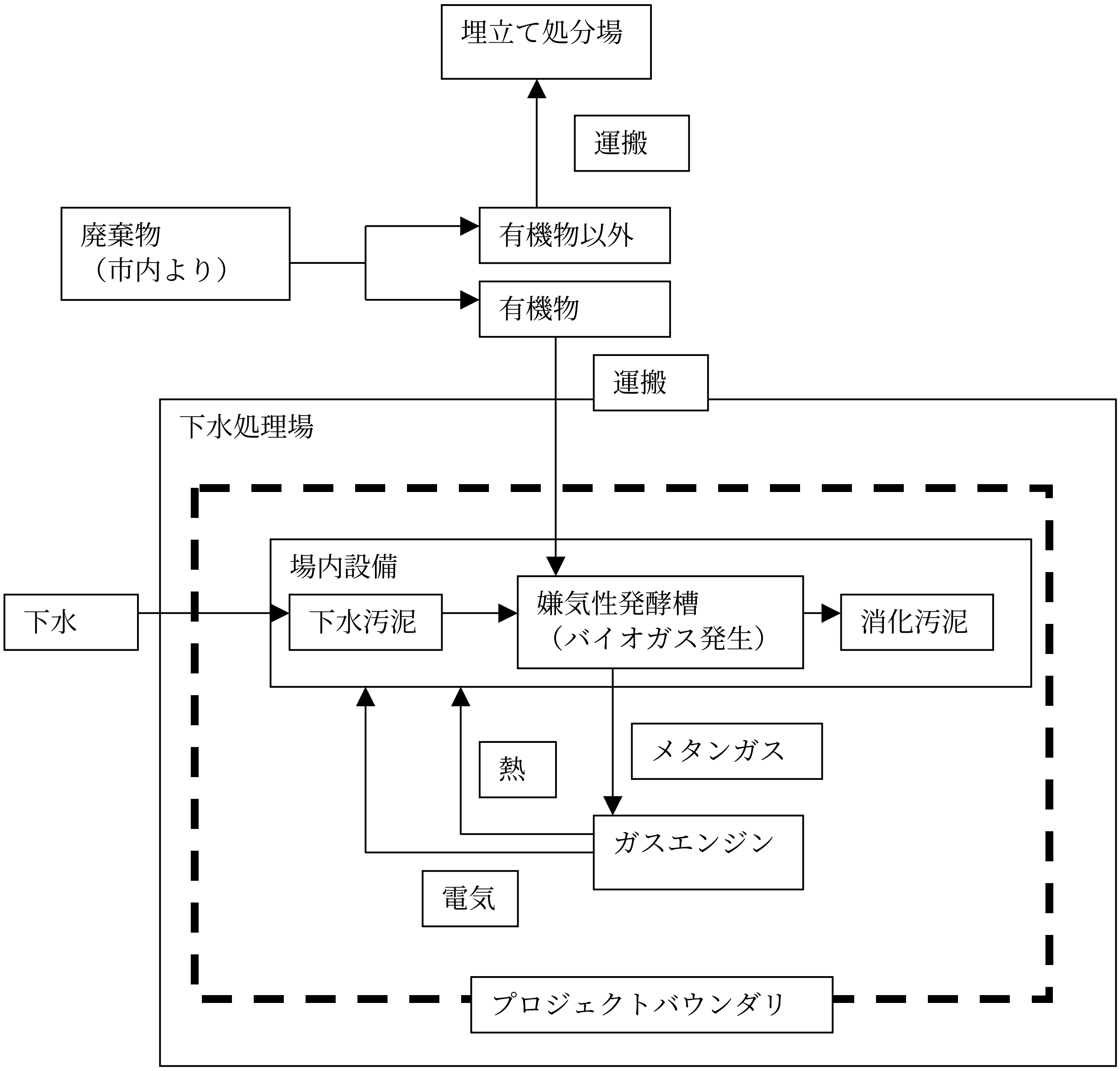
プロジェクトシナリオについては，総合評価にて，次点となった案１２「廃棄物のうち，分別回収または工場からの有機物を下水処理場へ搬入し，その有機廃棄物は下水汚泥と一緒に下水処理場の嫌気性発酵に投入され，発生したメタンガスは発電に利用される。」とする。

このプロジェクトシナリオは，ベースラインシナリオと比較して，技術的バリア，投資バリヤで劣っている。しかし，JI プロジェクトを実施することにより，技術的バリアは技術指導などによりバリアを超えることができ，投資バリヤについては，CO2 クレジットによりバリヤを低くすることができる。

なお，投資バリヤについては，クレジットを考慮する場合としない場合の経済的効果については、クレジットがあることでプロジェクトの NPV を 2700 千 USD 程度改善する効果がある。

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

>>
プロジェクトバウンダリーは，下水処理場内における嫌気性発酵槽，発電設備である。
廃棄物を分別し，下水処理場内にある嫌気性発酵槽まで搬入する行為は，行政の役目であり当該プロジェクトのプロジェクトバウンダリーとしない。
　また，リーケージとして考えられることは，有機廃棄物をプロジェクトバウンダリーに運ぶための輸送機器からのＧＨＧである。市郊外にある埋立て処分場に運ぶ運搬距離と下水処理場までの距離はほぼ同等であり，プロジェクト実施によりＧＨＧ排出量が増加しないことからリーケージはないものとする。



ここで，下水処理場におけるシステムフローについて，以下に示す。

なお，現在，下水処理場には日本の国際協力銀行（以下 JBIC）による上下水道プロジェクトが進められており，そのプロジェクトとの整合もシステムフローにてわかるようにした。

[　システムフロー　]

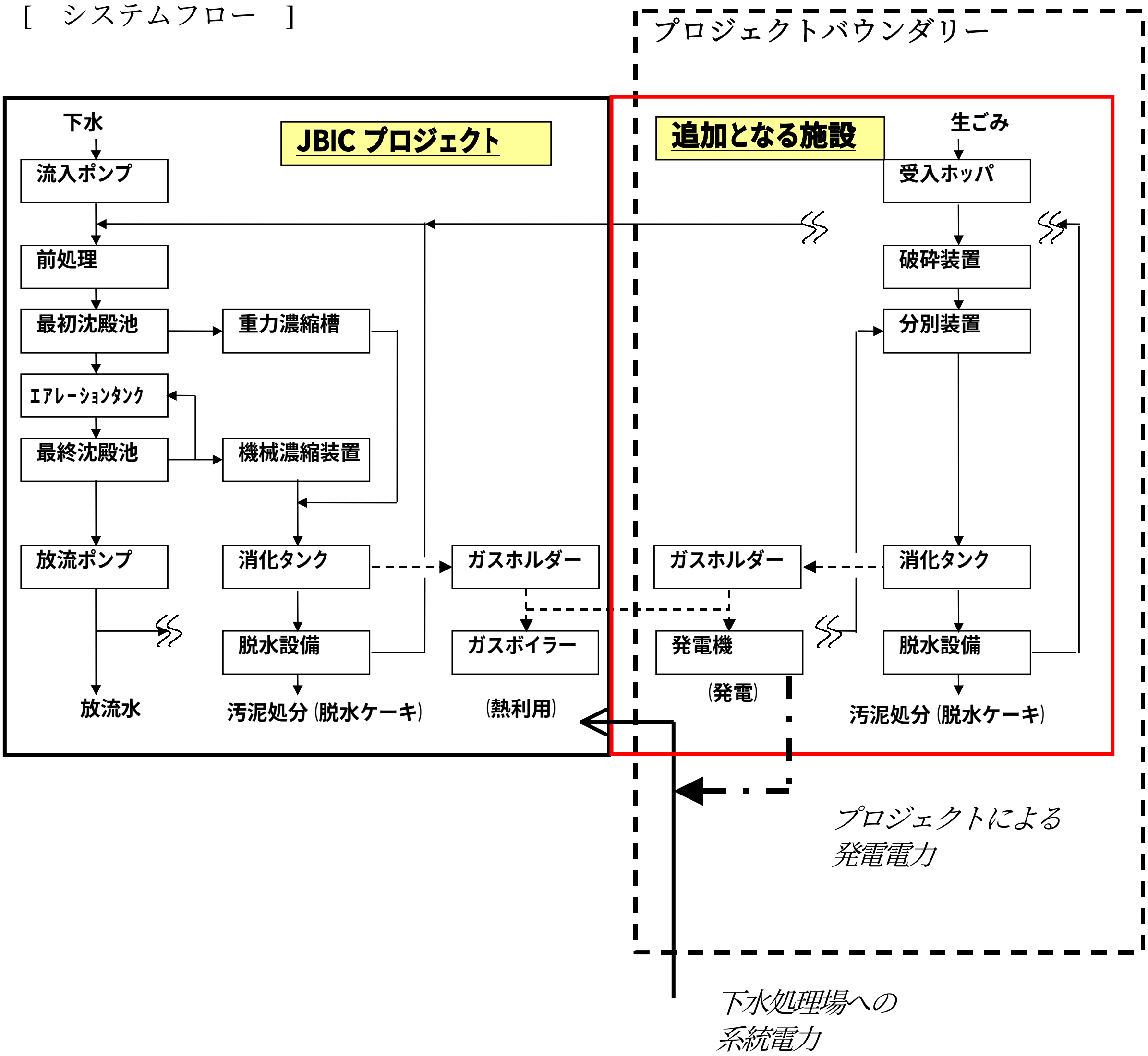


表　シナリオごとの GHG 排出量

	バウンダリー内	バウンダリー外
ベースラインシナリオ	下水処理場で使用されるグリッド電力による CO2 排出	埋立て処分場からのメタンガス排出
プロジェクトシナリオ	下水処理場で使用されるグリッド電力による CO2 排出ーバイオガス発電による CO2 排出	有機性廃棄物輸送車両による CO2 排出

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

>>

Tohoku Electric Power Co., Inc.
7-1, Honcho 1-chome, Aoba-ku, Sendai, Miyagi 980-8550 JAPAN
Tel +81-22-799-6281
Fax +81-22-213-5190

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

2008.11

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

>>

日本政府の第１号 JI 事業となった「熱電併給所省エネルギー化モデル事業（カザフスタン）」に準拠し，クレジット獲得機関は，７年を第１期とし，当事者間にて協議が無ければ，自動的に期間延長とする。プロジェクト実施期間については，21 年間とする。

一般的に本プロジェクト設備は適切な保守を実施することにより 20 年以上の運転が可能である。

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>

2008 年 11 月

現在，アスタナにおいてＪＢＩＣの上下水道円借款事業が実施され，設備が 2008 年 11 月に運開予定であり，工事には当該円借款事業との整合を図るため 2008 年 11 月からとする。

C.2.1.2. Length of the first crediting period:

>>

第一期クレジット期間　７年０ヶ月

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

C.2.2.2. Length:

>>

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

>>

下水汚泥と有機性廃棄物の共発酵によるバイオガス発電のモニタリング方法論

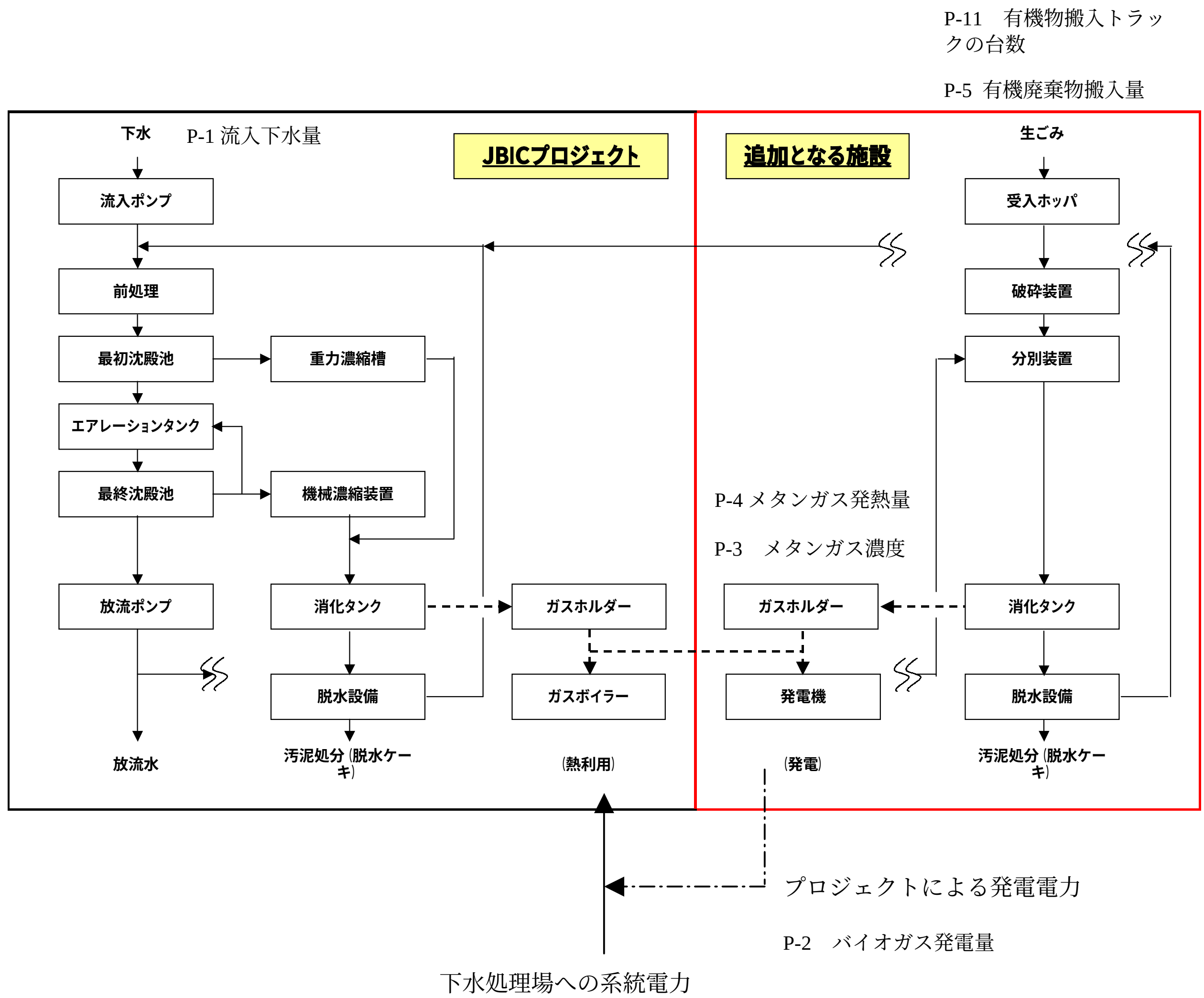
D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

>>

「下水汚泥と有機性廃棄物の共発酵によるバイオガス発電のモニタリング方法論」は，下水汚泥と有機性廃棄物の共発酵によるバイオガス発電のベースライン方法論を使用し，グリッド電力を代替し，埋立て処分場に運ばれる有機性廃棄物から放出されるメタンガスを削減するプロジェクト活動に適用可能である。

この方法論は，「Biogas Power Generation utilizing Organic Wastes and Sewage Sludge in Astana」に以下の理由から，適用が可能である。

- アスタナ市は，下水処理場にメタンガスを利用した発電プラントがない。
- 政府エネルギープランに再生可能エネルギーを開発するあるいは，優先する政策が記載されているが，具体的な補助制度が無い。
- アスタナ市には下水処理場の下水汚泥処理施設があり，利用できること。
- 埋め立て処分場はＬＦＧのフレア処理を実施する予定であるが，ＬＦＧ発電を行う予定は，現在，また将来的にも想定されていないこと。
- ＬＦＧフレア処理について，これを強制する法律はない。
- 有機廃棄物について将来的に分別回収が実施される予定である。
- プロジェクト近郊には石炭火力発電所があり，電力はすべてこの発電所から供給されて折り，ガスを利用した大きなガス火力発電所がない。
- 2005 年 1 月以降，埋立地に運搬される廃棄物量はトラックスケールを用いて測定される。
- アスタナ市は，現在人口 50 万人である。2030 年には 100 万人になることが想定されている。
- 固形廃棄物と下水処理を管轄する行政部門が別である。



B-1 有機廃棄物量（埋立て処分場のごみ比率）

B-2 ランドフィルガスの回収量

その他モニタリング事項

P-6 電源構成

P-7　各燃料使用量

P-8 発電電力量

P-9 電力の排出係数

P-10 法律

L-1 トラックの台数
L-2 トラックの燃費
L-3 軽油の発熱量

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P-1	*流入下水量*	*流量計による測定*	*M3/日*	*m*	*Everyday*	*100%*	electronic/ paper	
P-2	*バイオガス発電量*	電力計による測定	kWｈ */day*	*m*	*Everyday*	*100%*	electronic/ paper	
P-3	*発酵槽からのメタンガス濃度*	*濃度計による測定*	*%*	*m*	*Weekly*	*100%*	electronic/ paper	
P-4	*メタンガス発熱量*	*発熱量計による測定*	*MJ/m3*	*m*	*Weekly*	*Sample*	electronic/ paper	
P-5	*有機廃棄物搬入量*	*トラックスケール*	*t/day*	*m*	*Everyday*	*100%*	electronic/ paper	
P-6	*カザフの電源構成*	*聞き取り*		*m,c*	*Year*	*Sample*	paper	*全電力平均の炭素排出係数を求めるためにモニタリングを行う。*
A-7	*カザフの火力発電に*	*聞き取り*	*t/year*	*e*	*Year*	*Sample*	paper	*全電力平均の炭素排出係数を求めるためにモニタリングを行う。*

	使う各燃料使用量							
P-8	*カザフの全発電量*	*聞き取り*	*MW/year*	*e*	*Year*	*Sample*	paper	*全電力平均の炭素排出係数を求めるためにモニタリングを行う。*
P-9	*電力のCO2 排出係数*	*聞き取りと計算*	*t-CO2MWh*	*c*	*Year*	*Sample*	paper	
P-10	*有機物搬入トラック数*	*目視による台数確認*	*Amount/day*	*m*	*Everyday*	*100%*	electronic/ paper	
P -11	*法律*	*聞き取り*			*Year*		paper	廃棄物やエネルギーに関する法律の改正や新法律の制定について

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

プロジェクトシナリオでの CO2 量排出量

PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε _METH

PEy ：プロジェクト CO2 削減量(t-CO2/year)
BE_SW_EL_GRIDy ：下水処理場で使用する電力量(KWh)
P_EL_GENy ：バイオガス発電電力量（kWh）
EF_GRID ：グリッドにおける CO２排出係数（t-CO2/kWh）

PE_METH_NWy ：発酵槽に投入された有機物と下水汚泥の共発酵により発生したメタンガス量(t-CH4/year)
ε _METH ：メタンの地球温暖化係数(=21 IPCC Guideline

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B- 1	*有機廃棄物量*	*計量ばかりによる計測*	*t /year*	*m，c*	*年２回*	*Sample*	electronic/ paper	*分別される前の廃棄物について，その組成を調べる*
B-2	*ランドフィルガスの回収量*	*流量計計算*	*t/year*	*m,c*	*Everyday*	*Sample*	electronic/ paper	*LFG 回収配管に流量計を設置し，流量と配管数をかけてLFG の回収量を計算する。*

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>
ベースラインシナリオにおける GHG 排出量の計算式は，次のとおりである。

BEy＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH

BEy ：ベースライン CO2 排出量(t-CO2/year)
BE_SW_EL_GRIDy ：下水処理場で使用する電力量(KWh)
EF_GRID ：グリッドにおける CO２排出係数（t-CO2/KWh）
BE_METH_Wy ：ＬＦＧとして回収できない埋立処理場から大気放出されるメタンガス量(t-CH4/year) 算定は IPCC を使用し計算する。ただし，モニタリング結果と比較し，保守的に少ない値を用いる。
ε_METH ：メタンの地球温暖化係数(=21 IPCC Guideline)(t-CO2/t-CH4)

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
L-1	*トラックの台数*	*目視による台数確認*	*Unit/year*	*m*	*Everyday*	*100%*	electronic/ paper	
L-2	*トラックの燃費*	*聞き取り*	*Km/l*	*m,c*	*Half year*	*Sample*	electronic/ paper	
L-3	*軽油の*	*聞き取り*	*Kcal/kg*	*e*	*Hafyear*	*Sample*	electronic/ paper	

	発熱量							

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>
Ｌ１＝EF_TR×TR_ AM

L1　：リーケージによる CO2 排出量(t-CO2/年)
EF_TR　：有機物運搬トラック１台が市内から下水処理場まで有機廃棄物を運搬した場合のＣＯ２排出量（(t-CO2/台)
TR_AM　：トラック台数。トラック台数は運搬時にカウントされた値を使用する。

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>> CO2 排出削減量は以下のとおりとなる。
GHG 削減量＝ベースライン GHG 排出量－プロジェクト GHG 排出量－リーケージ
＝BEy－Pey－L1
＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH－（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID－L1
＝BE_METH_Wy × ε_METH＋ P_EL_GENy ×EF_GRID－L1

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
P-1	*Low*	*QA あり。流入下水量は，下水処理場において流量計によって計測される。流量計は，当該国の測定装置の校正に関する規格に基づくが，ない場合はメーカーの推奨する校正を定期的に実施する。*
P-2	*Low*	*バイオガス発電量は，当該国の測定装置の校正に関する規格に基づくが，ない場合はメーカーの推奨する校正を定期的に実施する。。*

P-3	*Low*	*発酵槽からのメタンガス濃度は，当該国の測定装置の校正に関する規格に基づくが，ない場合はメーカーの推奨する校正を定期的に実施する。*
P-4	*Low*	*メタンガス発熱量は，当該国の測定装置の校正に関する規格に基づくが，ない場合はメーカーの推奨する校正を定期的に実施する。*
P-5	*Low*	*有機廃棄物搬入量は，トラックスケールで計測される。　スケールは当該国の測定装置の校正に関する規格に基づくが，ない場合はメーカーの推奨する校正を定期的に実施する。*
P-6	*Low*	*電源構成について国の機関より聞き取りを行う。*
P-7	*Low*	*各燃料使用量について国の機関より聞き取りを行う。*
P-8	*Low*	*発電電力量について国の機関より聞き取りを行う。*
P-9	*Low*	*電力の CO2 排出係数は，発電電力量，石炭使用量により求められる。計算上もとめられることから，積算時に注意を行う。*
P-10	*Low*	*有機物搬入トラック数，数量をカウントする。*
P-11	*Low*	*廃棄物やエネルギーに関する法律の改正や新法律の制定について調査を行う。*
B-1	*Low*	*有機廃棄物量は，人手により，無機と有機物に分別され組成が測定される。このとき，作業員には正確に分別を行うように指示を行い，測定には校正された重量計測装置を用いることとする。*
B-2	*Medium*	*ランドフィルガスの回収量は，LFG 回収配管に流量計を設置し，流量と配管数をかけて LFG の回収量を計算する。そのため，測定には校正された計測装置を用いることとする。*
L-1	*Medium*	*トラックの台数*
L-2	*Medium*	*トラックの燃費*
L-3	*Medium*	*軽油の発熱量*

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>

D.5 Name of person/entity determining the monitoring methodology:

>>

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>
プロジェクトシナリオは，有機廃棄物を下水汚泥および有機性廃棄物を嫌気性発酵槽で共発酵させ，発生したバイオガスによって発電を行うものである。本計算には，CDM“ AM0012 ”を参考とした。

プロジェクトを実施した場合の GHG 排出量は以下の式で計算される。
プロジェクトシナリオでの CO2 量排出量
PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε_METH

PEy ：プロジェクト CO2 削減量(t-CO2/year)
BE_SW_EL_GRIDy ：下水処理場で使用する電力量(KWh)
P_EL_GENy ：バイオガス発電電力量（kWh）
EF_GRID ：グリッドにおける CO２排出係数（t-CO2/kWh）

PE_METH_NWy ：発酵槽に投入された有機物と下水汚泥の共発酵により発生したメタンガス量(t-CH4/year)
ε_METH ：メタンの地球温暖化係数(=21 IPCC Guideline
ここで，PE_METH_NWy は全量バイオガス発電に使用されるため GHG として大気放出されない。

よって，プロジェクトシナリオでの CO2 排出量は
PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε_METH＝（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID

プロジェクトを実施した場合の系統電力による CO2 排出量について計算する。
まず，系統における CO2 排出量であるが，この値は,聞き取り調査により求める。
次にバイオガス発電電力量をもとめる。

メタン発酵槽に投入する下水汚泥と有機廃棄物の発生量は，以下のとおりである。
下水汚泥 ：下水処理量 136,000ｍ３／日から下水汚泥は 562m3／day 発生。
有機廃棄物：廃棄物 60,130m３/年から内容物を精査し，279m3／day 発生

　この下水汚泥と有機廃棄物を嫌気性発酵槽に投入すると，設置するプロジェクト機器から発生する有機性廃棄物由来のバイオガスは， 18,360m3/day となる。
　この機器から発生するメタンガス濃度は「下水道施設計画・設計指針と解説」((社)日本下水道協会）によると 60～65%であることから，保守的な値を選択し 60%とした。
　このことから，発生するメタンガス量は，11,016m3/day となる。

以上のことから，メタンガスを利用した発電量は，メタンガス発電機の効率を 27.45%，メタンガス発熱量 35.8MJ/m3，kWh と MJ の換算係数を 3.6kWh/MJ とし発電量を計算すると，
一日あたりの発電量＝メタンガス量×メタンガス発熱量×発電効率／3.6
＝11016 × 35.8 × 0.2745 / 3.6
＝30.07MWh/day である。

メタンガス発電所の発電電力量は，メンテナンス期間（年 10 日間）において，ガス発生量が４０％となることから年間稼働率を 97.28%，メタンガス発電所の所内電力が 4,540ｋWh/日であることから，

発電電力量は，年間供給電力量は，
（30.07-4,540/1000）MWh ×365×0.9728＝9,064MWh となる。

次にグリッドにおけるＣＯ２排出係数を求める。
アスタナ市の電力は，アスタナ市にある石炭火力発電所から供給されており，CO2 排出係数は石炭火力発電所のデータから算出できる。
しかしながら，アスタナ市の系統は単独の系統ではなく，他地域とも連携されていることから，保守的に考え，カザフスタンの全電源の加重平均排出係数を用いることとした。

カザフスタンの発電電力量は，年間 61,000GWh であり，各電源の構成は，88%が火力、12%が水力発電である。火力発電の燃料構成は，75%が石炭，23%がガス，2%が油である。
ここで，次の条件で加重平均排出係数を求めた。
・ガス，油火力発電所の発電効率は保守的に日本の１９９０年代の平均を用いた。
・ガスの発熱量はカザフスタンのｳﾗﾙｽｸ TETS の値を用いた。
・油の発熱量は，保守的に日本における平均的な油の発熱量を用いた。

		発電電力量	CO2 排出量
		GWh	×10^3 t-CO_2/年
火力	石炭	40,260.0	38,947.03
	ガス	12,346.4	6,391.07
	油	1,073.6	730.72
水力		7,320.0	0.00
合計		61,000.0	46,068.82

以上の値を用いて，計算した結果，加重平均排出係数は，0.75t-CO2/MWh

メタンガスによる発電量が 8,617MWh/year であることから，
P_EL_GENy ×EF_GRID
＝ 9,064MWh ×0.75［ｔ-CO2/MWh］
＝ 6,798 ［ｔ-CO2］

以上のことから，本プロジェクトによる GHG 排出量は，以下のとおり。

PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε _METH＝（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID
＝BE_SW_EL_GRIDy ×EF_GRID－6,798 ［ｔ-CO2］

E.2. Estimated leakage:

>>

今回のプロジェクトにおいて，考えられるリーケージは，プロジェクト機器運用に関係する電気，熱，および有機物を下水処理場の発酵槽に搬入するトラック等の機器が考えられる。
プロジェクト機器の電気，熱については，プロジェクト機器から発電される電力，熱を利用することから，プロジェクトを実施したために新たに発生するリーケージはない。
ここで，有機物の下水処理場への搬入時のリーケージについて算出する。

Ｌ１＝EF_TR×TR_ AM

L1 ：リーケージによる CO2 排出量(t-CO2/年)
EF_TR ：有機物運搬トラック１台が市内から下水処理場まで有機廃棄物を運搬した場合のＣＯ２排出量（(t-CO2/台)
TR_AM ：トラック台数。トラック台数は運搬時にカウントされた値を使用する。

EF_TR を求める。
カザフスタンにおける平均的な５ｔトラックの燃費が 5km/L であり有機物を運搬する距離がアスタナ市を横断する距離で約 15kmなので，使用する燃料は３L である。
ここで，IPCC ガイドラインより
酸化係数 0.99
CO２原単位換算 44/12＝3.7
炭素排出原単位 19.6［ｔ-c/TJ］
発熱量 0.043TJ/ｔ (10,300kcal/kg)日本の軽油の平均値を使用した。
燃料使用量 28.908 m3/year
比重 0.84

EF_TR＝使用した軽油量[m3]×比重×発熱量×参加係数×CO２原単位換算×炭素排出原単位［ｔ-c/TJ］
＝3×0.84×0.043×0.99×3.7×19.6［ｔ-CO2/台］
＝0.00778［ｔ-CO2/台］

次にトラックの台数を求める。
年間の有機物の排出量が 48.18Ｇｇ/年であることから，運搬用トラックを５ｔトラックとすると年間のトラック台数はいかのとおりとなる。
TR_AM＝48.18[Ｇｇ/年]×1,000[t/Gg]／５[ｔ]＝9,636 台

以上のことから，リーケージによる CO2 排出量は，
L1＝EF_TR×TR_ AM＝ 9,636×0.00778
＝75 ［ｔ-CO2/年］

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>>
プロジェクト活動による GHG 排出量は，以下のとおりとなる。

E1+E2＝PEｙ＋L1

＝BE_SW_EL_GRIDy ×EF_GRID－6,798＋75
＝BE_SW_EL_GRIDy ×EF_GRID－6,723 ［ｔ-CO2］

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>>
ベースラインシナリオにおける GHG 排出量の計算式は，次のとおりである。

ベースラインシナリオ GHG 排出量＝
ベースラインでの埋立て処分場からの LFG 排出量
＋ベースラインの系統電力による CO2 排出量

BEy＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH

ここで，
BEy ：ベースライン CO2 排出量(t-CO2/year)
BE_SW_EL_GRIDy ：下水処理場で使用する電力量(KWh)
EF_GRID ：グリッドにおける CO２排出係数（t-CO2/KWh）
BE_METH_Wy ：ＬＦＧとして回収できない埋立処理場から大気放出されるメタンガス量(t-CH4/year) 算定は IPCC を使用し計算する。ただし，モニタリング結果と比較し，保守的に少ない値を用いる。
ε_METH ：メタンの地球温暖化係数(=21 IPCC Guideline)(t-CO2/t-CH4)

始めにＬＦＧとして回収されず埋立処理場から大気放出されるメタンガス量を求める。

ＩＰＣＣガイドラインの式に準拠してメタンガス排出量は,
BE_METH_Wy (Gg/year)
= (MSWT ×MSWF ×MCF ×DOC×DOCF× F×16/12 – R)×(1-OX)
＝(MSWT ×MSWF ×MCF ×DOC×DOCF× F×16/12)（１ – R）×(1-OX)

ここで，記号は
MSWT = total MSW generated (G/yr)
MSWF = fraction of MSW disposed to solid waste disposal sites
MCF = methane correction factor (fraction)
DOC = degradable organic carbon (fraction)

DOCF = fraction DOC similated
F = fraction of CH4 in landfill gas
R = recovered CH4 (Gg/yr)
OX = oxidation factor

ここで,
MCF ：アスタナ市の廃棄物埋立て場は，管理型埋立て処分場のため，IPCCより 1.0
DOCF：IPCCのデフォルト値は，0.77であるが， DOCFに対する冬季温度の影響を考慮し，値を0.68とした。

廃棄物処分場の管理や研究に携わる研究者からのヒアリングを行った結果，寒冷地であっても土中に埋立処理された有機廃棄物の温度は，自らの嫌気性発酵による発熱もあって40℃～60℃に保たれ，場合によっては70℃に達することもあると言われている。

IPCCCにおけるDOCFのDefault値0.77は，数式0.014T+0.28にT=35℃を代入して得られる数値であり，それ自体が保守的であると言うことことができる。

しかしながら，埋設深の浅い箇所については，外気温の影響を受けることから，メタンガス発生に対する温度の影響を考えるに際し，極寒地における気温の影響範囲を考慮することとした。

一般的な温帯域においては，冬季においても凍結深は0.5m程度であるとされている。これに対し，カザフスタン国では，設計上の凍結深は2.0mとされている。また，北海道で廃棄物処分場の研究に携わる学識者の見解として，気温の影響を受ける廃棄物処分場の深さは5.0m程度との意見もあり，今回は安全を見て地表より5.0mの影響を考慮する。

今回の処分場の廃棄物埋立方法は，透水性シートを挟みつつ廃棄物2.00m+土砂0.5mを7層に積上げ，更に土を盛る計画としていることから，埋立層の厚さは,
(2.00m+0.50m)×7+0.50m＝18.00m

このうち，温帯域で通常気温の影響を受けていない部分が，18.00-0.50＝17.50mであり，これが，通年に渡り35.0℃に相当する見掛け上のDOCF特性を有すると考える。

これに対し，冬季間については，凍結による影響を受けない部分は，18.00-5.00＝13.00mであり，この間のDOCFは，容積の減分，すなわち13.00/17.50だけ減少すると考える。

すなわち，DOCF（冬）＝0.77×13.00/17.50＝0.572

実際には，全体層の大きさと比較して影響は小さいものの，ガス抜き配管周りの温度低下などもあることから，DOCF（冬）＝0.56とする。

アスタナ市では，月平均最高気温が氷点下となる期間が，11月～3月の5ヶ月間であり，本プロジェクトのDOCFは,
DOCF=（0.77×7＋0.56×5）/12＝0.68とする。
実際には，11月～3月の全ての期間に低温の影響が凍結深である2mを超えて5mの範囲にまでに達していることは考え難く，本想定は充分に保守的であると考えられる。

F：IPCCよりデフォルト値を用いる。 0.5
ただし，この値についてはモニタリングを行い，IPCCデフォルト値と比較し保守的に低い値を利用する。

R ： 米国環境保護局（以下EPA）のLandfillに関するハンドブックによると，メタンガスの回収率は，50%から90%の間と想定されている。また，EPAのハンドブックによるとLFG回収のオペレーションを実施した場合の回収効率は，メタンガス発生量の

70%から 85%の間とも記載されており，運用上の回収効率を利用し，保守的に回収効率は 85%とした。

OX　　　　：ＩＰＣＣよりデフォルト値　0.0
MSWT ×MSWF ×MCF ×DOC：このデータの意味するものは，アスタナ市の埋立て処分場に捨てられる有機性廃棄物の量であることから，アスタナ市のデータより有機性廃棄物の処分量は 48.18Ｇｇ/年とした。

値を代入すると
BE_METH_Wy（Gg/year）
= (MSWT ×MSWF ×MCF ×DOC×DOCF× F×16/12 – R)×(1-OX)
＝(MSWT ×MSWF ×MCF ×DOC×DOCF× F×16/12)（１ – R）×(1-OX)
＝（48.18×1.0×0.68×0.5×16/12)（１– 0.85）×(1-0)
=3.20 Gg/year

埋め立て処分場から発生する CO２排出量は以下のとおりとなる。
BE_METH_Wy×ε_METH
＝3.20[Ｇｇ/年]×1000[t/Gg]×21＝67,200［ｔ-CO2/年］

次に，系統における CO2 排出量であるが，この値は聞き取り調査により求める。

以上のことから，ベースラインにおける CO2 排出量は以下のとおりとなる。

BEy＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH
＝67,200＋BE_SW_EL_GRIDy ×EF_GRID［ｔ-CO2/年］

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

>>
CO2 排出削減量は以下のとおりとなる。
GHG 削減量＝E4－E3
＝ベースライン G HG 排出量―（プロジェクト GHG 排出量＋リーケージ）
＝BEｙ－（PEｙ＋L1）
＝（67,200＋BE_SW_EL_GRIDy ×EF_GRID）－（ BE_SW_EL_GRIDy ×EF_GRID －6,723 ）
＝67,200＋6,723
＝73,923［ｔ-CO2］

E.6. Table providing values obtained when applying formulae above:

>>

第一期約束期間（2008－2012）における削減量は，308,012［ｔ-CO2］

年	有機廃棄物を埋立て処分場に処分することによる CO2 排出量［ｔ-CO2/年］	バイオガス発電による系統電源の削減量［ｔ-CO2/年］	リーケージ［ｔ-CO2/年］	GHG 削減量［ｔ-CO2/年］
2008	11,200	1,133	13	12,320
2009	67,200	6,798	75	73,923
2010	67,200	6,798	75	73,923
2011	67,200	6,798	75	73,923
2012	67,200	6,798	75	73,923
2013	67,200	6,798	75	73,923
2014	67,200	6,798	75	73,923
合計				455,858

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

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

>>

SECTION G. Stakeholders' comments

>>

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

>>

G.2. Summary of the comments received:

>>

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

>>

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

ベースラインシナリオ設定と排出量算定に用いた主要な項目について，変数，パラメーター，データの出典等を表形式に整理する。

Annex 4

MONITORING PLAN

モニタリング計画に関する主要な項目について，表形式で整理することがのぞましい。（ベースラインシナリオ設定と排出量算定に用いた主要な項目について，変数，パラメーター，データの出典等を表形式に整理する。）

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添付資料Ⅱ-2　PROPOSED NEW METHODOLOGY : BASELINE　（和文）

CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: BASELINE (CDM-NMB)
Version 01 - in effect as of: 1 July 2004

CONTENTS

SECTION A. Identification of methodology

A.1. Proposed methodology title:

>>
下水汚泥と有機性廃棄物の共発酵によるバイオガス発電

A.2. List of category(ies) of project activity to which the methodology may apply:

>>
プロジェクトの活動のカテゴリーは以下のとおり。
１.エネルギー産業（再生可能/非再生可能）
13.廃棄物処理及び処分

A.3. Conditions under which the methodology is applicable to CDM project activities:

>>
下記の条件を満たすプロジェクトであれば，本方法論が適用可能である。

- プロジェクト実施地域にメタンガスを利用した発電プラントがないこと。
- 政府が再生可能エネルギーを開発するあるいは，優先する政策を持っている。
- 再生可能エネルギーへの補助制度が無いこと。
- 下水処理場の下水汚泥処理施設が利用できること。
- 埋め立て処分場において，ランドフィルガス（以下ＬＦＧ）発電を行っていないこと。
- ＬＦＧフレア処理について，これを強制する法律が無いこと。
- 有機廃棄物について将来的に分別回収が実施されること。
- プロジェクト近郊には石炭火力発電所があり，電力はすべてこの発電所から供給されており，ガスを利用した大きなガス火力発電所がない。
-
- 埋立地に運搬される廃棄物量を測定できる機器があること。
- 大きな都市で，今後人口の増加が予想されること。
- 固形廃棄物と下水処理を管轄する行政部門が別である。

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

>>
強み
本方法論は，下水汚泥と有機性廃棄物を共発酵させ，バイオガスを発生させてそのガスを利用した発電に利用できる方法論である。
発生するバイオガス量，発電量の測定技術は，一般的であり正確性を維持できる。

弱み

- 埋立地に廃棄された有機廃棄物の量の測定が弱みとなりうる。この測定は，埋立て処分場から大気に放出されるバイオガス量の計算のため，重要である。

　そのため，埋立て処分場に廃棄物を搬入するトラックの台数と重量を測定し，その値に公共機関によって毎年測定される埋立て処分場に搬入される有機廃棄物の比率を乗算することにより，有機廃棄物の量を測定することができる。そのため，正確性を維持できる。

・埋立地から発生するバイオガス発生量は IPCC データあるいは運用開始された後に測定された値を比較し，保守的な値を用いる。

SECTION B. Overall summary description:

>>
本方法論におけるプロジェクトシナリオは，下水汚泥および有機性廃棄物を嫌気性発酵槽で共発酵させ，ランドフィルガス（以下 LFG）として回収できない埋立て処分場メタンガスを大気に放出せずに回収する。その上，メタンガスによる発電システムを導入することによりグリッド電力の一部を代替し，グリッドの化石燃料発電設備より排出される GHG を削減するものである。

本方法論のベースラインシナリオは，埋め立て処分場で LFG の燃焼処理，下水汚泥は下水処理場でメタン発酵を行い，発生したメタンをボイラ燃料に使用する場合とした。

本方法論におけるプロジェクトは以下のバリヤにより，ベースラインシナリオの正当性が判断され，プロジェクトシナリオの追加性が認められる。
・ 法律・制度，技術的バリヤ，投資バリヤ，市場障壁，環境影響，地域性

ベースラインシナリオにおける GHG 排出量の計算式は，次のとおりである。
BEy＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH

BEy	：ベースライン CO2 排出量(t-CO2/year)
BE_SW_EL_GRIDy	：下水処理場で使用する電力量(KWh)
EF_GRID	：グリッドにおける CO２排出係数（t-CO2/KWh）
BE_METH_Wy	：ＬＦＧとして回収できない埋立処理場から大気放出されるメタンガス量(t-CH4/year) 算定は IPCC を使用し計算する。ただし，モニタリング結果と比較し，保守的に少ない値を用いる。
ε_METH	：メタンの地球温暖化係数(=21 IPCC Guideline)(t-CO2/t-CH4)

プロジェクトシナリオ実施によるリーケージは，有機廃棄物の運搬による CO2 排出である。
有機物の下水処理場への搬入時のリーケージについては，有機物を運搬する距離が市を横断する距離として，運搬するトラックが 1 年間で消費する軽油が燃焼した場合に発生する CO2 量とする。

Ｌ１＝EF_TR×TR_ AM

EF_TR：有機物運搬トラック 1 台が市内から下水処理場まで有機廃棄物を運搬した場合のＣＯ２排出量（(t-CO2/台)
TR_AM：トラック台数。トラック台数は運搬時にカウントされた値を使用する。

プロジェクトシナリオでの CO2 量排出量
PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε_METH

PEy	：プロジェクト CO2 削減量(t-CO2/year)
BE_SW_EL_GRIDy	：下水処理場で使用する電力量(KWh)
P_EL_GENy	：バイオガス発電電力量（kWh）

EF_GRID　　　　　　：グリッドにおける CO２排出係数（t-CO2/kWh）

PE_METH_NWy　　　　：発酵槽に投入された有機物と下水汚泥の共発酵により発生したメタンガス量(t-CH4/year)
ε_METH　　　　　　：メタンの地球温暖化係数(=21 IPCC Guideline
ここで，PE_METH_NWy は全量バイオガス発電に使用されるため GHG として大気放出されない。

よって，プロジェクトシナリオでの CO2 排出量は
PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε_METH＝（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID

以上のことから，CO2 排出削減量は，以下のとおりとなる。

GHG 削減量＝ベースライン GHG 排出量ープロジェクト GHG 排出量ーリーケージ
＝BEy－Pey－L1
＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH－（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID－L1
＝BE_METH_Wy × ε_METH＋ P_EL_GENy ×EF_GRID－L1

SECTION C. Choice of and justification as to why one of the baseline approaches listed in paragraph 48 of CDM modalities and procedures is considered to be the most appropriate:

>>

C.1. General baseline approach:

□ Existing actual or historical emissions, as applicable;

■ Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;

□ The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.

C.2. Justification of why the approach chosen in C.1 above is considered the most appropriate:

>>経済的に最適な技術を用いることにより，法律を守りなおかつ投資を伴わないベースラインが選択されたことから。

SECTION D. Explanation and justification of the proposed new baseline methodology:

D.1. Explanation of how the methodology determines the baseline scenario (that is, indicate the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity):

>>ベースラインシナリオは，何らかのプロジェクトが実施されない場合に想定されるその地域の状況を表したものである。

想定される地域は,

・有機廃棄物も無機廃棄物も一括収集された後に埋立地に搬入され，衛生埋立後にＬＦＧフレア処理が行われている。

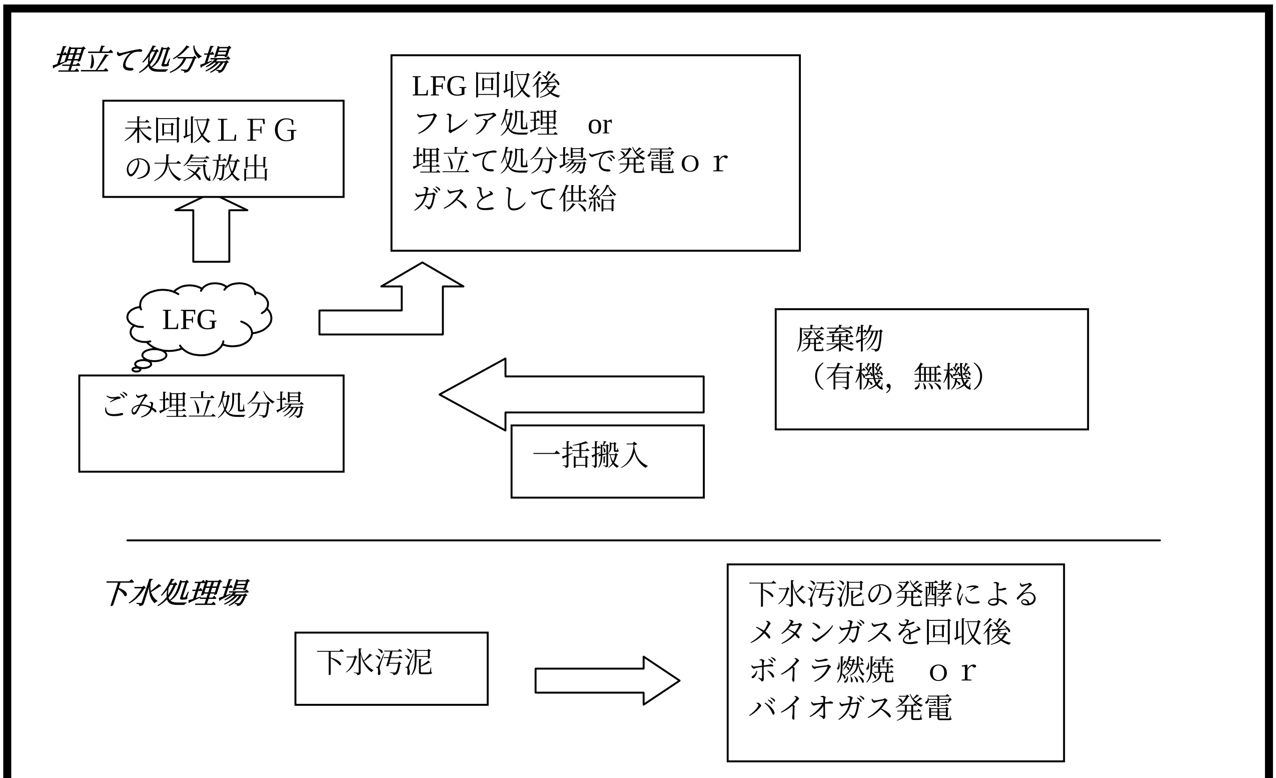
・下水処理場の下水汚泥は消化槽にて嫌気性発酵され，そのバイオガスはボイラの燃料として冬の期間に利用されている。

と想定する。

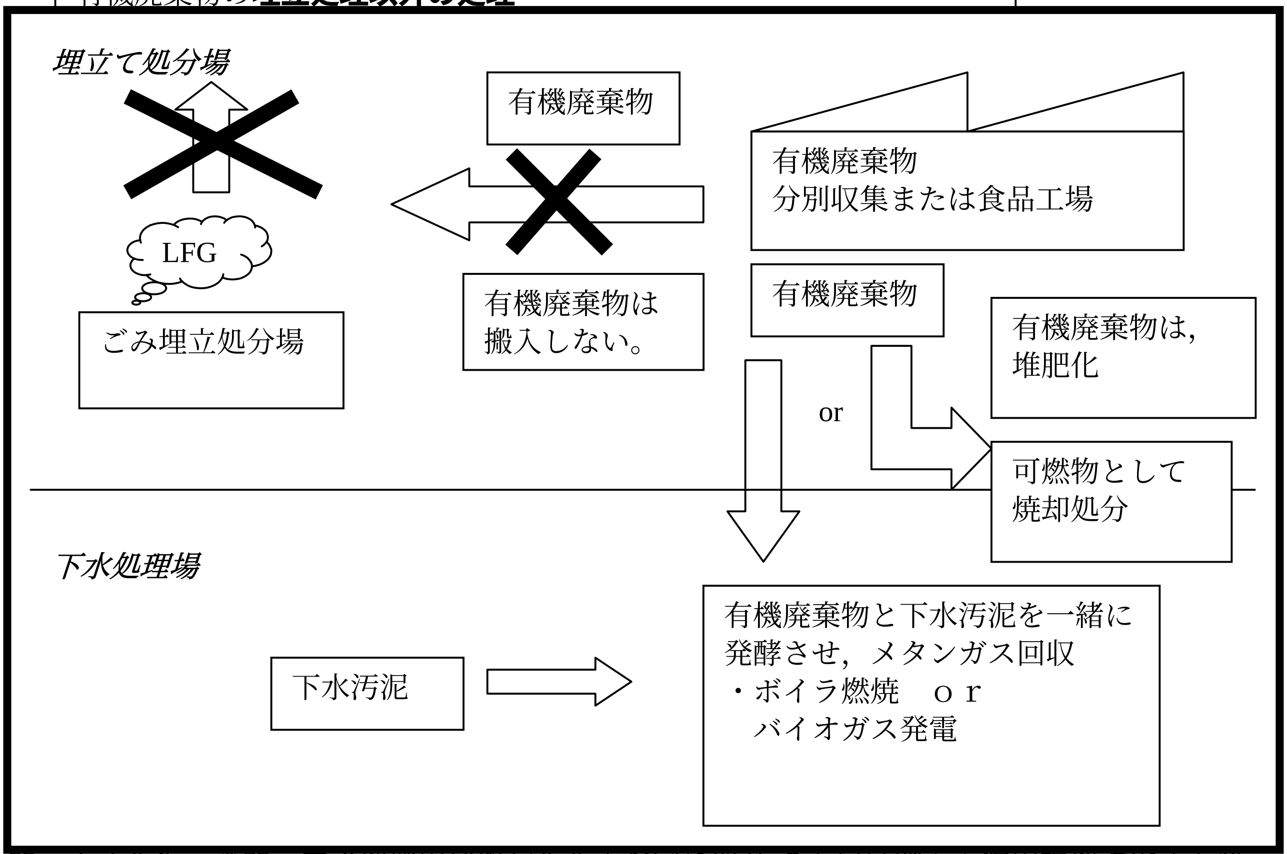
この状況をふまえ，シナリオとして考えられるのは，次の１２のシナリオである。

ケース	収集されたごみ		下水処理場	
1	一括収集後埋立処理	**埋立て処分を行い，発生した LFG をフレア処理**	**下水汚泥によるメタン発酵**	**ボイラによる燃焼**
2				**発電機による発電**
3		**埋立て処分を行い，発生した LFG は埋立て処分場で発電に利用される。**	**下水汚泥によるメタン発酵**	**ボイラによる燃焼**
4				**発電機による発電**
5		**埋立て処分を行い，発生した LFG の処分場以外への提供**	**下水汚泥によるメタン発酵**	**ボイラによる燃焼**
6				**発電機による発電**
7	埋立処理以外の処理	廃棄物のうち，分別回収または工場からの有機物を用いて，**有機物の堆肥化**	**下水汚泥によるメタン発酵**	**ボイラによる燃焼**
8				**発電機による発電**
9		**可燃物の焼却処分**	**下水汚泥によるメタン発酵**	**ボイラによる燃焼**
10				**発電機による発電**
11		廃棄物のうち，分別回収または工場からの有機物を用いて，**下水処理場への有機物の搬入下水処理場への有機物の搬入**	**下水汚泥＋有機廃棄物によるメタン発酵**	**ボイラによる燃焼**
12				**発電機による発電**

想定されるシナリオの概略図を以下に示す。



有機廃棄物の**埋立処理以外の処理**



門，エネルギー部門，当該地域の技術レベル等を聞き取り,あるいは既設設備の現地調査する必要がある。

ベースラインシナリオはこの１２のシナリオの中から，この申請書 A.３項において規定した適用条件に基づき，さまざまなバリヤを考慮し適切なベースラインを選択していく。

検討項目に合致するものには「Yes」（以下略して N）を，合致しないものに「No」（以下略して N），どちらともいえないものに「－」を記載した。

検討項目を評価した後，その項目による全項目「Y」の場合は評価「２」，1 項目「Y」の場合は評価「１」，２項目以上「N」の場合は「０」とした。

以上の評価を各項目について実施し，最終的に数字の大きなものがベースラインプロジェクトになるものとした。

ｉ）法律・制度

検討項目	1	2	3	4	5	6	7	8	9	10	11	12
政府のエネルギー政策に合致している	N	Y	N	Y	Y	Y	N	Y	N	Y	N	Y
関係機関との協議・調整を必要としない。	Y	Y	Y	Y	N	N	N	N	N	N	N	N
評価	1	2	1	2	1	1	0	1	0	1	0	1

- 政府が再生可能エネルギーを開発あるいは優先する政策をもち，適用できる場合を「Y」とした。
- 関係機関との協議・調整は検討に時間がかかりプロジェクトの大きな障害になりえることから，必要がないものを「Y」とした。
- 当該政府は，政府が再生可能エネルギーを開発するあるいは，優先する政策を持っていることから，案 2,4,6,8,10,12 はバイオガスを用いて発電を行うこと，案 5 は，バイオガスが発電設備にて利用される可能性もあるため，「Y」をつけた。
- 案 7～12 までは，固形廃棄物のうち，有機廃棄物を下水処理場へ搬入しなければならず，当該国は，固形廃棄物の管理機関と，下水処理機関が分離されて管理されていることから，複数の管理機関と協議調整が必要である。
- 案 1~4 は，現状の処理行政区分をまたがないことから，協議を必要としない「Y」とした。
- 案 5,6 は，バイオガスを埋立地以外に供給するものであり，そのためにエネルギーセクター等との管理機関との協議が発生する。

ii）技術的バリヤ

検討項目	1	2	3	4	5	6	7	8	9	10	11	12
技術開発・実用に伴うリスクが小さい。	Y	N	N	N	N	N	N	N	N	N	N	N
建設に関する技術リスクが小さい。	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y
３）運用の技術リスクが小さい。	Y	N	Y	N	N	N	N	N	N	N	Y	N
評価	2	0	1	0	0	0	0	0	0	0	1	0

・案 1 は運用実績があり，技術的バリヤは小さい。
案 2,4,6,8,10,12 は，有機物を発酵させ発生したメタンガスを発電に利用するシステムを用いるが，この設備は日本では一般的な技術であるが，当該国で初めて適用される技術であるため技術開発リスクがある。また，案 3,5 の LFG を利用する技術，案 7,9 の分別回収された後の有機物の処理も同様に当該国で始めて適用される技術のため，技術開発リスクがある。
案 9,10 は大型の燃焼設備であり，経験不足による品質管理にリスクがある。

案 2,4,6,8,10,12 は，強制発酵させたメタンガスの性状，量が安定しない可能性があるため，発電を行う場合には運用の技術リスクがあるものとした。案 5,6 は，発生した LFG を他の場所に送るため，ガスの性状について連続してモニタリングし相手先に連絡する必要があるため「N」とした。案 7,8 は堆肥の製造は温度管理，水分量管理など難しいため「N」とした。案 9,案 10 は廃棄物を焼却処分する案であるが，有機物に水分が多い場合には焼却温度の管理が難しなり運用の技術リスクがあるため，「N」とした。

iii）投資バリヤ

検討項目	1	2	3	4	5	6	7	8	9	10	11	12
新規投資が不要または投資効率が良い	Y	N	N	N	N	N	N	N	N	N	N	N
運用コストが低い	Y	Y	Y	Y	Y	Y	N	N	N	N	Y	Y
評価	2	1	1	1	1	1	0	0	0	0	1	1

- 案１は，現状のままであり新規投資は不要である。
- 案 2,3,4,10,12 に関して，再生可能エネルギーに関する政府の政策はあるが補助政策は無いことから，発電設備を投資するインセンティブがなく，投資効率が良いとはいえないことから「N」とした。
- 案 5,6 のＬＦＧ供給は供給先までの配管が必要となり，初期投資が多額となるため，「N」とした。
- 案 7,8 は現在，当該国内の農業セクターに購買力がないことから肥料の販売による収入が考えにくく，投資効率が良いとはいえない。
- 案 9,10 は焼却場設備の新設が必要となり，その初期投資は大きいため，「N」とした。
- 運用コストについては，案 7,8 は堆肥化するための管理費用や当該国内は農業セクターに購買力がないことから堆肥販売が進まない場合，堆肥の保管費用も発生する可能性があるため，「N」とした。また，案 9,10 の廃棄物の焼却処分は，焼却ガスにはさまざまな成分が含まれ，石炭ボイラなどよりもボイラへの損傷が大きく保守コストが割高となるため「N」とした。
- 案 1,2,3,4,5,6,11,12 の運用コストで一番高価と考えられるのはメンテナンス費用であり，基本的に現地で可能な機械メンテナンスを実施すれので，7～10 に比べて安価であることから「Y」とした。

iv）環境影響

検討項目	1	2	3	4	5	6	7	8	9	10	11	12
環境問題解決に適している。	N	N	N	N	―	―	N	Y	N	N	N	Y
評価	0	0	0	0	―	―	0	1	0	0	0	1

- 環境影響として，地球温暖化ガスを削減できること，地域の環境向上に適していること，この 2 点から判断した。
- 案 9，案 10 は廃棄物を焼却処分する案であるが，焼却温度の管理をしなければダイオキシン問題等の発生するリスクがあるため，「N」とした。
- 案 1,7,11 は，発電を実施しない案であるが，発電により石炭燃焼を代替し煤塵等の削減をすることができないことから，大気環境問題解決に寄与しないと考え，「N」とした。

- 案 5,6 は別の施設へガスを送る案だが，現状，近隣にガス発電設備がないことから，大気環境問題解決には，案 2,3,4,8,10,12 の発電に比べ，煤塵，CO2 の削減を図れないことから，「－」とした。
- 案 2,3,4 は，LFG を 100%回収できないことから，メタンガスが大気中に放出されるため，地球温暖化という環境問題に適していない。

v）地域性

検討項目	1	2	3	4	5	6	7	8	9	10	11	12
地域のニーズに合っている。	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
評価	0	0	0	0	0	0	1	1	1	1	1	1

- 想定する都市は，人口が急激に増加しており，ごみの問題を検討することが必要である。また，世界的なごみの問題の解決策として分別回収を行うことが進められている現状から，案 7 から 12 は分別回収を行い，埋立て処分場の延命を図ることができるため，地域のニーズに合っていることから「Y」とした。

vi）市場障壁

検討項目	1	2	3	4	5	6	7	8	9	10	11	12
地域に普及する可能性がある。	Y	Y	N	N	N	N	N	N	N	N	Y	Y
評価	1	1	0	0	0	0	0	0	0	0	1	1

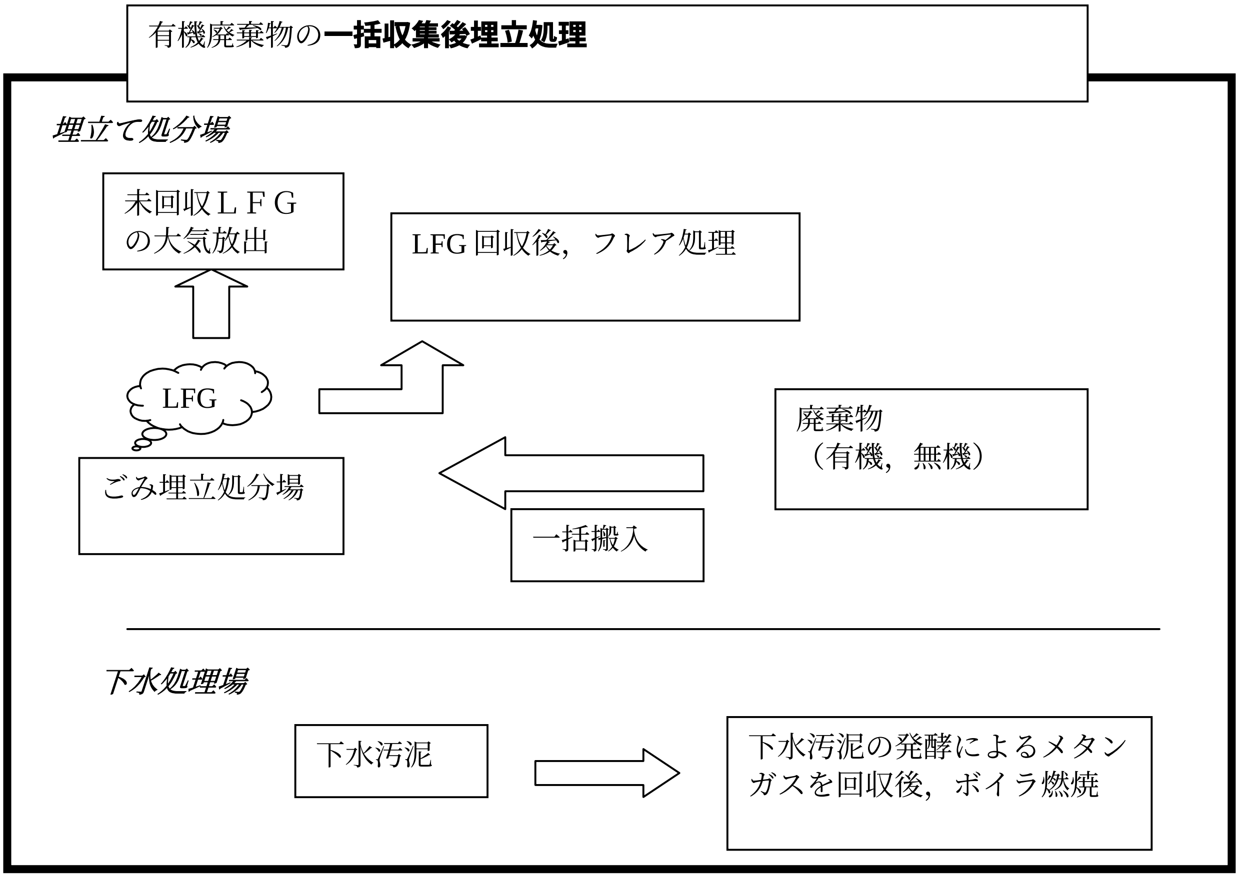
・案 1,2 の埋め立て処分場における LFG のフレア処理は，簡易なシステムを用いること，実際に開始され実績ができることから普及が見込まれるため,「Y」とした。
・案 3,4 の LFG による処分場での発電はカザフ国において実績がないことから，普及まで時間が必要と考えられることから「N」とした。
・案 5,6 の LFG を埋立処分場以外に提供する案も，カザフ国において実績がないことから，普及まで時間が必要と考えられることから「N」とした。
・案 7,8 の有機物の堆肥化は製造により堆肥が大量に発生するため，その扱いが難しいことから，「N」とした。
・案 9,10 の焼却処分については，聞き取り調査によって，焼却処分が国の法律で認められていないことから「N」とした。
・案 11，12 は，現実には運用等の問題はあるものの，運用実績があり有機廃棄物の収集など条件がそろえば普及する可能性があるため，「Y」とした。

ベースラインの選択
現在まで，検討した内容を次の表にまとめた。

検討項目	案１	案２	案３	案４	案５	案６	案７	案８	案９	案１０	案１１	案１２
法律・制度	1	2	1	2	1	1	0	1	0	1	0	1
技術的バリヤ	2	0	1	0	0	0	0	0	0	0	1	0
投資バリヤ	2	1	1	1	1	1	0	0	0	0	1	1
環境影響	0	0	0	0	―	―	0	1	0	0	0	1
地域性	0	0	0	0	0	0	1	1	1	1	1	1
市場障壁	1	1	0	0	0	0	0	0	0	0	1	1
総合評価	6	4	3	3	2	2	1	3	1	2	4	5

以上のことから，法律・制度，技術的バリヤ，投資バリヤ，環境影響，地域性，市場性を考慮し，各項目を検討した結果として案１が一番点数が高いことから，ベースラインシナリオとした。

案１のシナリオは「廃棄物は一括収集後，埋立て処分され，発生したメタンガス（以下ＬＦＧ）はフレア処理される。また，下水汚泥は嫌気性発酵させ，発生したメタンガスはボイラにて燃焼される。」であり，いかに概略図を記載する。



ベースラインのＧＨＧ排出量は，下水処理場での系統電力使用によるＣＯ２排出量と LFG として回収されなかった埋立て処分場から排出されるメタンガス量をＣＯ２排出量に換算した量の合計となる。

プロジェクトシナリオについては，総合評価にて，次点となった案１２「廃棄物は分別回収を行い，有機廃棄物は下水汚泥と一緒に下水処理場の嫌気性発酵に投入し発生したメタンガスは発電に利用される。」とする。

このプロジェクトシナリオは，ベースラインシナリオと比較して，技術的バリア，投資バリヤで劣っている。しかし，JI プロジェクトを実施することにより，技術的バリアは技術指導などによりバリアを超えることができ，投資バリヤについては，CO2 クレジットによりバリヤを低くすることができる。

D.2. Criteria used in developing the proposed baseline methodology:

>>
ベースライン方法論を開発する際の主な基準として，法律・制度，技術的バリヤ，投資バリヤ，環境影響，地域性，市場障壁について検討した。
また，次の項目を使用した。

GHG 排出量を過大評価しないためには，メタンガスによる発電電力量を正確に計測する必要があるが，その計測技術は一般的であり，ベースラインシナリオの GHG ガス削減量の計算との真値とずれが少ない。

- 埋立地に廃棄された有機廃棄物の量の測定が弱みとなりうる。この測定は，埋立て処分場から大気に放出されるバイオガス量の計算のため，重要である。

そのため，埋立て処分場に廃棄物を搬入するトラックの台数と重量を測定し，その値に公共機関によって毎年測定される埋立て処分場に搬入される有機廃棄物の比率を乗算することにより，有機廃棄物の量を測定することができる。そのため，正確性を維持できる。

・埋立地から発生するバイオガス発生量は IPCC データあるいは運用開始された後に測定された値を比較し，保守的な値を用いる。

この方法論は，特殊な前提条件を必要とするわけではないことから，適用できる汎用性は高い。

D.3. Explanation of how, through the methodology, it can be demonstrated that a project activity is additional and therefore not the baseline scenario (section B.3 of the CDM-PDD):

>>
プロジェクトシナリオである下水汚泥等を活用したバイオガス発電は，追加性がありベースラインシナリオとはなりえない理由は以下のとおり。

- 法律・制度
  廃棄物を利用した嫌気性発酵システムを運用するためには，縦割りである行政をＪＩプロジェクトで一緒に活動させることができることから，追加性がある。
- 技術バリヤ
  下水汚泥と有機性廃棄物の共発酵によるバイオガス発電における技術的バリヤは，プロジェクトシナリオを実行することで技術移転が可能となり，バリヤをクリアできることから，追加性がある。
- 投資バリヤ

ＬＦＧの取り扱いに対する法律がなく，再生可能エネルギーにも投資のインセンティブが働かない状況でありプロジェクト化することで投資効果が向上することから，プロジェクトシナリオには追加性がある。

・ 環境影響
当該国の埋立て処分場の環境問題，大気汚染ならびに地球温暖化問題にプロジェクトの実施は効果があることから追加性がある。

・ 地域性
当該地域では固形廃棄物の処理方法を検討しており，本プロジェクトは地域ニーズに合っている

・ 市場障壁
嫌気性発酵槽の運用実績があり有機廃棄物の収集など条件がそろえば，本プロジェクトが実施されることにより，普及する可能性があるため，市場障壁のバリヤをクリアすることができる。

D.4. How national and/or sectoral policies and circumstances can been taken into account by the methodology:

>>

ベースラインを同定する時に，ホスト国の政策等は重要な関係がある。

再生可能エネルギーに関する補助制度があれば，投資バリヤに影響があり，また，埋立処分場に関する法律があれば，有機性廃棄物を利用に制約が発生する可能性がある。

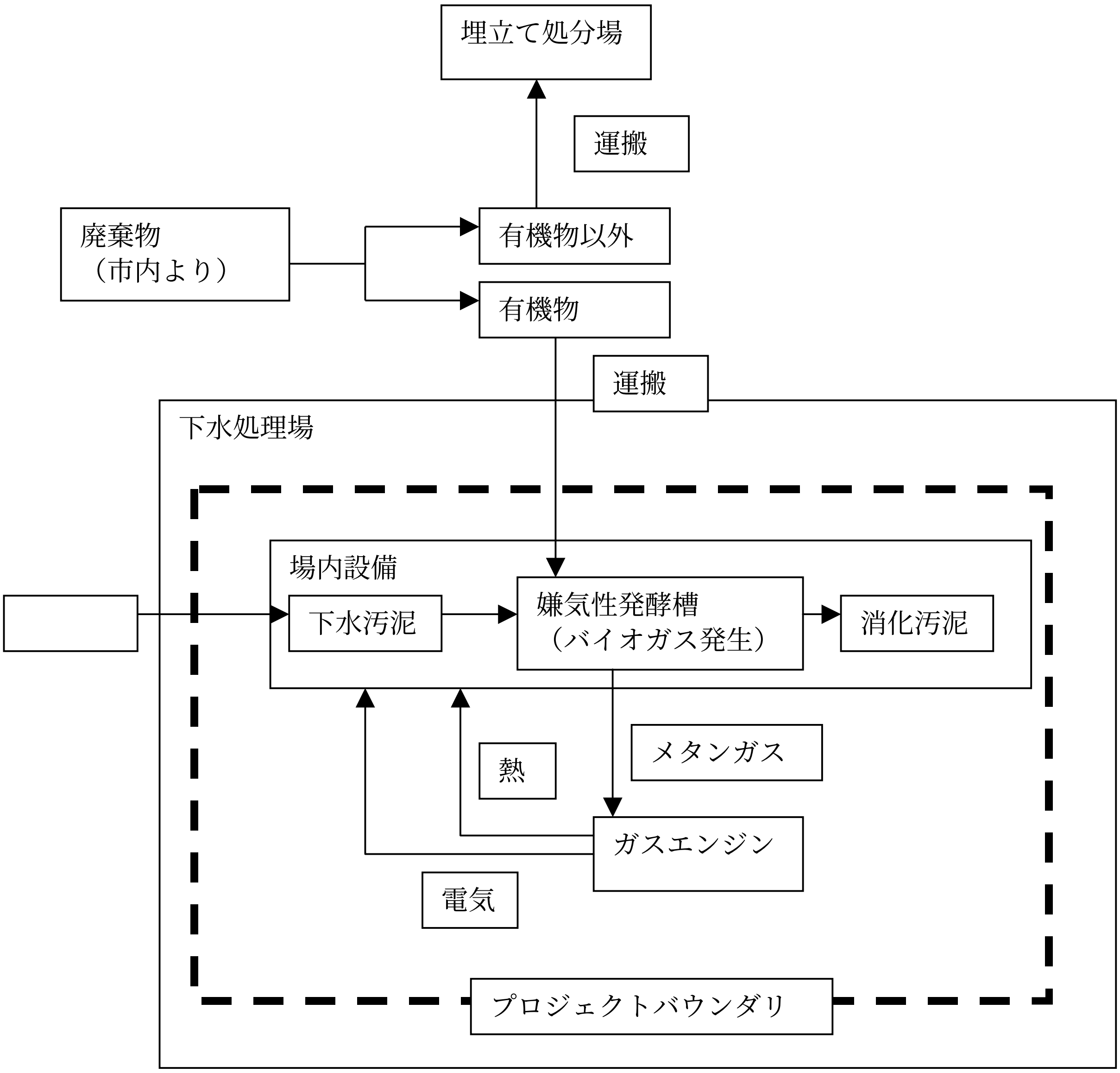
以上のことから，ホスト国における政策，規制については，関係諸機関に質問を行い，確認を取る必要がある。

D.5. Project boundary (gases and sources included, physical delineation):

>>

プロジェクトバウンダリーは，下水処理場内における嫌気性発酵槽，発電設備である。
廃棄物を分別し，下水処理場内にある嫌気性発酵槽まで搬入する行為は，行政の役目であり当該プロジェクトのプロジェクトバウンダリーとしない。

リーケージとして考えられることは，有機廃棄物をプロジェクトバウンダリーに運ぶための輸送機器からのＧＨＧである。


埋立て処分場
運搬
廃棄物
（市内より）
有機物以外
有機物
運搬
下水処理場
場内設備
下水汚泥
嫌気性発酵槽
（バイオガス発生）
消化汚泥
熱
メタンガス
ガスエンジン
電気
プロジェクトバウンダリ

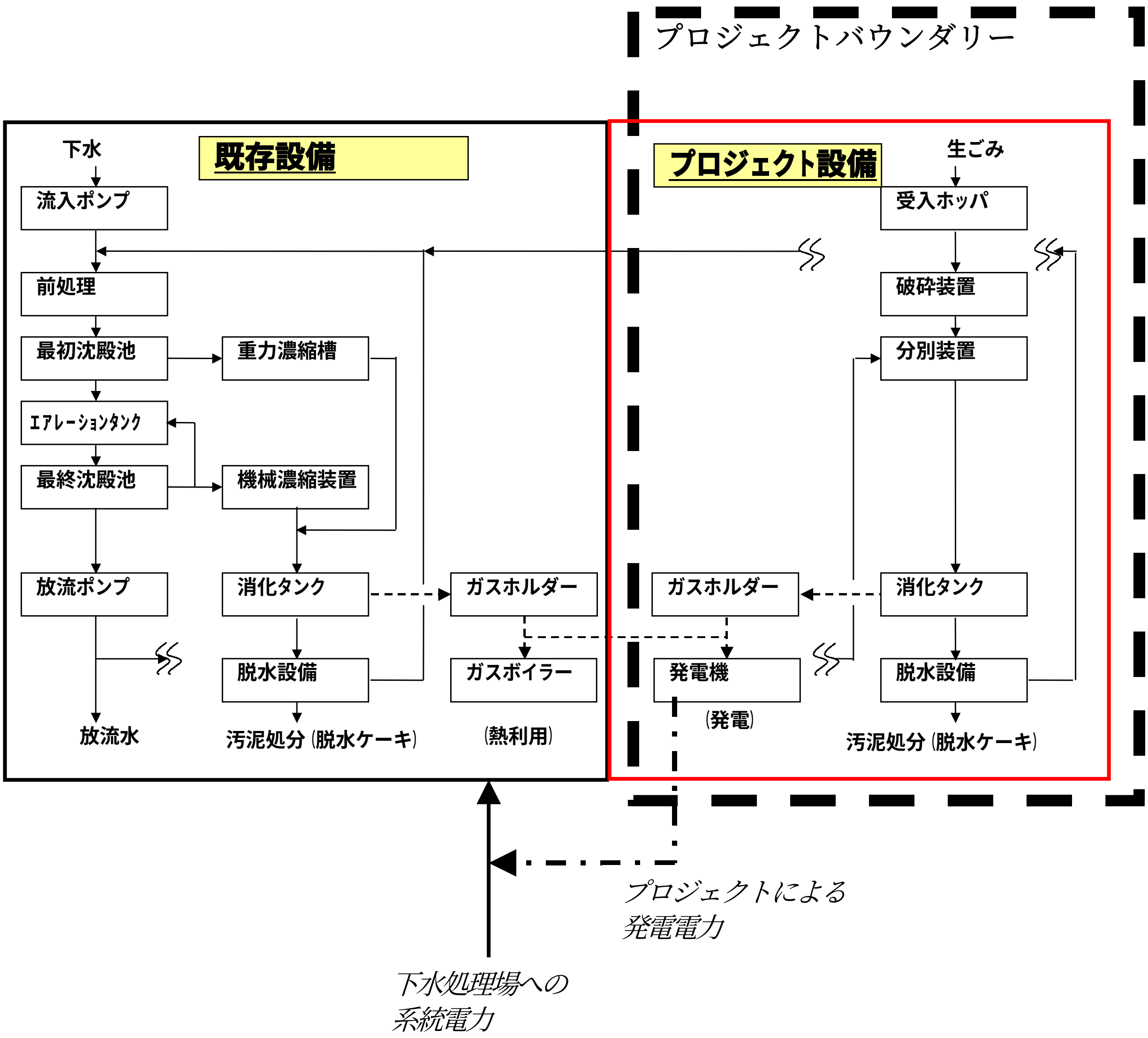


表　シナリオごとの GHG 排出量

	バウンダリー内	バウンダリー外
ベースラインシナリオ	下水処理場で使用されるグリッド電力による CO2 排出	埋立て処分場からのメタンガス排出
プロジェクトシナリオ	下水処理場で使用されるグリッド電力による CO2 排出ーバイオガス発電による CO2 排出	有機物搬入による CO2 排出

D.6. Elaborate and justify formulae/algorithms used to determine the baseline scenario. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

>>
ベースラインシナリオにおける GHG 排出量の計算式は，次のとおりである。
BEy＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH

BEy ：ベースライン CO2 排出量(t-CO2/year)
BE_SW_EL_GRIDy ：下水処理場で使用する電力量(KWh)であり，測定はグリッド電力使用量がわかる電力計で行う。
EF_GRID ：グリッドにおける CO２排出係数（t-CO2/KWh）は，保守的に考え全電力平均を用いる。
BE_METH_Wy ：ＬＦＧとして回収されず埋立処理場から大気放出されるメタンガス量(t-CH4/year) 算定は IPCC を使用し計算する。ただし，モニタリング結果と比較し，保守的に少ない値を用いる。
ε_METH ：メタンの地球温暖化係数(=21 IPCC Guideline)

D.7. Elaborate and justify formulae/algorithms used to determine the emissions from the project activity. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

>>

プロジェクトシナリオでの CO2 量排出量
PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε_METH

PEy ：プロジェクト CO2 削減量(t-CO2/year)
BE_SW_EL_GRIDy ：下水処理場で使用する電力量(KWh)
P_EL_GENy ：バイオガス発電電力量（kWh）
EF_GRID ：グリッドにおける CO２排出係数（t-CO2/kWh）

PE_METH_NWy ：発酵槽に投入された有機物と下水汚泥の共発酵により発生したメタンガス量(t-CH4/year)
ε_METH ：メタンの地球温暖化係数(=21 IPCC Guideline
ここで，PE_METH_NWy は全量バイオガス発電に使用されるため GHG として大気放出されない。

よって，プロジェクトシナリオでの CO2 排出量は
PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε_METH＝（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID

D.8. Description of how the baseline methodology addresses any potential leakage of the project activity:

>>
リーケージとして考えられるものは，プロジェクトラインへの有機廃棄物の運搬による CO2 排出である。

有機物の下水処理場への搬入時のリーケージについては，有機物を運搬する距離が市を横断する距離として，運搬するトラックが１年間で消費する軽油が燃焼した場合に発生する CO2 量とする。

Ｌ１＝EF_TR×TR_ AM

EF_TR：有機物運搬トラック１台が市内から下水処理場まで有機廃棄物を運搬した場合のＣＯ２排出量（(t-CO2/台)
TR_AM：トラック台数。トラック台数は運搬時にカウントされた値を使用する。

D.9. Elaborate and justify formulae/algorithms used to determine the emissions reductions from the project activity. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

>>

GHG 排出量は，以下のとおりとなる。

GHG 削減量＝ベースライン GHG 排出量ープロジェクト GHG 排出量ーリーケージ
＝BEyーPeyーL1
＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METHー（BE_SW_EL_GRIDy ーP_EL_GENy） ×EF_GRIDーL1
＝BE_METH_Wy × ε_METH＋ P_EL_GENy ×EF_GRIDーL1

SECTION E. Data sources and assumptions:

E.1. Describe parameters and or assumptions (including emission factors and activity levels):

>>

排出係数は，現地データを用い，入手できないデータについては保守的に現地よりも効率の良い日本のプラントの熱効率を用いて全電力平均を計算した。
埋立処分場への廃棄物の量は当局から入手できる。
埋立処分場のメタンガスについては, ＩＰＣＣより求めることができる。

E.2. List of data used indicating sources (e.g. official statistics, expert judgement, proprietary data, IPCC, commercial and scientific literature) and precise references and justify the appropriateness of the choice of such data:

>>

項目	利用データソース	利用した理由
メタンガスの発生量に関する変換係数	IPCC	現地での実験棟は行われておらず，情報を確保することは難しい。ＩＰＣＣのデータを使用した。モニタリング結果から現地データが利用できれば保守的にその値を用いる。
燃料性状	現地情報	現地にて使用されているものを用いる。
発電所の効率	現地情報	現地にて使用されているものを用いる。

E.3. Vintage of data (e.g. relative to starting date of the project activity):

>>
使用したデータの年代
・ IPCC ガイドブック　1996 年
燃料の熱量は，現地での聞き取りを行い最新データを使用したが確保できない情報は，保守的な値を用いた。
・ バイオマスの搬入量については，現地の最新データを利用した。

E.4. Spatial level of data (local, regional, national):

>>
今回の使用した IPCC データの地理的範囲は旧ソ連の範囲とした。
それ以外のデータについては，当該地域のデータを利用した。

SECTION F. Assessment of uncertainties (sensitivity to key factors and assumptions):

>>今回使用した値には，IPCC のデフォルト値の利用が含まれている。この値はランドフィルからのメタンガス発酵量に影響を与えるため，GHG 排出量の削減量に誤差が出る可能性がある。
そのため，当該国以外におけるデータから類推し，保守的な値を用いた。
測定機器の誤差については，構成された機器を用いることにより，計器の精度は確保できることから，不確実性は減少する。

SECTION G. Explanation of how the baseline methodology allows for the development of baselines in a transparent and conservative manner:

>>
GHG 削減量の計算において，ごみの排出量のデータによっては，不確実性を伴う恐れがあるため，現地の値を保守的に採用する。

添付資料Ⅱ-3　PROPOSED NEW METHODOLOGY : MONITORING　　（和文）

CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: MONITORING (CDM-NMM)
Version 01 - in effect as of: 1 July 2004

CONTENTS

SECTION A. Identification of methodology

A.1. Title of the proposed methodology:

>>
下水汚泥と有機性廃棄物の共発酵によるバイオガス発電のモニタリング方法論

A.2. List of category(ies) of project activity to which the methodology may apply:

>>
プロジェクトの活動のカテゴリーは以下のとおり。
１.エネルギー産業（再生可能/非再生可能）
13.廃棄物処理及び処分

A.3. Conditions under which the methodology is applicable to CDM project activities:

>>
本モニタリング方法論は，下水汚泥等を用いたバイオガス発電のベースライン方法論を使用し，グリッド電力を代替し，埋立て処分場に運ばれる有機性廃棄物から放出されるメタンガスを削減するプロジェクト活動に適用可能である。

下記の条件を満たすプロジェクトであれば，本モニタリング方法論が適用可能である。

- 当該地域には，下水処理場にメタンガスを利用した発電プラントがない。
- 政府エネルギープランに再生可能エネルギーを開発するあるいは，優先する政策が記載されているが，具体的な補助制度が無い。
- 当該地域にはには下水処理場の下水汚泥処理施設があり，利用できること。
- 埋め立て処分場はＬＦＧのフレア処理を実施する予定であるが，ＬＦＧ発電を行う予定は，現在，また将来的にも想定されていないこと。
- ＬＦＧフレア処理について，これを強制する法律はない。
- 有機廃棄物について将来的に分別回収が実施される予定である。プロジェクト近郊には石炭火力発電所があり，電力はすべてこの発電所から供給されており，ガスを利用した大きなガス火力発電所がない。
- 埋立地に運搬される廃棄物量を測定できる機器があること。
- 大きな都市で，今後人口の増加が予想されること。
- 固形廃棄物と下水処理を管轄する行政部門が別である。

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

>>

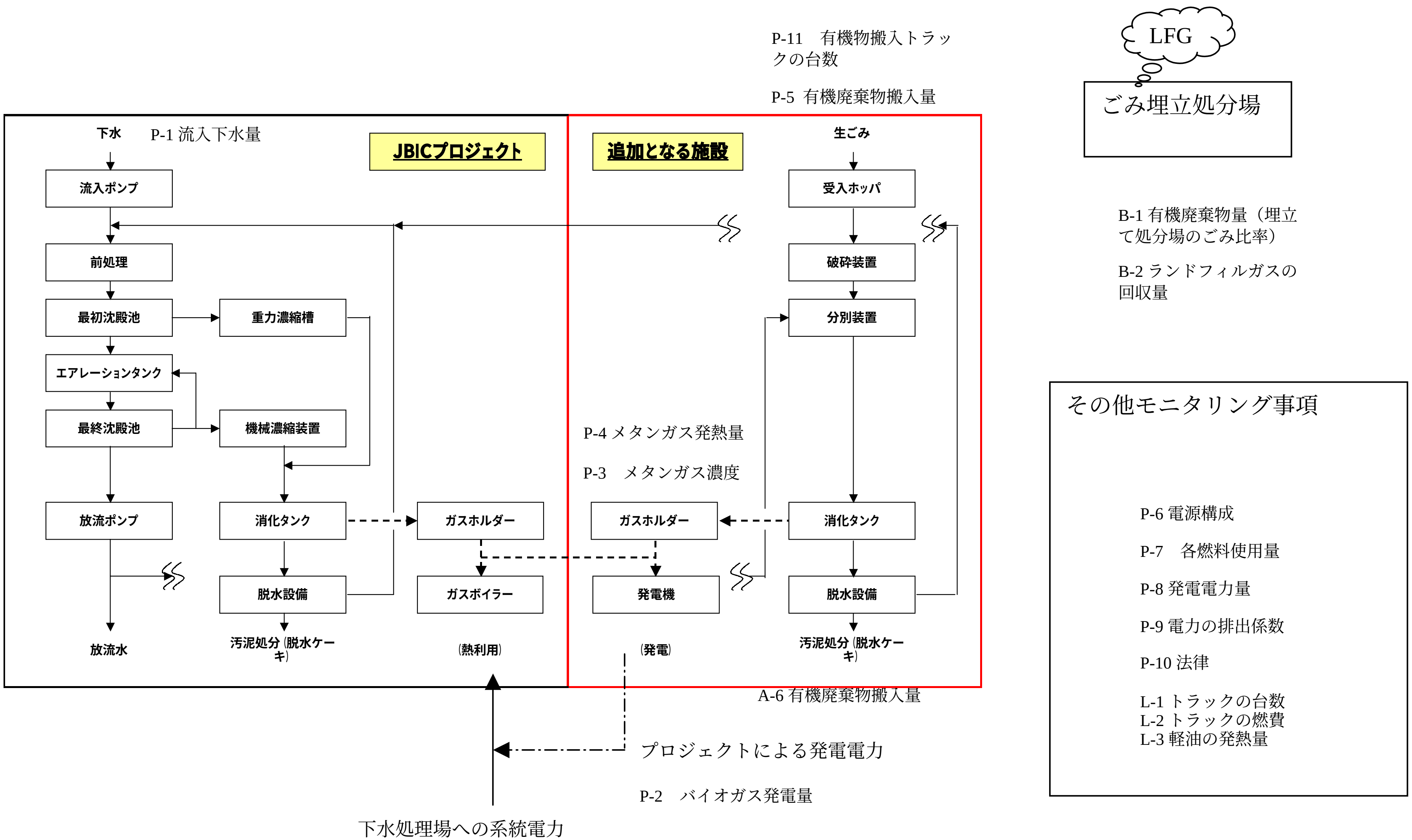
強み
このモニタリング方法論は，特別な計器を使用していないことから，校正を含めた計器の管理が簡単であり，現地のモニタリング作業が重荷なることがない。

弱み
発電所からの石炭使用量，発電電力量のデータを入手する必要があるが，発電所に対して本プロジェクトは強制力がないことから測定を依頼するなどの必要が発生し弱みとなる。しかし，発電所はこの値を日々管理しているため新規に労働が発生しないことから，協力が得やすいと考える。そのため，本モニタリングプランを発電所に説明，理解してもらい，記録を提供してもらうようにする。

SECTION B. Proposed new monitoring methodology

B.1. Brief description of the new methodology:

>>モニタリングすべき項目は，次のとおり。


P-11　有機物搬入トラックの台数
P-5 有機廃棄物搬入量
LFG
ごみ埋立処分場
B-1 有機廃棄物量（埋立て処分場のごみ比率）
B-2 ランドフィルガスの回収量
下水
P-1 流入下水量
JBICプロジェクト
追加となる施設
生ごみ
流入ポンプ
前処理
最初沈殿池
重力濃縮槽
エアレーションタンク
最終沈殿池
機械濃縮装置
放流ポンプ
消化タンク
ガスホルダー
脱水設備
ガスボイラー
放流水
汚泥処分（脱水ケーキ）
（熱利用）
受入ホッパ
破砕装置
分別装置
P-4 メタンガス発熱量
P-3　メタンガス濃度
ガスホルダー
消化タンク
発電機
脱水設備
（発電）
汚泥処分（脱水ケーキ）
A-6 有機廃棄物搬入量
プロジェクトによる発電電力
P-2　バイオガス発電量
下水処理場への系統電力
その他モニタリング事項
P-6 電源構成
P-7　各燃料使用量
P-8 発電電力量
P-9 電力の排出係数
P-10 法律
L-1 トラックの台数
L-2 トラックの燃費
L-3 軽油の発熱量

B.2. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario:

>>

B.2.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P-1 P_EL_GENy	*流入下水量*	*流量計による測定*	*M3/日*	*ｍ*	*Everyday*	*100%*	electronic/ paper	
P-2 P_EL_GENy	*バイオガス発電量*	電力計による測定	kWｈ */day*	*m*	*Everyday*	*100%*	electronic/ paper	
P-3 P_EL_GENy	*発酵槽からのメタンガス濃度*	*濃度計による測定*	*%*	*ｍ*	*Weekly*	*100%*	electronic/ paper	
P-4 P_EL_GENy	*メタンガス発熱量*	*発熱量計による測定*	*MJ/m3*	*m*	*Weekly*	*Sample*	electronic/ paper	
P-5 P_EL_GENy	*有機廃棄物搬入量*	*トラックスケール*	*t/day*	*m*	*Everyday*	*100%*	electronic/ paper	
P-6 EF_GRID	*カザフの電源構成*	*聞き取り*		*m,c*	*Year*	*Sample*	paper	*全電力平均の炭素排出係数を求めるためにモニタリングを行う。*
P-7 EF_GRID	*カザフの火力*	*聞き取り*	*t/year*	*e*	*Year*	*Sample*	paper	*全電力平均の炭素排出係数を求めるためにモニタリングを行*

	発電に使う各燃料使用量							*う。*
P-8 EF_GRID	*カザフの全発電量*	*聞き取り*	*MW/year*	*e*	*Year*	*Sample*	paper	*全電力平均の炭素排出係数を求めるためにモニタリングを行う。*
P-9 EF_GRID	*電力のCO2 排出係数*	*聞き取りと計算*	*t-co2MWh*	*c*	*Year*	*Sample*	paper	
P-10 EF_GRID	*有機物搬入トラック数*	*目視による台数確認*	*Amount/day*	*m*	*Everyday*	*100%*	electronic/ paper	
P -11	*法律*	*聞き取り*			*Year*		paper	廃棄物やエネルギーに関する法律の改正や新法律の制定について

B.2.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

PEy ＝ （BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID＋×PE_METH_NWy× ε_METH

PEy ：プロジェクト CO2 削減量(t-CO2/year)
BE_SW_EL_GRIDy ：下水処理場で使用する電力量(KWh)
P_EL_GENy ：バイオガス発電電力量（kWh）
EF_GRID ：グリッドにおける CO２排出係数（t-CO2/kWh）

PE_METH_NWy ：発酵槽に投入された有機物と下水汚泥の共発酵により発生したメタンガス量(t-CH4/year)
ε_METH ：メタンの地球温暖化係数(=21 IPCC Guideline

B.2.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary and how such data will be collected and archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B-１ B_LFG_METHy	*有機廃棄物量*	*計量ばかりによる計測*	*ｔ/year*	*m，c*	*年２回*	*Sample*	electronic/ paper	*分別される前の廃棄物について，その組成を調べる*
B-2 B_LFG_METHy	*ランドフィルガスの回収量*	*流量計計算*	*t/year*	*m,c*	*Everyday*	*Sample*	electronic/ paper	*LFG 回収配管に流量計を設置し，流量と配管数をかけてLFG の回収量を計算する。*

B.2.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

ベースラインシナリオにおける GHG 排出量の計算式は，次のとおりである。

ベースラインシナリオ GHG 排出量＝
ベースラインでの埋立て処分場からの LFG 排出量
＋ベースラインの系統電力による CO2 排出量

BEy＝BE_METH_Wy　×　ε_METH ＋ BE_SW_EL_GRIDy ×EF_GRID

BEy　：ベースライン CO2 排出量(t-CO2/year)
BE_SW_EL_GRIDy　：下水処理場で使用する電力量(kWh)
EF_GRID　：グリッドにおける CO２排出係数（t-CO2/kWh）
BE_METH_Wy　：ＬＦＧとして回収できない埋立処理場から大気放出されるメタンガス量(t-CH4/year) 算定は IPCC を使用し計算する。ただし，モニタリング結果と比較し，保守的に少ない値を用いる。
ε_METH　：メタンの地球温暖化係数(=21 IPCC Guideline)(t-CO2/t-CH4)

B.3. Option 2: Direct monitoring of emission reductions from the project activity:

>>

B.3.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

B.3.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

B.4. Treatment of leakage in the monitoring plan:

>>

B.4.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity:								
ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
L-1 TR_AM	*トラックの台数*	*目視による台数確認*	*Unit/year*	*m*	*Everyday*	*100%*	electronic/ paper	
L-2 EF_TR	*トラックの燃*	*聞き取り*	*Km/l*	*m,c*	*Half year*	*Sample*	electronic/ paper	

	費							
L-3	*軽油の発熱量*	*聞き取り*	*Kcal/kg*	*e*	*Hafyear*	*Sample*	electronic/ paper	

B.4.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

Ｌ１＝EF_TR×TR_ AM

L1 ：リーケージによる CO2 排出量(t-CO2/年)

EF_TR ：有機物運搬トラック１台が市内から下水処理場まで有機廃棄物を運搬した場合のＣＯ２排出量（(t-CO2/台)

TR_AM ：トラック台数。トラック台数は運搬時にカウントされた値を使用する。

B.5. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

CO2 排出削減量は以下のとおりとなる。

GHG 削減量＝ベースライン GHG 排出量―プロジェクト GHG 排出量―リーケージ

＝BEy－Pey－L1

＝BE_SW_EL_GRIDy ×EF_GRID＋BE_METH_Wy × ε_METH－（BE_SW_EL_GRIDy －P_EL_GENy） ×EF_GRID－L1

＝BE_METH_Wy × ε_METH＋ P_EL_GENy ×EF_GRID－L1

B.6. Assumptions used in elaborating the new methodology:

>>

ＬＦＧからのメタンガス排出量の計算には，以下の値を用いる。

MCF = methane correction factor (fraction)は，管理型埋立て処分場のため，IPCC より 1.0 を用いた。

DOCF = fraction DOC similated は DOCF の値は,当該地域の地域性を考え，保守的に 0.68 とする。

F = fraction of CH4 in landfill gas はさまざまな数値が報告されているが，保守的にＩＰＣＣデフォルト値を用いる。 ０．５ただし，この値についてはモニタリングを行い，IPCC デフォルト値と比較し，保守的に低い値を利用する。

R ： 米国環境保護局（以下 EPA）の
Landfill に関するハンドブックによると，メタンガスの回収率は，50%から 90%の間と想定されている。また，EPA のハンドブックによると LFG 回収のオペレーションを実施した場合の回収効率は，メタンガス発生量の 70%から 85%の間とも記載されており，運用上の回収効率を利用し，保守的に回収効率は 85%とした。

OX = oxidation factor は，ＩＰＣＣよりデフォルト値 0.0 を用いる。

MSWT = total MSW generated (G/yr)
MSWF = fraction of MSW disposed to solid waste disposal sites
DOC = degradable organic carbon (fraction)
MSWT ×MSWF ×MCF ×DOC：このデータは，埋立て処分場に捨てられる有機性廃棄物の量をあらわすことから，埋立て処分場の廃棄物のデータを市当局から入手する。

メタン発酵槽に投入する下水汚泥と有機廃棄物の発生量は，下水汚泥に関しては下水処理量より計算で求める。
廃棄物処分場に埋め立てられる有機廃棄物については，トラックスケールによって測定する。
設置するプロジェクト機器から発生する有機性廃棄物由来のバイオガス量，メタンガス濃度，メタンガス発熱量，発電電力量は，実測を行う。
当該地域の電力は，近郊の石炭火力発電所から供給されているが，他の系統と連携されていることから，保守的に考え，全電源の加重平均排出係数を用いることとする。

次のものは，保守的に IPCC のガイドラインを利用する。
酸化係数 0.995
CO２原単位換算 44/12＝3.7
炭素排出原単位 25.8［ｔ-c/TJ］

B.7. Please indicate whether quality control (QC) and quality assurance (QA) procedures are being undertaken for the items monitored:		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
P-1	*Low*	*QA あり。流入下水量は，下水処理場において流量計によって計測される。流量計は，当該国の測定装置の校正に関する規格に基づくが，ない場合はメーカーの推奨する校正を定期的に実施する。*
P-2	*Low*	*バイオガス発電量は，当該国の測定装置の校正に関する規格に基づくが，ない場合はメーカーの推奨する校正を定期的に実施する。。*
P-3	*Low*	*発酵槽からのメタンガス濃度は，当該国の測定装置の校正に関する規格に基づくが，ない場合はメーカーの推奨する校正を定期的に実施する。*
P-4	*Low*	*メタンガス発熱量は，当該国の測定装置の校正に関する規格に基づくが，ない場合はメーカーの推奨する校正を定期的に実施する。*
P-5	*Low*	*有機廃棄物搬入量は，トラックスケールで計測される。　スケールは当該国の測定装置の校正に関する規格に基づくが，ない場合はメーカーの推奨する校正を定期的に実施する。*
P-6	*Low*	*電源構成について国の機関より聞き取りを行う。*
P-7	*Low*	*各燃料使用量について国の機関より聞き取りを行う。*
P-8	*Low*	*発電電力量について国の機関より聞き取りを行う。*
P-9	*Low*	*電力の CO2 排出係数は，発電電力量，石炭使用量により求められる。計算上もとめられることから，積算時に注意を行う。*
P-10	*Low*	*有機物搬入トラック数，数量をカウントする。*
P-11	*Low*	*廃棄物やエネルギーに関する法律の改正や新法律の制定について調査を行う。*
B-1	*Low*	*有機廃棄物量は，人手により，無機と有機物に分別され組成が測定される。このとき，作業員には正確に分別を行うように指示を行い，測定には校正された重量計測装置を用いることとする。*
B-2	*Medium*	*ランドフィルガスの回収量は，LFG 回収配管に流量計を設置し，流量と配管数をかけて LFG の回収量を計算する。そのため，測定には校正された計測装置を用いることとする。*
L-1	*Medium*	*トラックの台数*
L-2	*Medium*	*トラックの燃費*
L-3	*Medium*	*軽油の発熱量*

B.8. Has the methodology been applied successfully elsewhere and, if so, in which circumstances?

>>

none

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添付資料Ⅲ-1　DETERMINATION REPORT　（英文）

DETERMINATION REPORT

PRELIMINARY DETERMINATION OF THE BIOGAS POWER GENERATION UTILIZING ORGANIC WASTE AND SEWAGE SLUDGE IN ASTANA IN KAZAKHSTAN

REPORT NO. 2005-0234

REVISION NO. 0

DET NORSKE VERITAS

DETERMINATION REPORT

Date of first issue: 2005-02-21	Project No.: 28624552
Approved by: Einar Telnes Technical Director	Organisational unit: DNV Certification, International Climate Change Services
Client: Tohoku Electric Power Co., Inc.	Client ref.: Mr. Masahiro Chiba

Summary:

DNV Certification has performed a determination of the Biogas Power Generation Utilizing Organic Waste and Sewage Sludge in Astana in Kazakhstan (hereafter called "the project"). The determination was performed on the basis of the UNFCCC criteria for JI projects, in particular the verification procedures under the Article 6 supervisory committee, as well as criteria given to provide for consistent project operations, monitoring and reporting.

Based upon Tohoku Electric Power's request, the determination has been performed as a desk review of the project design, the baseline determination, the GHG emission reduction estimates and the monitoring plan presented in the project design document submitted by Tohoku Electric Power. In addition, Tohoku Electric Power has been visited and staff related to the project has been interviewed. The preliminary determination has NOT assessed the environmental impact and Kazakhstan requirements for JI projects, and the assumptions made for the baseline determination have not been verified.

In summary, it is DNV Certification's opinion that the project needs to be further developed to resolve the issues identified in this report and to meet all relevant UNFCCC requirements for the JI. Furhermore, the project has not yet obtained written approval by the Kazakhstan and Japanese government.

Report No.: 2005-0234	Subject Group: Environment
Report title: Preliminary Determination of the Biogas Power Generation Utilizing Organic Waste and Sewage Sludge in Astana in Kazakhstan	
Work carried out by: Tsuyoshi Nakao, Akira Sekine,	
Work verified by: Einar Telnes	

Date of this revision:	Rev. No.:	Number of pages:
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Abbreviations

BLS	Baseline Study
CAR	Corrective Action Request
CEF	Carbon Emission Factor
CH_4	Methane
CL	Clarification request
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalent
DNV	Det Norske Veritas
EIA	Environmental Impact Assessment
ERU(s)	Emission Reduction Unit(s)
FOD	First Order Decay
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
LFG	Landfill Gas
MP	Monitoring Plan
MSW	Municipal Solid Waste
NGO	Non-governmental Organisation
PDD	Project Design Document
UNFCCC	United Nations Framework Convention for Climate Change

1 INTRODUCTION

Tohoku Electric Power Co., Inc. of Japan has commissioned DNV Certification to perform a preliminary determination of the Biogas Power Generation Utilizing Organic Waste and Sewage Sludge(hereafter called "the project") in Astana, Kazakhstan.

This report summarises the findings of this preliminary determination of the project, performed on the basis of the UNFCCC criteria for JI projects, as well as criteria given to provide for consistent project operations, monitoring and reporting.

The determination team consists of the following personnel:

Mr Tsuyoshi Nakao	DNV Certification Japan	Team Leader, GHG auditor
Mr Akira Sekine	DNV Certification Japan	GHG auditor
Mr Einar Telnes	DNV Certification Oslo	Internal verifier

(Please note that the validation activity for JI projects is referred to as "determination").

1.1 Objective

The purpose of the determination is to have an independent third party assessing the project design. In particular, the project's baseline, the monitoring plan, and the project's compliance with relevant UNFCCC and host Party criteria are validated in order to confirm that the project design as documented is sound and reasonable and meets the identified criteria. Determination is a requirement for JI projects following the verification procedures under the Article 6 supervisory committee and it is seen as necessary to provide assurance to stakeholders of the quality of the project and its intended generation of the emission reduction units (ERUs).

1.2 Scope

The determination scope is defined as an independent and objective review of the Project Design Document (PDD) and other relevant documents. The information contained in those documents is reviewed against the Kyoto Protocol requirements for Joint Implementation (JI) projects, the guidelines for the implementation of Article 6 of the Kyoto Protocol (Decision 16/CP.7) as agreed in the Marrakech Accords, in particular the verification procedures under the Article 6 supervisory committee, and associated interpretations. DNV Certification has, based on the recommendations in the Validation and Verification Manual /5/, employed a risk-based approach in the determination process, focusing on the identification of significant risks for project implementation and the generation of ERUs.

Based on Tohoku Electric Power's request, DNV Certification has only carried out limited validation, which included a desk review of the project design, the baseline determination, monitoring plan and the GHG emission reduction estimates presented in the project design document (PDD) submitted by Tohoku Electric Power /1/. In addition, Tohoku Electric Power has been visited and staff involved in the project has been interviewed. However, the preliminary determination has NOT assessed Kazakhstan requirements for JI projects, including the assumptions made for the baseline determination, the analysis of the potential environmental impacts of the project and the stakeholder consultation process. Moreover, DNV Certification has not yet invited comments by Parties, stakeholders and UNFCCC accredited NGOs. Hence, the preliminary determination carried out by DNV Certification does not represent a complete determination of the project in accordance with the CDM rules and modalities.

The determination is not meant to provide any consulting towards Tohoku Electric Power Co., Inc. and other project participants. However, stated request for clarifications and/or corrective actions may provide input for improvement of the project design.

1.3 The Biogas Power Generation Utilizing Organic Waste and Sewage Sludge in Astana

This project is, as a JI project, to introduce an anaerobic cofermentation system and a power generation unit into a sewage plant in Astana City, the capital of the Republic of Kazakhstan. The anaerobic cofermenration system utilizes both organic waste and sewage sludge and the biogas generated from the system is to be introduced into a gas engine as motive energy to generate electricity for use in the plant. The project is in line with the policy of Kazakhstan government for GHG emission reduction and renewable energy usage.

Through this project, GHG emissions can be reduced for the following two reasons.

- By cofermentation of organic wastes and sewage sludge at the anaerobic fermenters, released methane gas in to the atmosphere, which is uncollectible as landfill gas (LFG) at the landfill site, will be avoided.
- By the introduction of the power generation system fuelled by methane gas produced from the anaerobic cofermentation system, the project will be able to displace a part of the grid electricity and contribute to reduction of GHGs emitted from fossil fuel-fired generation units in the grid.

The project will be operated from November, 2008 and expected emission reductions are 73 923 ton of CO_2e per year.

2 METHODOLOGY

The determination consisted of the following three phases:

i) a desk review of the project design document, the baseline sturdy and the monitoring plan,
ii) follow-up interviews at Tohoku Electric Power Co., Inc., and
iii) the resolution of outstanding issues (Corrective Action or Clarification Requests) and the issuance of the preliminary determination report and opinion.

The determination has been carried out in line with the verification procedure under the Article 6 supervisory committee, as well as, in line with determination process outlined in the Validation and Verification Manual /5/.

In order to ensure transparency, a determination protocol was customised for the project, according to the Validation and Verification Manual. The protocol shows, in a transparent manner, criteria (requirements), means of verification and the results from validating the identified criteria. The determination protocol serves the following purposes:

- It organises, details and clarifies the requirements a JI project is expected to meet;

- It ensures a transparent determination process where the independent entity will document how a particular requirement has been validated and the result of the determination.

The determination protocol consists of three tables. The different columns in these tables are described in Figure 1.

2.1 Review of Documents

The Project Design Document (PDD) of January 2005 /1/ for the Biogas Power Generation Utilizing Organic Waste and Sewage Sludge in Astana, Kazakhstan, prepared by Tohoku Electric Power Co., Inc. and submitted in January 2005 by Tohoku Electric Power to DNV Certification, was reviewed.

2.2 Follow-up Interviews

On 26 January 2005, a lead validator performed interviews with key personnel of Tohoku Electric Power Co., Inc. to confirm selected information and to resolve issues identified in the document review. The main topics of the interviews are summarised in Table 1.

Table 1 Interview topics

Interviewed organisation	Interview topics
Tohoku Electric Power Co., Inc.	➢ Project's environmental additionality as mandated in Article 6 of the Kyoto Protocol ➢ Technological, institutional, legal/policy, investment, market, environmental and/or other barriers to investment in the projects ➢ Project technology and provisions for technology and capacity transfer to the host country ➢ Estimation of emission reductions and potential leakage ➢ Monitoring Plan

Determination Protocol Table 1: Mandatory Requirements			
Requirement	***Reference***	***Conclusion***	***Cross reference***
The requirements the project must meet.	*Gives reference to COP decision where the requirement is found.*	*This is either acceptable based on evidence provided (**OK**), or a **Corrective Action Request (CAR)** of risk or non-compliance with stated requirements. The corrective action requests are numbered and presented to the client in the determination report.*	*Used to refer to the relevant checklist questions in Table 2 to show how the specific requirement is validated. This is to ensure a transparent determination process.*

Determination Protocol Table 2: Requirement checklist				
Checklist Question	***Reference***	***Means of verification (MoV)***	***Comment***	***Draft and/or Final Conclusion***
The various requirements in Table 1 are linked to checklist questions the project shall meet. The checklist is organised in six different sections. Each section is then further sub-divided. The lowest level constitutes a checklist question.	*Gives reference to documents where the answer to the checklist question or item is found.*	*Explains how conformance with the checklist question is investigated. Examples of means of verification are document review (DR) or interview (I).*	*The section is used to elaborate and discuss the checklist question and/or the conformance to the question. It is further used to explain the conclusions reached.*	*This is either acceptable based on evidence provided (**OK**), or a **Corrective Action Request (CAR)** due to non-compliance with the checklist question (See below). **Clarification (CL)** is used when the independent entity has identified a need for further clarification. N/A means not applicable.*

Determination Protocol Table 3: Resolution of Corrective Action and Clarification Requests			
Draft report clarifications and corrective action requests	***Ref. to checklist question in table 2***	***Summary of project owner response***	***Determination conclusion***
If the conclusions from the draft determination are either a Corrective Action Request or a Clarification Request, these should be listed in this section.	*Reference to the checklist question number in Table 2 where the Corrective Action Request or Clarification Request is explained.*	*The responses given by the project proponent or other project participants during the communications with the independent entity should be summarised in this section.*	*This section should summarise the independent entity's responses and final conclusions. The conclusions should also be included in Table 2, under "Final Conclusion".*

Figure 1 Determination protocol tables

2.3 Resolution of Clarification and Corrective Action Requests

Findings established during the determination process can either be seen as a non-fulfilment of determination criteria or where a risk to the fulfilment of project objectives is identified. *Corrective Action Requests* (CAR) are issued, where:

i) mistakes have been made with a direct influence on project results;
ii) JI or host Party requirements have not been met; or
iii) there is a risk that the project would not be accepted as a JI project or that emission reductions will not be certified.

The term *Clarification* may be used where additional information is needed to fully clarify an issue.

The objective of this phase of the validation was to resolve the requests for corrective actions (CAR) and requests for clarification (CL), and other outstanding issues which needed to be clarified for DNV Certification's positive conclusion on the project design. To guarantee the transparency of the validation process, the concerns raised and responses given will be summarised in chapter 3 below and documented in more detail in Table 3 of the Determination Protocol in Appendix A.

Since modifications to the project design are necessary to resolve DNV Certification's concerns, Tohoku Electric Power was recommended to revise the PDD considering this determination report.

3 DETERMINATION FINDINGS

The findings of the determination are stated in the following sections. The determination criteria, the means of verification and the results from validating the identified criteria are documented in more detail in the determination protocol in Appendix A.

3.1 Project design

The project design, process, constructions, and know-how are dependent upon the similar experience and technologies currently applied in Japan. The project design appears to represent good engineering practice. The project intends to introduce leading edge technology for municipal solid waste management including anaerobic treatment for both organic waste and sewage sludge and utilisation of generated methane for electricity generation, resulting in technology transfer from Japan to Kazakhstan.

Currently, Astana city has some experience with management of anaerobic wastewater treatment system, but extensive training and maintenance efforts as for the methane generation using both the organic waste and sewage sludge and electricity generation will be required to implement and operate the proposed project.

The Kazakhstan Government and the Japanese Government have not yet formally approved the project and Letters of Approval have not yet been issued by the relevant authorities. The Letters of Approval needs to be approved formally at the appropriate stage of project implementation.

The project starting date and the crediting period is defined from 2008 to 2012. .

Corrective Action Request (CAR1 and 2 in Table 1 of Appendix A):

· *The project has not yet been formally approved by Kazakhstan and Japan.*

· *Approvals from Kazakhstan and Japan are not yet submitted.*

3.2 Baseline

The methodology has been designed for this project and the baseline methodology discusses the selection of the baseline scenarios and GHG emissions estimations.

The Baseline Study (BLS) describes twelve different cases including the current case (flaring for LFG treatment, anaerobic treatment of sewage sludge, and methane utilization for boilers) and the project case. These scenarios are discussed from the view point of regulation and policy, technology, investment, environment and market condiations, and points are used for rating of each scenario. The highest point implies the likely scenario in the absence of the project. The ratings done by Tohoku Electric Power Co., Inc. concludes that current case is the baseline scenario due to the highest rating. The project case, which is given the second highest rating, is not viable due to an investment barrier and a technological barrier.

There is no system using anaerobic treatment of both organic waste and sewage sludge in order to generate methane and utilize this for power generation in Kazakhstan. Also, two existing anaerobic tanks in Astana City are not operated properly at present. Hence, the technology barrier is likely to exist.

Regarding the investment barrier, DNV Certification requests to verify the investment analysis in order to confirm this and before it can be concluded that the project is additional to what would have occurred in the absence of the project activity.

For the baseline methodology, an IPCC model for estimation of LFG emissions that is not treated by flaring is applied. The CEF for accounting the electricity usage is determined by using the generation-weighted average emissions for the Kazakhstan grid.

Clarification (CL1 in Table 2 of Appendix A):

- *DNV Certification requests to verify the investment analysis in order to confirm the investment barrier.*

3.3 Monitoring Plan

The general monitoring plan (MP) in the PDD gives an overview of the relevant indicators to be monitored and reported, but the details of the MP have not yet been fully developed. Measurement methodologies and record-keeping methodologies for data are scarcely described in the PDD. Data archiving period, responsibilities and authorities and detailed procedures for registration, measurement, reporting, project management, and monitoring are not yet sufficiently described. These need to be completed after the engineering details are decided.

The monitoring points are described in a flow diagram in the PDD and reflect the baseline, project and leakage GHG emissions. Monitoring items are shown in a table and formulae for calculation are described in PDD.
Content (ID: B-1) of the organic waste in MSW is measured for the “ex-ante” estimation. However, the data monitored and used for estimation of the baseline GHG emission from the organic waste for ex-post is not clearly described.

Clarification (CL2, 3, and 4 in Table 2 of Appendix A):

- *DNV requests a clarification how long project data is to be archived.*
- *DNV requests to clarify which data is applied for the estimation of the baseline GHG emission from the organic waste for ex-post calculations of this.*
- *The details in the monitoring plan, including the responsibilities for Japanese entities involved, needs to be completed after the engineering details are decided.*

3.4 Calculation of GHG Emissions

The methodology and formulae for estimating the project and baseline GHG emissions are sufficiently described in the PDD, and all aspects related to direct and indirect emissions are considered.. GHG emission reductions are achieved by utilizing organic waste for methane generation, power generation, and consequently avoidance of methane emissions from the landfill site. The project is expected to reduce emissions of 308 012 tonnes of CO_{2e} from 2008 to 2012. The potential project leakage is also discussed in the PDD and transportation of organic waste by trucks is considered. However, DNV requests the clarification with regard to the possibility of methane releases at non-regular operation such as start-up or shut-down of operations.

The baseline methane emissions avoided by the project will be determined *ex-ante* by applying an IPCC model. For the estimation of baseline emissions of LFG not treated by flaring, a 85% collection efficiency is applied. This is taken from the US-EPA /3/ handbook that describes *"a reasonable assumption for a newer collection system operated for energy recovery is 75 to 85 percent collection efficiency"*. However, the handbook also shows that the collection efficiency *"can vary 50 to over 90%"* and 85% might not be deemed as a conservative number fro these calculations. Hence, DNV requests a clarification with regard to conservativeness of 85% as the recovery efficiency. Furthermore, IPCC also describes the FOD model which is a kinetic approach and simulates landfill gas generation rate curves. DNV request a clarification about the applicability of the FOD model for estimation of baseline LFG emissions compared to what is suggested.

The monitoring data of biogas power generation and the CEF, which applies the generation-weighted average emissions per electricity unit (t-CO_{2e}/MWh) of all generating sources serving the grid of Kazakhstan, will be applied for the project emissions for "ex-post" calculations.

Clarification (CL5 and6 in Table 2 of Appendix A):

- *DNV requests a clarification with regard to the possibility of methane releases at non-regular operation such as start-up or shut-down of operation.*
- *DNV requests the clarification with regard to:*

1). Conservativeness of 85% as LFG recovery efficiency. The US-EPA handbook explains that the collection efficiency can vary 50 to over 90%, hence 85% might not be a conservative number.

2). Application of IPCC FOD model. The FOD model is a kinetic approach and the application of the model might be more conservative than what is suggeted.

3.5 Environmental Impacts

Validation of the environmental impacts was outside of the scope of this preliminary determination.

4 COMMENTS BY LOCAL PARTIES, STAKEHOLDERS AND NGOS

According to the modalities for the determination of JI projects, the validator shall make publicly available the project design document and receive, within 30 days, comments from Parties, stakeholders and UNFCCC accredited observers and make them publicly available. The PDD has not yet been publicised because the formal determination has not yet started.

5 PRELIMINARY DETERMINATION OPINION

DNV Certification has made a preliminary determination of the Biogas Power Generation Utilizing Organic Waste and Sewage Sludge in Astana in Kazakhstan. The preliminary determination was performed on the basis of the UNFCCC criteria for JI projects, in particular the verification procedures under the Article 6 supervisory committee, as well as criteria given to provide for consistent project operations, monitoring and reporting.

The project design appears to represent good engineering practice and the project intends to introduce leading edge technology for municipal solid waste management. This includes anaerobic treatment for both organic waste and sewage sludge and utilisation of generated methane for electricity generation, resulting in a technology transfer from Japan to Kazakhstan.

The Kazakhstan Government and the Japanese Government have not yet formally approved the project and Letters of Approval have not yet been issued by the relevant authority. The Letters of Approval needs to be approved formally at the appropriate stage of it.

Twelve different cases including the current case and the project case are discussed from the view point of regulation and policy, technology, investment, environment, and marketconditions in order to select the baseline scenario and to demonstrate the additionality of the project. There is no system for anaerobic treatment of organic waste and sewage sludge in order to generate methane in Kazakhstan. Hence, a technology barrier is likely to exist. DNV Certification requests to verify the investment analysis in order to confirm the presented investment barrier before it can be concluded that the project is additional to what would have occurred in its absence.

The general monitoring plan given in the PDD gives an overview of the relevant indicators to be monitored and reported. However, responsibilities and authorities and detailed procedures for registration, measurement, reporting, project management, and monitoring are not yet sufficiently described. These need to be completed after the engineering details are decided. Furthermore, the data monitored for estimation of the baseline GHG emission from the organic waste for ex-post is not clearly described.

The methodology and formulae for estimating the project and baseline GHG emissions are sufficiently described in the PDD. The project is expected to reduce emissions of 308 012 tonnes of CO_{2e} *from 2008 to 2012.*

It is the validation team's opinion that the project needs to be further developed to resolve the issues identified in this report to meet all relevant UNFCCC requirements for the JI.

The preliminary determination is based on the information made available to us and the engagement conditions detailed in this report. DNV Certification can not guarantee the accuracy or correctness of this information. Hence, DNV Certification can not be held liable by any party for decisions made or not made based on the determination opinion.

References

Category 1 Documents:

List documents provided by the Client that relate directly to the GHG components of the project. These have been used as direct sources of evidence for the determination conclusions.

/1/ Tohoku Electric Power Co. Inc, *Biogas Power Generation Utilizing Organic Waste and Sewage Sludge in Astana, Kazakhstan: Project Design Document*, January 2005.

Category 2 Documents:

Background documents related to the design and/or methodologies employed in the design or other reference documents. Where applicable, Category 2 documents should have been used to check project assumptions and confirm the validity of information given in the Category 1 documents.

/2/ Government of the Republic of Kazakhstan, *Electricity Energy Development Program Up To 2030*, #384, April 9, 1999

/3/ US-EPA, *A Landfill Gas-to-Energy Project Development Handbook*, EPA 430-B-96-0004, 1996

/4/ Japan Sewage Works Association, *Guideline for design of sewage works (Gesuidou Shisetsu Keikaku ・sekkei Shishin to Kaisetsu Ko-hen)*, p403, 2001

/5/ IETA/PCF: *Validation and Verification Manual*. http://www.vvmanual.info

Persons interviewed:

List persons interviewed during the determination, or persons contributed with other information that are not included in the documents listed above.

/5/ Tohoku Electric Power Co., Inc., 26 January 2005 at Tohoku Electric Power Co., Inc., Sendai, Japan, Interviewed By Tsuyoshi Nakao (DNV Certification Japan)

- Mr. Masahiro Chiba (Overseas Business, Group Business Dept, Tohoku Electric Power Co., Inc.)
- Mr. Osamu Kanno (Overseas Business, Group Business Dept, Tohoku Electric Power Co., Inc.)
- Mr. Hiroyuki Matsuzaki (Overseas Business, Group Business Dept, Tohoku Electric Power Co., Inc.)
- Mr. Shigeru Matsuoka (Overseas Business, Group Business Dept, Tohoku Electric Power Co., Inc.)

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添付資料III-2　DETERMINATION REPORT APPENDIX A　　　　　　（英文）

APPENDIX A

JI DETERMINATION PROTOCOL FOR

BIOGAS POWER GENERATION UTILIZING ORGANIC WASTE AND SEWAGE SLUDGE IN ASTANA, KAZAKHSTAN

Table 1 Mandatory Requirements for Joint Implementation (JI) Project Activities

REQUIREMENT	REFERENCE	CONCLUSION	Cross Reference / Comment
1. The project shall have the approval of the Parties involved	Kyoto Protocol Article 6.1 (a)	CAR1	The Kazakhstan Government and the Japanese government have not yet formally approved the project. Letters of Approval will be provided after issuance of this determination report.
2. Emission reductions, or an enhancement of removal by sinks, shall be additional to any that would otherwise occur	Kyoto Protocol Article 6.1 (b)	CL1	Table 2, Section B.2
3. The sponsor Party shall not aquire emission reduction units if it is not in compliance with its obligations under Articles 5 & 7	Kyoto Protocol Article 6.1 (c)	OK	The validation has not assessed Japan’s compliance with article 5 and 7 of the Kyoto Protocol in detail. However, Japanese government has in place a national system for estimating and reporting GHG emissions.
4. The acquisition of emission reduction units shall be supplemental to domestic actions for the purpose of meeting commitments under Article 3	Kyoto Protocol Article 6.1 (d)	OK	The validation has not assessed Japan’s domestic actions for meeting commitments under Article 3 in detail. However, Japan is undertaking several measures to reduce domestic GHG emissions under the New Climate Change Policy Programme by the Government of Japan.
5. Parties participating in JI shall designate national focal points for approving JI projects and have in place national guidelines and procedures for the approval of JI projects	Marrakech Accords, JI Modalities, §20	-	The Kazakhstan focal point expects to be the Climate Change Coordination Centre, but has not yet decided. The Japanese focal point is the Liaison Committee for the Utilization of the Kyoto Mechanisms

REQUIREMENT	REFERENCE	CONCLUSION	Cross Reference / Comment
6. Parties participating in JI shall be a Party to the Kyoto Protocol	Marrakech Accords, JI Modalities, §21(a)/24	-	Kazakhstan has not ratified the Kyoto Protocol. Japan is a Party to the Kyoto Protocol and has ratified the Kyoto Protocol on 04. June 2002.
7. The participating Parties' assigned amount shall have been calculated and recorded	Marrakech Accords, JI Modalities, §21(b)/24	-	Kazakhstan's assigned amount is not calculated and recorded. Japan's assigned amount is 94% of the base year emissions.
8. The host Party shall have in place a national registry in accordance with Article 7, paragraph 4	Marrakech Accords, JI Modalities, §21(d)/24	-	This is expected to confirm through interview with the key person of Kazakhstan and this is out of scope of the preliminary determination.
9. The sponsor Party shall have in place a national system for estimating GHG emissions and a national registry and has submitted annualy its most recent inventory in accordance with Kyoto Protocol Article 5 and 7	Guidelines for the implementation of Art. 6 §21c,d,e,f	OK	Japan has submitted the 3rd national communication on May 2002.
10. Project participants shall submit to the independent entity a project design document that contains all information needed for the determination	Marrakech Accords, JI Modalities, §31	CAR2	A Project Design Document (PDD) has been submitted for pre-determination. Approval from the Parties are not yet submitted.
11. The project design document shall be made publicly available and Parties, stakeholders and UNFCCC accredited observers shall be invited to, within 30 days, provide comments	Marrakech Accords, JI Modalities, §32	-	The PDD shall be published on www.dnv.com/certification/ClimateChange, Parties, stakeholders and NGOs will be invited to provide comments on the validation requirement during a period of 30 days. However, the formal determinaiton process has not yet started.

REQUIREMENT	REFERENCE	CONCLUSION	Cross Reference / Comment
12. Documentation on the analysis of the environmental impacts of the project activity, including transboundary impacts, in accordance with procedures as determined by the host Party shall be submitted, and, if those impacts are considered significant by the project participants or the Host Party, an environmental impact assessment in accordance with procedures as required by the Host Party shall be carried out	Marrakech Accords, JI Modalities, §33(d)	Out of scope of the preliminary determination	Table 2, Section F
13. The baseline for a JI project shall be the scenario that reasonably represents the GHG emissions or removal by sources that would occur in absence of the proposed project	Marrakech Accords, JI Modalities, Appendix B	CL1	Table 2, Section B.2
14. A baseline shall be established on a project-specific basis, in a transparent manner and taking into account relevant national and/or sectoral policies and circumstances	Marrakech Accords, JI Modalities, Appendix B	CL1	Table 2, Section B.2
15. The baseline methodology shall exclude to earn CERs for decreases in activity levels outside the project activity or due to force majeure	Marrakech Accords, JI Modalities, Appendix B	CL1	Table 2, Section B.2
16. The project shall have an appropriate monitoring plan	Marrakech Accords, JI Modalities, §33(c)	CL2-4	Table 2, Section D

Table 2 Requirements Checklist

CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
A. General Description of Project Activity The project design is assessed.					
A.1. Project Boundaries Project boundaries are the limits and borders defining the GHG emission reduction project.					
A.1.1. Are the project's spatial (geographical) boundaries clearly defined?	/1/	DR I	The anaerobic methane generation and power generation facilities in the sewage plant in Astana, Kazakhstan, define the project's spatial boundaries.		OK
A.1.2. Are the project's system (components and facilities used to mitigate GHGs) boundaries clearly defined?	/1/	DR	The anaerobic methane generation and power generation facilities can be described as avoidance of passive LFG venting from the landfill site and electricity generation by utilizing the generated and collected methane.		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
A.2. Technology to be employed Validation of project technology focuses on the project engineering, choice of technology and competence/ maintenance needs. The validator should ensure that environmentally safe and sound technology and know-how is used.					
A.2.1. Does the project design engineering reflect current good practices?	/1/	DR	The process, construction and know-how are dependent upon similar experience and technologies applied in Japan and reflect current good practice.		OK
A.2.2. Does the project use state of the art technology or would the technology result in a significantly better performance than any commonly used technologies in the host country?	/1/	DR	The anaerobic treatment using organic waste and methane generation for electricity generation represents leading edge technology for sewage sludge treatment.		OK
A.2.3. Is the project technology likely to be substituted by other or more efficient technologies within the project period?	/1/	DR	The methane generation utilizing organic waste and sewage sludge and power generation will not likely be substituted by other more efficient technologies.		OK
A.2.4. Does the project require extensive initial training and maintenance efforts in order to work as presumed during the project period?	/1/	DR	The project requires extensive training and maintenance efforts for the operation of the new facilities. This includes power generation utilizing the generated methane.		OK
A.2.5. Does the project make provisions for meeting training and maintenance needs?	/1/	DR I	Maintenance needs are summarised in QC/QA procedure in the table of D.3. The training about the operation and		OK

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CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			maintenance for the local staffs will be carried out by Japanese staffs.		
B. Project Baseline The validation of the project baseline establishes whether the selected baseline methodology is appropriate and whether the selected baseline represents a likely baseline scenario.					
B.1. Baseline Methodology It is assessed whether the project applies an appropriate baseline methodology.					
B.1.1. Is the discussion and selection of the baseline methodology transparent?	/1/	DR I	The baseline methodology has been designed for this project and the justification of the choice of the methodology is described in PDD.		OK
B.1.2. Does the baseline methodology specify data sources and assumptions?	/1/	DR I	The data used for indicating sources are based on the information from Kazakhstan. IPCC is also referred for the data not to be obtained.		OK
B.1.3. Does the baseline methodology sufficiently describe the underlying rationale for the algorithm/formulae used to determine baseline emissions (e.g. marginal vs. average, etc.)	/1/	DR I	The baseline methodology includes the study of barriers (political, technological, investment, environmental and local situations) and the GHG emissions estimation methodology.		OK

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CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
B.1.4. Does the baseline methodology specify types of variables used (e.g. fuels used, fuel consumption rates, etc)?	/1/	DR I	IPCC guidelines are used for the estimation of baseline GHG emissions as LFG.		OK
B.1.5. Does the baseline methodology specify the spatial level of data (local, regional, national)?	/1/	DR I	Legislation and the political situation of Kazakhstan, technology presently used in Kazakhstan and other specific local conditions are taken into account for the selection of the baseline scenario. These should be confirmed through the interviews with key personnel in Kazakhstan. This is out of scope of this preliminary determination.		(OK)
B.2. Baseline Determination The choice of baseline will be validated with focus on whether the baseline is a likely scenario, whether the project itself is not a likely baseline scenario, and whether the baseline is complete and transparent.					
B.2.1. Is the application of the methodology and the discussion and determination of the chosen baseline transparent?	/1/	DR I	Yes, twelve baseline cases are discussed and the application of the baseline methodology is transparently described. The discussion takes into account 1) regulations and policies, 2) technology, 3)the investment attractiveness, 4) environmental influence to the local area, 5) market conditions.		OK

CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
B.2.2. Has the baseline been determined using conservative assumptions where possible?	/1/	DR I	Discussions about regulation and policy, technology, investment, environment and market conditions exist for twelve baseline cases and the results of the discussion are rated. The highest rating point implies the likely scenario, and through the assessment the current scenario was given the highest rating. Second highest rating was given to the project case. Because both a financial barrier and a technology barrier exist, the case rated second, the project case, is not deemed to respresent the baseline scenario. However, DNV Certification requests to verify the underlying investment analysis in order to confirm the investment barrier and the conservative assumptions used for unknown factors.	CL1	
B.2.3. Has the baseline been established on a project-specific basis?	/1/	DR	The baseline is current situation; flaring of LFG, and anaerobic treatment for sewage sludge and utilisation of methane as fuel of boiler. The baseline is determined under the condition of host country and it is determined on a project specific basis.		OK
B.2.4. Does the baseline scenario sufficiently take into account relevant national and/or sectoral	/1/	DR	For the selection of baseline, legal requirements of Kazakhstan, environmental		OK

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CHECKLIST QUESTION		Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
	policies, macro-economic trends and political aspirations?		I	impacts on the local area and the local situation are taken into account.		
B.2.5.	Is the baseline determination compatible with the available data?	/1/	DR I	The analysis of investment barrier might be supported by available data. The analysis of technological barriers is supported by information from the host country study. DNV Certification requests to verify the investment analysis in order to confirm the investment barrier for the project case. See B2.2.	CL1	
B.2.6.	Does the selected baseline represent a likely scenario in the absence of the project?	/1/	DR I	Judging from the assessment, the current situation might be the likely baseline scenario. The next likely scenario is the project case. Due to the claimed investment barrier and the technology barriers, this scenario might not occur. However, DNV Certification requests to verify the investment analysis in order to confirm the investment barrier for the project case. See B2.2.	CL1	
B.2.7.	Is it demonstrated that the project activity itself is not a likely baseline scenario (e.g. through (a) a flow-chart or series of questions that lead to a narrowing of potential baseline options, (b) a	/1/	DR I	It is demonstrated that project activity itself is not a likely baseline scenario because there are presently an investment barrier and a technology barrier to the project	CL1	

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CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
qualitative or quantitative assessment of different potential options and an indication of why the non-project option is more likely, (c) a qualitative or quantitative assessment of one or more barriers facing the proposed project activity or (d) an indication that the project type is not common practice in the proposed area of implementation, and not required by a Party's legislation/regulations)?			implementation. However, DNV Certification requests to verify the investment analysis in order to confirm the investment barrier for the project case. See B2.2.		
B.2.8. Have the major risks to the baseline been identified?	/1/	DR I	The major risks might be the influence of Kazakhstan's political direction. For example, subsidies to the renewable energy might have a good influence on the investment situation. To reduce the risk, regulation developments are monitored in the monitoring plan.		OK
B.2.9. Is all literature and sources clearly referenced?	/1/	DR I	The source for base line assessment basically from the study of local situation by Tohoku Electric Power Co.		OK
C. Duration of the Project/ Crediting Period It is assessed whether the temporary boundaries of the project are clearly defined.					
C.1.1. Are the project's starting date and operational lifetime clearly defined and reasonable?	/1/	DR I	The project is planned to start in 2008 and the project lifetime is expected to be 21 years.		OK

CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
C.1.2. Is the project's crediting time clearly defined?	/1/	DR	The starting date of the first crediting period is November 2008. There is no official decision by UNFCCC for the treatment of ERU after the first period (2008-2012). However, PDD describes the crediting time is expected to be 7 years from 2008.		OK
D. Monitoring Plan The monitoring plan review aims to establish whether all relevant project aspects deemed necessary to monitor and report reliable emission reductions are properly addressed.					
D.1. Monitoring Methodology It is assessed whether the project applies an appropriate baseline methodology.					
D.1.1. Does the monitoring methodology reflect good monitoring and reporting practices?	/1/	DR I	The methodology has been designed for this project, and reflects good monitoring and reporting practice.		OK
D.1.2. Is the selected monitoring methodology supported by the monitored and recorded data?	/1/	DR I	The monitoring plan presents the monitoring and reporting of the main project component.		OK
D.1.3. Are the monitoring provisions in the monitoring methodology consistent with the project boundaries in the baseline study?	/1/	DR I	The monitoring plan is consistent with the project boundaries.		OK

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CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
D.1.4. Have any needs for monitoring outside the project boundaries been evaluated and if so, included as applicable?	/1/	DR I	CEF for calculation of CO_2 emissions by grid electricity consumption and organic solid waste are obtained outside of the boundary. Availability of those data should be confirmed through the interviews with key personnel in Kazakhstan. This is out of scope of this preliminary determination.		(OK)
D.1.5. Does the monitoring methodology allow for conservative, transparent, accurate and complete calculation of the ex post GHG emissions?	/1/	DR I	1). Methane avoidance The GHG emission reduction by the methane avoidance from the landfill site is estimated by applying IPCC models and factors. 2). Grid-electricity Emission reduction by replacement of grid-electricity is estimated by monitoring of electricity supplied to the public grid and the associated CEF. DNV requests a clarification on how long the data is to be archived.	CL2	
D.1.6. Is the monitoring methodology clear and user friendly?	/1/	DR I	The monitoring plan is described by applying CDM standard form and user friendly.		OK
D.1.7. Does the methodology mitigate possible monitoring errors or uncertainties addressed?	/1/	DR	QA/QC procedures are summarized in table		OK

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CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
		I	D-3.		
D.2. Monitoring of Project Emissions It is established whether the monitoring plan provides for reliable and complete project emission data over time.					
D.2.1. Does the monitoring plan provide for the collection and archiving of all relevant data necessary for estimation or measuring the greenhouse gas emissions within the project boundary during the crediting period?	/1/	DR I	The project emissions might be electricity utilization for the project activities and GHG emissions from bio-electricity generation system. The electricity usage at the project premises is subtracted from the total electricity generation.		OK
D.2.2. Are the choices of project GHG indicators reasonable?	/1/	DR I	The indicator chosen is the electricity generated by biogas and supplied to the local grid. This is reasonable.		OK
D.2.3. Will it be possible to monitor / measure the specified project GHG indicators?	/1/	DR I	These are measured by the electricity meter.		OK
D.2.4. Will the indicators enable comparison of project data and performance over time?	/1/	DR I	The data is measured every day and archived by electronic means and on paper. Thus, this enables comparison of data over time.		OK

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CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
D.3. Monitoring of Leakage It is assessed whether the monitoring plan provides for reliable and complete leakage data over time.					
D.3.1. Does the monitoring plan provide for the collection and archiving of all relevant data necessary for determining leakage?	/1/	DR I	There is leakage related to transportation of organic waste by trucks. The number of trucks used for the transportation per day is monitored.		OK
D.4. Monitoring of Baseline Emissions It is established whether the monitoring plan provides for reliable and complete project emission data over time.					
D.4.1. Does the monitoring plan provide for the collection and archiving of all relevant data necessary for determining the baseline emissions during the crediting period?	/1/	DR I	The baseline emissions consist of the methane emissions which are not collected and treated by flaring. The GHG emission reduction by the methane avoidance from the landfill site is estimated by applying an IPCC model. The content (ID:B-1) of the organic waste in MSW is measured for the "ex-ante" estimation of emissions. DNV requests a clarification which data that are applied for the estimation of the baseline GHG emissions from the organic waste for the ex-post calculations.	CL3	

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CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
D.4.2. Is the choice of baseline indicators, in particular for baseline emissions, reasonable?	/1/	DR I	– ditto -		
D.4.3. Will it be possible to monitor the specified baseline indicators?	/1/	DR I	- ditto -		
D.5. Monitoring of Environmental Impacts It is checked that choices of indicators are reasonable and complete to monitor sustainable performance over time.					
D.5.1. Does the monitoring plan provide for the collection and archiving of relevant data on environmental impacts?	/1/	DR	Environmental impact is out of scope of the pre-determination.	-	
D.5.2. Will it be possible to monitor the specified environmental impact indicators?	/1/	DR	- ditto -		
D.6. Project Management Planning It is checked that project implementation is properly prepared for and that critical arrangements are addressed.					
D.6.1. Is the authority and responsibility of project management clearly described?	/1/	DR I	The details in the monitoring plan, including the responsibilities of the Japanese entities involved, need to be completed after the engineering details are decided.	CL4	
D.6.2. Is the authority and responsibility for registration, monitoring, measurement and reporting clearly described?	/1/	DR I	- ditto -		

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CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
D.6.3. Are procedures identified for training of monitoring personnel?	/1/	DR I	- ditto -		
D.6.4. Are procedures identified for emergency preparedness where emergencies can result in unintended emissions?	/1/	DR I	- ditto -		
D.6.5. Are procedures identified for calibration of monitoring equipment?	/1/	DR I	Calibrations of monitoring equipment are explained in D.3 of PDD and the methodology is based on Kazakhstan's standard.s		OK
D.6.6. Are procedures identified for maintenance of monitoring equipment and installations?	/1/	DR	See D.6.1.		
D.6.7. Are procedures identified for monitoring, measurements and reporting?	/1/	DR I	Monitoring, measurements and reporting procedures are roughly described in D.2 of PDD.		OK
D.6.8. Are procedures identified for day-to-day records handling (including what records to keep, storage area of records and how to process performance documentation)?	/1/	DR	See D.6.1.		
D.6.9. Are procedures identified for dealing with possible monitoring data adjustments and uncertainties?	/1/	DR	See D.6.1.		
D.6.10. Are procedures identified for internal audits of GHG project compliance with operational requirements where applicable?	/1/	DR	See D.6.1.		
D.6.11. Are procedures identified for project performance reviews?	/1/	DR	See D.6.1.		

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CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
D.6.12. Are procedures identified for corrective actions?	/1/	DR	See D.6.1.		
E. Calculation of GHG Emissions by Source It is assessed whether all material GHG emission sources are addressed and how sensitivities and data uncertainties have been addressed to arrive at conservative estimates of projected emission reductions.					
E.1. Predicted Project GHG Emissions The validation of predicted project GHG emissions focuses on transparency and completeness of calculations.					
E.1.1. Are all aspects related to direct and indirect GHG emissions captured in the project design?	/1/	DR I	The project emissions will be related to electricity generation and utilization for the project activities. This is subtracted from the electricity generation. DNV requests the clarification with regard to the possibility of methane releases at non-regular operation such as start-up or shut-down of operations.	CL5	
E.1.2. Are the GHG calculations documented in a complete and transparent manner?	/1/	DR I	The GHG calculations are documented in a complete and transparent manner.		OK
E.1.3. Have conservative assumptions been used to calculate project GHG emissions?	/1/	DR	For the calculation of biogas power generation, organic waste and sewage sludge		OK

CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
		I	are estimated by using the data from Astana City. Conservative numbers from a Guideline for design of sewage works by Japan Sewage Works Associationapplied for determination of the methane concentration in the biogas. The CEF applies the generation-weighted average emissions per electricity unit (t-CO_{2e}/MWh) taking into account all generating sources serving the grid of Kazakhstan. The monitoring data fro the biogas power generation and CEF will be applied for the ex-post estimation of methane.		
E.1.4. Are uncertainties in the GHG emissions estimates properly addressed in the documentation?	/1/	DR I	Monitoring data are utilised for project emissions estimation.		OK
E.1.5. Have all relevant greenhouse gases and source categories listed in Kyoto Protocol Annex A been evaluated?	/1/	DR I	CH_4 and CO_2 are evaluated because the project is related to the methane generation and landfill of MSW.		OK

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CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
E.2. Leakage Effect Emissions It is assessed whether there leakage effects, i.e. change of emissions which occurs outside the project boundary and which are measurable and attributable to the project, have been properly assessed.					
E.2.1. Are potential leakage effects beyond the chosen project boundaries properly identified?	/1/	DR I	The project leakage is related to transportation of organic waste by trucks. The number of trucks for the transportation per day is monitored for the estimation of this leakage.		OK
E.3. Baseline Emissions The validation of predicted baseline GHG emissions focuses on transparency and completeness of calculations.					
E.3.1. Have the most relevant and likely operational characteristics and baseline indicators been chosen as reference for baseline emissions?	/1/	DR I	The baseline emissions from the methane emissions, which are not treated by flaring, are determined using an IPCC model.		OK
E.3.2. Are the baseline boundaries clearly defined and do they sufficiently cover sources and sinks for baseline emissions?	/1/	DR	The baseline boundary includes the landfill site and the public grid.		OK
E.3.3. Are the GHG calculations documented in a complete and transparent manner?	/1/	DR I	The GHG emission reduction by the methane avoidance from the landfill site is estimated by applying an IPCC model and		OK

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CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			by referring to AM0012 for CDM projects.		
E.3.4. Have conservative assumptions been used when calculating baseline emissions?	/1/	DR I	The baseline emissions that are not flared from the landfill site are estimated “ex-ante” by using IPCC model. DOCF is estimated by considering the temperature in the landfill. Recovered methane estimated by referring US-EPA handbook /3/, which shows the reasonable recovery efficiency is 75-85% and 85% is applied for the calculation. However, DNV requests a clarification with regard to: 1). Conservativeness of 85% as the recovery efficiency. The handbook of US-EPA /3/ also explained the collection efficiency can vary 50 to over 90% and 85% might not represent a conservative number for Kazakhstan. 2). Application of IPCC FOD model. The FOD model is a kinetic approach and the application of the model might be more conservative than what is suggested.	CL6	
E.3.5. Are uncertainties in the GHG emission estimates properly addressed in the documentation?	/1/	DR I	The baseline emissions from landfill site will be determined *ex-ante* by using the IPCC model.	CL6	

CHECKLIST QUESTION	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			See E.3.4. The uncertainty for estimation of electricity generation is reduced by QA/QC procedures summarized in table D-3.		
E.3.6. Have the project baseline(s) and the project emissions been determined using the same appropriate methodology and conservative assumptions?	/1/	DR	Both estimations basically follow the proposed New Methodology.		OK
E.4. Emission Reductions Validation of baseline GHG emissions will focus on methodology transparency and completeness in emission estimations.					
E.4.1. Will the project result in fewer GHG emissions than the baseline scenario?	/1/	DR I	The project result in GHG emissions than the baseline case is 308 012 tCO_2 equivalent during the year 2008– 2012		OK
F. Environmental Impacts Documentation on the analysis of the environmental impacts will be assessed, and if deemed significant, an EIA should be provided to the validator.			*Out of scope*		

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Table 3 Resolution of Corrective Action and Clarification Requests

Draft report clarifications and corrective action requests	Ref. to checklist question in table 2	Summary of project owner response	Determination conclusion
CAR 1: The project has not yet been formally approved by Kazakhstan and Japan.	Table1,1		
CAR 2: Approval from the Parties are not yet submitted.	Table1,10		
CL 1: DNV Certification requests to verify the investment analysis in order to confirm the investment barrier and the conservative assumptions used for unknown factors.	B.2.2, 2.5, 2.6, 2.7		
CL 2: DNV requests a clarification with regards to how long the data is to be archived.	D.1.5		
CL 3: DNV requests to clarify which data is applied for the estimation of the baseline GHG emissions from the organic waste for ex-post calculations of emissions.	D.4.1- 4.3		
CL 4: The details in the monitoring plan, including the responsibilities for the Japanese entities involved, needs to be completed after the engineering details are decided.	D.6		
CL 5: DNV requests the clarification with regard to the possibility of methane releases at non-regular	E.1.1		

Draft report clarifications and corrective action requests	Ref. to checklist question in table 2	Summary of project owner response	Determination conclusion
operation such as start-up or shut-down of operations.			
CL 6: DNV requests a clarification with regard to: 1). The conservativeness of 85% as the recovery efficiency. The handbook of US-EPA explained that the collection efficiency can vary 50 to over 90%. 2). Application of IPCC FOD model. The FOD model is a kinetic approach and the application of the model might be more conservative than what is suggested.	E.3.4, 3.5		

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