CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>> Landfill Gas Capture and Power Generation Project in Tbilisi Ver001, 06/11/2006

A.2. Description of the project activity:

>> Shimizu Corporation, a general construction and engineering firm based in Tokyo, the capital of Japan, was founded in 1804. Shimizu Corporation's business spans a wide range of activities including construction of buildings and plants, construction of tunnels, dams, bridges and roads, real estate, design and consulting, etc.

Since 1999, Shimizu Corporation, working in cooperation with the Government of Georgia and cities including Tbilisi, etc., has conducted a feasibility study (FS) into a number of CDM (clean development mechanism) projects. One of these, the project in hand, proposes to collect landfill gas (LFG) from landfill sites in Tbilisi, Georgia, and to burn methane, a combustible greenhouse gas (GHG) contained in LFG, in a gas engine generator (GEG) with a view to generating electricity.

In Tbilisi, the municipal government owns four landfill sites, i.e. Gldani 1, Gldani 2, Lilo and Iagulja. Upon taking into account terrain and the condition of solid waste products in the landfills, it was decided to target the two landfill sites of Gldani 2 and Iagulja in the project.
Gldani 2 started full-scale operation at the end of 2002 while Iagulja went into service in 2003, and the two sites are currently in service. It is likely that both sites will reach their full capacity around 2012.
However, the proper processing of LFG is not carried out on these landfill sites. Therefore, LFG from the sites is released into the atmosphere unchecked and current conditions on the sites are detrimental to the local environment. This is because LFG is a source of odor when emitted in low concentrations and is a potential cause of explosion or ignition when emitted in high concentrations. Moreover, since the main constituent of LFG is methane, which has a global warming potential (GWP) of 21, it also has a negative impact on the global environment. Furthermore, there is currently no legislation requiring the collection of LFG from landfill sites in Georgia or Tbilisi City; and even if such legislation did exist, Georgia does not possess the funds to implement it. And, needless to say, it has no intention of establishing such legislation in the future.

Moreover, no LFG collection system has been introduced to a landfill site in Georgia until now. In other words, the LFG collection system and GEG technology described above are totally untried in Georgia. Although these technologies have been frequently applied in Japan and other advanced nations with positive environmental effects in terms of improving landfill site environments (mitigating odor and fire risk caused by methane contained in LFG) and making effective use of energy. Therefore, in order to apply these technologies to Georgia, opportunities to receive proper training and education will need to be provided. Moreover, since these technologies have reached a fairly advanced stage of maturation in recent years, there is little likelihood of them being superseded by a better technology in Georgia during the project period.

In the project, it is planned to commission a flaring system at Gldani 2 from 2008. Moreover, introduction of a 800 kW (0.8 MW) GEG is envisaged at Gldani 2, however, this shall be determined upon first installing the LFG collection equipment, confirming the amount of generated LFG and re-examining the required GEG installation capacity according to that amount. If the amount of LFG is inadequate or fluctuates wildly, it is possible the GEG will not be installed and only flaring shall be carried out.

The project crediting period is 14 years, and the aggregate reduction of emissions at Gldani 2 and Iagulja during this period is estimated as $1.02*10^6$ ton-CO_2 ("ton-CO_2" means "ton-CO_2 equivalent", and so forth.).

In addition to realizing reduced emissions of GHG, in Tbilisi, it is anticipated the project will contribute to sustainable development in the following ways:
- Improvement of landfill site environment (prevention of odor and fires);
- Replacement of existing power generation systems through introduction of state-of-the-art generation technology;
- Improvement in human resources through introduction of new technology;
- Effective utilization of energy; and
- Creation of new employment.

The project also has great potential to stimulate similar CDM undertakings not only in Georgia, but also in other former Soviet states.

A.3. Project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Japan	**Private entity / Shimizu Corporation**	**No**
Japan	**Private entity / The Bank of Tokyo-Mitsubishi UFJ, Ltd.**	**No**
Japan	**Private entity / The Chugoku Electric Power Co., Inc**	**No**
Georgia (host)	**Public entity / Tbilisi City Municipality**	**No**

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

>> Tbilisi City

A.4.1.1. Host Party(ies):

>>Georgia

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

>> N/A

A.4.1.3. City/Town/Community etc:

>>Tbilisi City

Figure 1 shows the location of Georgia and Tbilisi. The Project sites are situated on the outskirts of Tbilisi.

Source: UNEP/GRID-Arendal Maps and Graphics Library（http://maps.grida.no/go/graphic/georgia_topographic_map#metainfo）

Figure 1 Location of Georgia and Tbilisi City

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

>> Gldani 2 landfill site is situated in a valley adjacent to hills approximately 12 km to the north of Tbilisi city center. Gldani 2 went into full-scale service at the end of 2002 and is currently in operation.

The site is surrounded by forest and grasslands, and the nearest houses are around 2 km away. Gldani 1 landfill site is located adjacent to here: this started service in 1972 and was closed in 2002. Iagulja landfill site is located approximately 25 km southeast of the center of Tbilisi. This site went into full-scale service in 2003 and is currently in operation. Both sites are expected to reach full capacity by around 2012.
Figure 2 shows the locations of the landfill sites. Gldani 2 covers an area of approximately 16 ha and Iagulja approximately 10 ha. The maximum depth of waste landfill is currently approximately 15 m at Gldani 2 and approximately 8-9 m at Iagulja.

Figure 2 Map of the Tbilisi Landfill Sites (Red Marks)

The current population of Tbilisi is approximately 1,230,000. The amount of waste carried into Gldani 2 is roughly 145,000 tons per year and the amount carried into Iagulja is approximately 96,000 tons per year. Since the population of Tbilisi is more or less static, the amount of waste carried into the sites is not expected to increase greatly. Currently in Tbilisi, approximately 3,000 m^3 of waste is collected and carried into the landfill sites every day. Roughly 1,800 m^3/day of this is carried into Gldani 2 from the western side of the city including the city center, whereas 1,200 m^3/day is carried into Iagulja.

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

Fugitive gas capture and alternative / renewable energy
Out of 15 Sectoral Scope, this corresponds to 13: Waste handling and disposal and 1: Energy industries (renewable - / non-renewable sources).

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

>>

○**LFG collection system technology**. This is composed of vertical collection holes, gas collection pipes, airtight sheet, gasholders, measuring instruments, and blowers. It is a high-efficiency system in which an LFG collection efficiency of 60% or more can be anticipated.

○ **Biogas small-scale GEG technology**. This is composed of a gas engine capable of realizing stable operation using even a rarefied LFG like methane, generators, control panels, grid connection lines, and measuring instruments. The gas engine has generating efficiency of 30~40%, which is equivalent to or better than existing steam turbines in Georgia. In addition, high-level technology is required for a gas engine that can stably operate on a rare gas fuel such as LFG.

Figure 3 shows a schematic view of the LFG collection system.

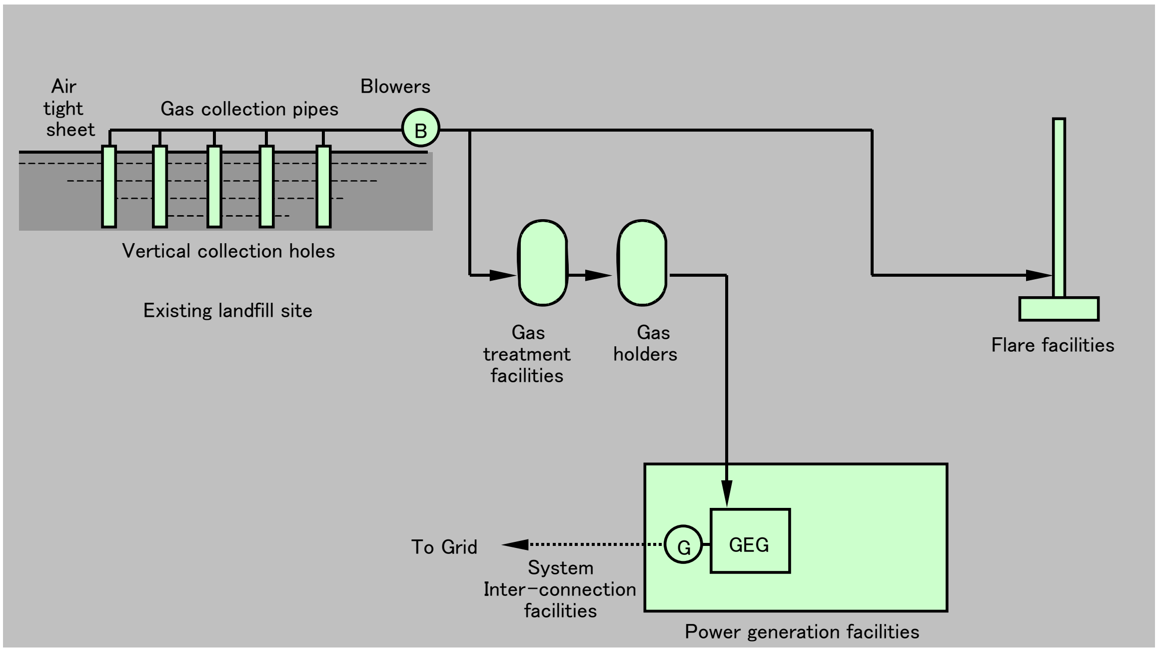

Figure 3 Landfill gas collection system schematic

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

>> The project crediting period is 14 years and the amount of reduction is calculated as follows. Moreover, the following table shows the estimated emission reductions for each site.

<Total>

Years	Annual estimation of emission reductions in tonnes of CO_2e
2008	3.91E+04
2009	3.66E+04
2010	3.43E+04
2011	9.10E+04
2012	8.45E+04
2013	1.07E+05
2014	9.98E+04
2015	9.26E+04
2016	8.60E+04
2017	7.98E+04
2018	7.41E+04
2019	6.88E+04
2020	6.39E+04
2021	5.93E+04
Total estimated reductions (tonnes of CO_2e)	1.02E+06
Total number of crediting years	14
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	7.27E+04

<Gldani2>

Years	Annual estimation of emission reductions in tonnes of CO_2e
2008	3.91E+04
2009	3.66E+04
2010	3.43E+04
2011	5.71E+04
2012	5.30E+04
2013	6.67E+04
2014	6.19E+04
2015	5.75E+04
2016	8.60E+04
2017	4.96E+04
2018	4.60E+04
2019	4.28E+04
2020	3.97E+04
2021	3.69E+04
Total estimated reductions (tonnes of CO_2e)	6.75E+05
Total number of crediting years	14
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	4.82E+04

<Iagluji>

Years	Annual estimation of emission reductions in tonnes of CO_2e
2008	–
2009	–
2010	–
2011	3.39E+04
2012	3.15E+04
2013	4.08E+04
2014	3.79E+04
2015	3.51E+04
2016	3.26E+04
2017	3.02E+04
2018	2.80E+04
2019	2.60E+04
2020	2.41E+04
2021	2.24E+04
Total estimated reductions (tonnes of CO_2e)	3.43E+05
Total number of crediting years	14
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	2.45E+04

A.4.5. Public funding of the project activity:

>> This project is not planned as an ODA undertaking and as such will not receive ODA funding.

SECTION B. Application of a baseline and monitoring methodology

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

>> The following baseline and monitoring methodology shall be applied to the Project:

Revision to the approved consolidated baseline methodology ACM0001/Version4
"Consolidated baseline methodology for landfill gas project activities"
and
Revision to the approved consolidated monitoring methodology ACM0001/Version4
"Consolidated monitoring methodology for landfill gas project activities"

Moreover, the following is referred to as the tool for demonstrating additionality in this consolidated methodology.

Tool for the demonstration and assessment of additionality (version 02)

Moreover, the following methodologies are applied for calculating the amount of reductions obtained as a result of supplying the generated electricity:

INDICATIVE SIMPLIFIED BASELINE AND MONITORING METHODOLOGIES FOR
SELECTED SMALL-SCALE CMD PROJECT ACTIVITY CATEGORIES
TYPE I-RENEWABLE ENERGY PROJECTS-I.D./Version9
'Grid connected renewable electricity generation'

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

>>In the Project, the following large-size methodology is used: Revision to the approved consolidated baseline methodology ACM0001/Version4 "Consolidated baseline methodology for landfill gas project activities.

This methodology (ACM0001) is applicable to landfill gas capture project activities, where the baseline scenario is the partial or total atmospheric release of the gas and the project activities include situations such as:

a) The captured gas is flared; or
b) The captured gas is used to produce energy (e.g. electricity/thermal energy), but no emission reductions are claimed for displacing or avoiding energy from other sources; or

c) The captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reductions are claimed for displacing or avoiding energy generation from other sources. In this case a baseline methodology for electricity and/or thermal energy displaced shall be provided or an approved one used, including the ACM0002 "Consolidated Methodology for Grid-Connected Power Generation from Renewable." If capacity of electricity generated is less than 15MW and/or substituted thermal energy is 54 TJ (15 GWh) or less, small-scale CDM methodology will be applicable.

Meanwhile, conditions in the Project are as follows:

<1> Currently, LFG collection is not carried out on the landfill sites in Tbilisi and all LFG is released into the atmosphere.
<2> The project proposes to collect LFG on the existing landfill sites in Tbilisi and the captured gas is flared.
<3> The captured gas is used to produce energy (electricity), and emission reductions are claimed for displacing energy generation from other sources.

Therefore, since the project falls under applicability of (a) and (c) for the approved consolidated baseline methodology ACM0001 "Consolidated baseline methodology for landfill gas project activities" (hereinafter referred to as the consolidated methodology), this methodology is applied.
Moreover, due to the power generation and grid supply stated under condition (c) of the consolidated methodology, concerning claims for emissions reductions resulting from use of other energy sources, because the generator planned for installation has capacity of 0.8 MW, which is less than 15 MW, the indicative simplified baseline and monitoring methodology for selected small-scale CDM project activity categories (hereinafter referred to as the small-scale CDM methodology) is applied. Specifically speaking, out of the grid connected renewable electricity generation stated in the small-scale CDM methodology, the methodology given in paragraph 9 (b) is set.

B.3. Description of the sources and gases included in the project boundary

>>The generation sources and gases included in the Project boundary are as indicated below.

	Source	Gas	Included?	Justification/ Explanation
Baseline	The atmospheric release of the gas from LFG sites	CH_4	Yes	-
	Generation of power for supply to the power grid that the project is connected to.	CO_2	Yes	-
Project Activity	The atmospheric release of the gas from LFG sites	CH_4	Yes	-
	The combustion of fuel for transport of generated heat	CO_2	No	No transport of heat

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The baseline scenario is set and additionality is demonstrated according to the following methodology:

Tool for the demonstration and assessment of additionality (version 02)

Details concerning determination of the baseline scenario are described in the examination of additionality in section B.5. Accordingly, the following paragraphs give an outline description.

Step 1 Identification of alternatives to the project activity consistent with current laws and regulations）

Here, the following scenarios were examined:

Scenario 1 : Maintain the status quo. This scenario assumes that LFG is emitted into the atmosphere without conducting any management, collection or utilization at all on the landfill sites in Tbilisi and that no GEG is established.

Scenario 2 : LFG recovery project. This scenario assumes that LFG from landfill sites in Tbilisi is recovered and combusted by flaring in the interests of the environment and safety.

Scenario 3 : This project. This scenario assumes that LFG is recovered from landfill sites in Tbilisi and that methane, which is a GHG contained in the landfill gas, is combusted in a GEG with a view to generating electricity.

Step 2 Investment Analysis

As a result of conducting investment analysis, it became clear that Scenario 2 and Scenario 3 are not worth investing in. Accordingly, it was decided that the only plausible baseline is Scenario 1, i.e. maintenance of the status quo.

B.5. 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 (assessment and demonstration of additionality):

>>The state of landfill sites in Georgia and Tbilisi can be described as follows:

○ In Tbilisi, almost all solid waste is carried into the targeted landfill sites. Since there is no legislation prohibiting landfilling and sufficient space is available to conduct disposal, it is thought that landfilling will be continued into the future.

○ The landfill sites in Tbilisi do not possess the means to manage, control or collect LFG due to a lack of funds. Accordingly, the sites themselves have no plans to collect LFG in the future.

○ Neither Georgia nor Tbilisi have any legislation requiring the collection of LFG. As a result, the sites continue to generate methane gas, which has a high global warming potential, and all such gas is discharged into the atmosphere with negative environmental impact. Moreover, since there is no legal obligation to collect methane gas, and no funds are available even if this was required, methane gas will continue to be discharged even if the Project is not implemented.

On the other hand, project implementation will lead to additional reductions in GHG emissions for the following reasons:

Phase A : reduction of methane gas emissions as a result of capture of methane gas (GHG) via LFG collection, and destruction of this methane gas through combustion, i.e. GEG operation and flaring;
Phase B : emissions of CO_2 through combustion of methane gas, i.e. GEG operation and flaring;
Phase C : reduction of CO_2 emissions through GEG operation as a substitute for existing thermal power plant.

Moreover, concerning the above Phase B, since the methane gas generated at the disposal site originates from biomass, these emissions are not taken into account.

Therefore, the amount of emissions reductions is sought as the sum of Phase A and Phase C.

The baseline scenario is set and additionality is demonstrated according to the following methodology:

Tool for the demonstration and assessment of additionality (version 02)

Incidentally, here, the explanation given in the tool for the demonstration and assessment of additionality, this shall not be repeated here.

(a) Step 0: Preliminary screening based on the starting date of the project activity

Since the project is not scheduled to start before December 31, 2005, this step can be skipped.

(b) Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to the project activity
>> The following alternative scenarios are raised here.

Scenario 1 : Maintain the status quo. This scenario assumes that LFG is emitted into the atmosphere without conducting any management, collection or utilization at all on the landfill sites in Tbilisi and that no GEG is established.

Scenario 2 : LFG recovery project. This scenario assumes that LFG from landfill sites in Tbilisi is recovered and combusted by flaring in the interests of the environment and safety.

Scenario 3 : **This project.** This scenario assumes that LFG is recovered from landfill sites in Tbilisi and that methane, which is a GHG contained in the landfill gas, is combusted in a GEG with a view to generating electricity.

Sub-step 1b: Enforcement with applicable laws and regulations
>> Each of the above three scenarios complies with law in Georgia.

(c) Step 2: Investment Analysis

>>Scenario 3, which expresses the CDM project, contains income (for sale of electricity) other than CER. Therefore, Option I (Apply simple cost analysis) cannot be adopted, so it is necessary to select from either Option II (Apply investment comparison analysis) or Option III (Apply benchmark analysis). Here Option III is adopted.

IRR can be calculated either as project IRR or equity IRR. Here, we adopt project IRR, because we have not yet decided source of funding.

First, analysis of Scenario 2 is carried out. Here, CER income is not considered in accordance with the additionality demonstration tool. In Scenario 2, there is investment, but no corresponding returns can be anticipated. Since returns corresponding to the investment cannot be expected, this means that this baseline scenario is unfeasible.

Next, the analysis of Scenario 3 is carried out. Here, CER income is not considered in accordance with the additionality demonstration tool. In Scenario 3, there is investment but the problem concerns whether or not appropriate return (income from sale of electricity) can be expected. Since IRR calculation showed the IRR (both before tax and after tax) to be minus, it is clear that Scenario 3 is not worth investing in. Accordingly, the above analysis shows that Scenario 3 is not the baseline scenario. The preconditions and results of the calculation as well as the results of sensitivity analysis are indicated in Annex 3 (BASELINE INFORMATION).

(d) Step 3: Barrier Analysis

>> Since Step 2 was implemented, Step 3 can be skipped.

(e) Step 4: Common Practice Analysis）

>> There is no evidence to suggest that a similar project has been, is being, or will be implemented in Georgia (excluding the examination as CDM project) (text of the additionality demonstration tool: “in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc.”)

(f) Step 5: Impact of CDM Registration

>> CER economic value is introduced to the investment analysis that was implemented in Scenario 3. When CER = 10 EURO/t-CO_2, the IRR (before tax)is 9.78% and IRR (after tax) is 8.22%. This is a feasible level for investors. See Annex 3 (BASELINE INFORMATION) for the calculation preconditions, calculation results and sensitivity analysis results.

To sum up, the above analysis shows that neither Scenario 2 nor Scenario 3 can be the baseline, and Scenario 1 was determined as the baseline scenario. Because the examination estimates that the project will realize aggregate emission reductions of $1.02*10^6$ ton-CO_2 over 14 years, the project can be said to be additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

>>Based on ACM0001, the following expression is used to calculate the emission reductions.

(1) $ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + EL_y * CEF_{electricit,y} - ET_y * CEF_{thermal,y}$

Here, each item is defined as shown below.

ER_y	GHG emissions reduction (in year y), in tonnes of CO_2 equivalents (tCO_2e) as a result of project implementation
$MD_{project, y}$	The amount of methane that would have been destroyed/combusted during the year, in, tonnes of methane (tCH_4)
$MD_{reg, y}$	The amount of methane that would have been destroyed/combusted during the year in the absence of the project, in, tonnes of methane (tCH_4)
GWP_{CH4}	Global Warming Potential value for methane for the first commitment period is $21tCO_2e/tCH_4$
EL_y	Net quantity of electricity exported during year y, in megawatt hours (MWh). In the estimation of emission reductions, it is assumed that the amount of power consumed by the LFG collection system (blowers, etc.) and GEG auxiliary units, etc. accounts for a uniform ratio of generated electric energy. In the monitoring, the amount of power sold to the grid and the purchased amount of power are directly measured.
$CEF_{electricity, y}$	The CO_2 emissions intensity of the electricity displaced In the Project, this is calculated according to AMS.I.D.
ET_y	Incremental quantity of fossil fuel, defined as difference of fossil fuel used in the baseline and fossil use during project, for energy requirement on site under project activity during the year y, in TJ.
$CEF_{thermal, y}$	CO_2 emissions intensity of the fuel used to generate thermal/mechanical energy, in tCO_2e/TJ

Here, since the project does not include thermal utilization, Equation (1) is modified in the manner shown in (1’).

(1’) $ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + EL_y * CEF_{electricit,y}$

Where each item is defined as follows.

(1a) $EL_y = EL_{EX, LFG} - EL_{IMP}$

$EL_{EX, LFG}$	Net quantity of electricity exported during year y, produced using landfill gas, in megawatt hours (MWh).
EL_{IMP}	Net incremental electricity imported, defined as difference of project imports less any imports of electricity in the baseline, to meet the project requirements, in MWh

(2) $MD_{reg,y} = MD_{project,y} * AF$

Where, AF: adjustment factor

The AF is the ratio, adjustment factor between the amount of LFG that should be collected under the law and the amount of LFG that is collected in the project.

(3) $MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y}$

Where, $MD_{flared,y}$: the quantity of methane destroyed by flaring

$MD_{electricity,y}$: the quantity of methane destroyed by generation of electricity

$MD_{thermal,y}$: the quantity of methane destroyed by generation of thermal

Here, since the project does not include thermal utilization, Equation (3) is modified in the manner shown in (3’).

(3’) $MD_{project,y} = MD_{flared,y} + MD_{electricity,y}$

Here, $MD_{flared,y}$ and $MD_{electricity,y}$ can be calculated using expressions (4) and (5) below.

(4) $MD_{flared,y} = LFG_{flared,y} * w_{CH4,y} * D_{CH4} * FE$

Where, $LFG_{flare,y}$: the quantity of landfill gas flared during the year measured in cubic meters

$w_{CH4,y}$: the average methane fraction of the landfill gas as measured during the year and expressed as a fraction

D_{CH4} : the methane density expressed in tonnes of methane per cubic meter of methane

The flow rate of LFG is corrected to the standard state (standard temperature and pressure＝0℃, 1,013 bar) following measurement of the LFG temperature and pressure.

FE : flare efficiency

Flare efficiency is determined by measuring flaring time (according to the surface temperature of the flare stack) and methane gas concentration of flare exhaust gas.

(5) $MD_{electricity,y} = LFG_{electricity,y} * w_{CH4,y} * D_{CH4}$

Where, $LFG_{electricity,y}$: the quantity of landfill gas fed into electricity generator

Moreover, in this PDD, $MD_{project,y}$ is forecast in advance. Here, the First Order Decay Model (corresponding to EQUATION 3 in the Guideline) from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual CHAPTER 6 WASTE) is used in its advanced forms (EQUATION 4 & EQUATION 5 in the Guidelines). Those equations are indicated below.

(6) $MD_{project,y} = EqC * \sum Q_{y,x} = EqC * \sum (k * R_x * L_0 * e^{-k(y-x)})$

(Note: In the above expression, x is summated).

Where, EqC : landfill gas collection efficiency

(7) $L_1 = L_0 / w_{CH4,y}$

Where:
- x : year in which the solid waste was carried in (y)
- R_x : the amount of solid waste carried in in year x (Mg/y)
  Since the target landfill sites have no exact data on landfill quantities, the amount was estimated based on the generated amount of waste in Tbilisi City, the ratios carried to Gldani 2 and Iagulja sites and and the volume of waste at each site (see Annex 3).
- y : current year (y)
- L_0 : methane generation potential (Nm^3/Mg, where Mg is the amount of solid waste)
- L_1 : LFG generation potential (Nm^3/Mg, where Mg is the amount of solid waste)
- k : methane generation rate (1/y)

B.6.2. Data and parameters that are available at validation:

(Copy this table for each data and parameter)

Data / Parameter:	$CEF_{electricity,y}$
Data unit:	tCO_2e/MWh
Description:	The CO_2 emissions coefficient on the grid to which the Project is connected
Source of data used:	Data provided by the Georgian Ministry of Environmental Protection and Natural Resources (the DNA in the host country)
Value applied:	0.093
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since these data were provided by the host country DNA, the selected data are appropriate.
Any comment:	Data are received from the host country DNA every year at the time of monitoring.

Data / Parameter:	AF - Adjustment factor
Data unit:	-
Description:	The AF is the ratio, adjustment factor between the amount of LFG that should be collected under the law and the amount of LFG that is collected in the project
Source of data used:	-
Value applied:	0.000
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since Georgia has no law requiring the collection of methane gas and no such law is scheduled to be established in future, the selected data are appropriate.
Any comment:	Changes to the law, etc. shall be checked for in monitoring.

Data / Parameter:	$w_{CH4,y}$
Data unit:	%
Description:	Average methane fraction of the landfill gas (volume ratio)
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual CHAPTER 6 WASTE
Value applied:	50.0
Justification of the choice of data or description of measurement methods and procedures actually applied:	Since the value is based on the IPCC Guidelines, the selected data are appropriate.
Any comment:	Measured values at the time of monitoring shall be applied.

Data / Parameter:	FE
Data unit:	-
Description:	Flare efficiency
Source of data used:	Flare equipment specifications as presented by the manufacturer.
Value applied:	0.995
Justification of the choice of data or description of measurement methods and procedures actually applied:	Since the used equipment adopts specifications guaranteed by the manufacturer, the selected data are appropriate.
Any comment:	If the measured value during monitoring exceeds 0.995, adopt 0.995; if it is on or below 0.995, adopt the measured value as it is.

Data / Parameter:	EqC
Data unit:	%
Description:	Landfill gas collection efficiency
Source of data used:	NEDO Overseas Report, Shimizu Corporation, Feasibility Study on The Utilization of Methane(CH_4) Gas and Power Generation of Municipal Wastes in Yerevan Armenia 2002, P2-45、P2-46
Value applied:	60.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since the used equipment adopts specifications guaranteed by the manufacturer and the above value is based on experience, the selected data are appropriate.
Any comment:	The amount of gas taking into account EqC shall be measured in monitoring.

Data / Parameter:	k
Data unit:	1/y
Description:	Methane generation rate
Source of data used:	McBean, Rovers & Farquhar 1995 "Solid Waste Landfill Engineering And Design, Englewood Cliffs, New Jersey : Prentice Hall PTR;" NEDO & Technical Consultants Co., Ltd. Research of Waste Electricity Generation Using Landfill Gas in Samarkand 2000,P 4-9, 4-15; Shimizu Corporation, Feasibility Study on The Utilization of Methane(CH_4) Gas and Power Generation of Municipal Wastes in Yerevan Armenia 2002, P2-41
Value applied:	0.0750
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since the value is set based on the value used in Armenia after taking waste composition and climate in Georgia into account, the selected data are appropriate.
Any comment:	The amount of gas taking into account k shall be measured in monitoring.

Data / Parameter:	L_0
Data unit:	Nm^3/Mg
Description:	Methane generation potential
Source of data used:	Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual CHAPTER 6 WASTE
Value applied:	100
Justification of the choice of data or description of measurement methods and procedures actually applied :	The lower threshold value based on the IPCC Guidelines is adopted. Incidentally, the value obtained based on solid waste in Tbilisi is 121.28, which is on the conservative side.
Any comment:	This shall be measured as methane gas concentration in monitoring.

Data / Parameter:	L1
Data unit:	Nm^3/Mg
Description:	LFG generation potential
Source of data used:	Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual CHAPTER 6 WASTE
Value applied:	200
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since the value obtained from $L0 \div wCH_4, y \times 100$ based on L0 in the IPCC Guidelines is adopted, the selected data are appropriate.
Any comment:	

Data / Parameter:	Rx
Data unit:	t/year
Description:	Amount of waste carried in year x.
Source of data used:	Calculated based on data provided by Tbilisi City and data surveyed on site.
Value applied:	-
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on the amounts of carried solid waste provided by Tbilisi City, the past cumulative amount of carried solid waste was examined using locally surveyed data. The future amount of incoming waste was set assuming the population will remain the same from now on.
Any comment:	-

Data / Parameter:	GWP_{CH4}
Data unit:	-
Description:	Global Warming Potential of methane
Source of data used:	IPCC Second Assessment Report : Climate Change 1995
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since the selected data are based on the IPCC report, they are considered to be appropriate.
Any comment:	The latest information shall be checked for in monitoring.

Data / Parameter:	D_{CH4} （standard state）
Data unit:	tCH_4/Nm^3 CH_4
Description:	Methane density at standard temperature and pressure
Source of data used:	Revision to the approved consolidated monitoring methodology ACM0001 “Consolidated monitoring methodology for landfill gas project activities”
Value applied:	0.0007168
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since the value adopted in the approved consolidated methodology is used, the selected data are considered to be appropriate.
Any comment:	Changes in the approved methodology shall be checked for in monitoring.

B.6.3 Ex-ante calculation of emission reductions:

>>

Step1. Estimate of GHG emissions by sources:

In the project, since the monitoring plan entails directly measuring the amount of emissions reductions in the case where the project is implemented, there will be no measurement of the actual amount of emissions. However, project emissions can be sought through subtracting the amount of methane destroyed in the project from the amount of methane occurring within the project boundary.

The amount of methane occurring within the project boundary can be estimated by means of the First Order Decay Model as shown below.

(8) $M_{landfill,y} = \sum Q_{y,x} = \sum (k * R_x * L_0 * e^{-k(y-x)})$

Project emissions can be sought through subtracting the amount of methane destroyed in the project from the above emissions. Therefore,

(9) $M_{project,y}=M_{landfill,y} - MD_{project,y}=(1\text{-}EqC) * \sum (k * R_x * L_0 * e^{-k(y-x)})$

Accordingly, project emissions can be sought by means of the following expression:

(10) $E_{project,y}= (1\text{-}EqC) * GWP_{CH4} * \sum (k * R_x * L_0 * e^{-k(y-x)})$

The preconditions and results of the calculation are indicated in Annex 3 (BASELINE INFORMATION). It should be noted, however, that these figures are estimate values and not actual emissions.

Step2. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>> In the project, since it is planned to adopt monitoring methodology that measures emission reductions in the case of project implementation, there will be no measurement of baseline emissions. However, concerning trial calculation of the baseline emissions, these can be calculated as follows as the sum of methane emissions at the baseline in Equation (8) and the emissions reductions through power generation and supply to the grid in the project:

(11) $E_{baseline,y} = GWP_{CH4} * (M_{landfill,y} - MD_{reg,y}) + EL_y * CEF_{electricity,y}$

$= GWP_{CH4} * (\sum (k * R_x * L_0 * e^{-k(y-x)}) - MD_{reg,y}) + EL_y * CEF_{electricity,y}$

Step3. Estimated leakage:

>> Based on the applied consolidated methodology, there is no leakage in the Project.

Step4. The sum of Step 1 and Step 3 representing the project activity emissions:

>> This is the same as in Step 1.

The preconditions and results of the calculation are indicated in Annex 3 (BASELINE INFORMATION). It should be noted, however, that these figures are estimate values and not actual emissions.

B.6.4 Summary of the ex-ante estimation of emission reductions:

>> The following table gives a summary of the ex-ante estimation of emission reductions caused by the Project. It should be noted, however, that these figures are estimate values and not actual emissions. Actual emission reductions are directly measured in the monitoring.

<Total>

Year	($ton\text{-}CO_2e$) Estimation of project activity emission (tonnes of CO_2e)	($ton\text{-}CO_2e$) Estimation of baseline emission (tonnes of CO_2e)	($ton\text{-}CO_2e$) Estimation of leakage (tonnes of CO_2e)	($ton\text{-}CO_2e$) Estimation of emission reductions (tonnes of CO_2e)
2008	6.23E+04	1.01E+05	0.00E+00	3.91E+04
2009	8.30E+04	1.20E+05	0.00E+00	3.66E+04
2010	1.02E+05	1.36E+05	0.00E+00	3.43E+04
2011	6.09E+04	1.52E+05	0.00E+00	9.10E+04
2012	8.17E+04	1.66E+05	0.00E+00	8.45E+04
2013	7.20E+04	1.79E+05	0.00E+00	1.07E+05
2014	6.68E+04	1.67E+05	0.00E+00	9.98E+04
2015	6.19E+04	1.55E+05	0.00E+00	9.26E+04
2016	5.74E+04	1.43E+05	0.00E+00	8.60E+04
2017	5.33E+04	1.33E+05	0.00E+00	7.98E+04
2018	4.94E+04	1.23E+05	0.00E+00	7.41E+04
2019	4.58E+04	1.15E+05	0.00E+00	6.88E+04
2020	4.25E+04	1.06E+05	0.00E+00	6.39E+04
2021	3.94E+04	9.87E+04	0.00E+00	5.93E+04
Total (tonnes of CO_2e)	8.78E+05	1.90E+06	0.00E+00	1.02E+06

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Year	(ton-CO_2e) Estimation of project activity emission (tonnes of CO_2e)	(ton-CO_2e) Estimation of baseline emission (tonnes of CO_2e)	(ton-CO_2e) Estimation of leakage (tonnes of CO_2e)	(ton-CO_2e) Estimation of emission reductions (tonnes of CO_2e)
2008	2.64E+04	6.55E+04	0.00E+00	3.91E+04
2009	3.96E+04	7.62E+04	0.00E+00	3.66E+04
2010	5.18E+04	8.61E+04	0.00E+00	3.43E+04
2011	3.80E+04	9.51E+04	0.00E+00	5.71E+04
2012	5.03E+04	1.03E+05	0.00E+00	5.30E+04
2013	4.44E+04	1.11E+05	0.00E+00	6.67E+04
2014	4.12E+04	1.03E+05	0.00E+00	6.19E+04
2015	3.82E+04	9.57E+04	0.00E+00	5.75E+04
2016	3.54E+04	8.88E+04	0.00E+00	5.34E+04
2017	3.29E+04	8.24E+04	0.00E+00	4.96E+04
2018	3.05E+04	7.65E+04	0.00E+00	4.60E+04
2019	2.83E+04	7.10E+04	0.00E+00	4.28E+04
2020	2.62E+04	6.59E+04	0.00E+00	3.97E+04
2021	2.43E+04	6.12E+04	0.00E+00	3.69E+04
Total (tonnes of CO_2e)	5.07E+05	1.18E+06	0.00E+00	6.75E+05

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Year	(ton-CO_2e) Estimation of project activity emission (tonnes of CO_2e)	(ton-CO_2e) Estimation of baseline emission (tonnes of CO_2e)	(ton-CO_2e) Estimation of leakage (tonnes of CO_2e)	(ton-CO_2e) Estimation of emission reductions (tonnes of CO_2e)
2008	3.59E+04	3.59E+04	0.00E+00	0.00E+00
2009	4.34E+04	4.34E+04	0.00E+00	0.00E+00
2010	5.04E+04	5.04E+04	0.00E+00	0.00E+00
2011	2.29E+04	5.68E+04	0.00E+00	3.39E+04
2012	3.13E+04	6.28E+04	0.00E+00	3.15E+04
2013	2.75E+04	6.84E+04	0.00E+00	4.08E+04
2014	2.56E+04	6.34E+04	0.00E+00	3.79E+04
2015	2.37E+04	5.88E+04	0.00E+00	3.51E+04
2016	2.20E+04	5.46E+04	0.00E+00	3.26E+04
2017	2.04E+04	5.06E+04	0.00E+00	3.02E+04
2018	1.89E+04	4.70E+04	0.00E+00	2.80E+04
2019	1.76E+04	4.36E+04	0.00E+00	2.60E+04
2020	1.63E+04	4.04E+04	0.00E+00	2.41E+04
2021	1.51E+04	3.75E+04	0.00E+00	2.24E+04
Total (tonnes of CO_2e)	3.71E+05	7.14E+05	0.00E+00	3.43E+05

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

>> The following table shows the data and parameters in the monitoring. Incidentally, the ID numbers of monitoring items in the consolidated methodology ACM0001 are also given under "Any comment." Because the Project entails no use of boilers or supply of heat using methane gas, monitoring items ID4, ID12 and ID15 out of the consolidated methodology have been omitted.

(Copy this table for each data and parameter)

Data / Parameter:	$LFG_{total,y}$
Data unit:	m^3
Description:	Total amount of landfill gas captured
Source of data to be used:	Flow meter Measured on site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Measured continuously and recorded once a month Data archive: electronic Length of archiving: the crediting period and two years after
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	ID number:1 $LFG_{total}=LFG_{flare} + LFG_{electricity}$: this measures the reliability of the flow meter data.

Data / Parameter:	$LFG_{flared, y}$
Data unit:	m^3
Description:	Amount of landfill gas flared
Source of data to be used:	Flow meter Measured on site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Measured continuously and recorded once a month Data archive: electronic Length of archiving: the crediting period and two years after
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	ID number:2

Data / Parameter:	$LFG_{electricity,y}$
Data unit:	m^3
Description:	Amount of landfill gas combusted in power plant
Source of data to be used:	Flow meter Measured on site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Measured continuously and recorded once a month Data archive: electronic Length of archiving: the crediting period and two years after
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	ID number:3

Data / Parameter:	FE
Data unit:	%
Description:	Flare/combustion efficiency, determined by (1) the flare operating rate FTf s (judged by measuring surface temperature Tf of the flare stack) and (2) the flare destruction efficincy Fwf.
Source of data to be used:	(1) Thermo meter - surface temperature Tf of the flare stack (2) Thermometer - Temperature of air TAIR（K） used in LFG flaring - Temperature of flare exhaust gas TEX（K） (2) Pressure gauge - Pressure of air PAIR（Pa） used in LFG flaring - Pressure of flare exhaust gas PEX（Pa） (2) Methane fraction meter - Methane concentration of flare exhaust gas wEX,CH4,y（%） (2) Oxygen fraction meter - Oxygen concentration of LFG wO2,y（%） - Oxygen concentration of air used in LFG flaring wAIR,O2,y（%） - Oxygen concentration of flare exhaust gas wEX,O2,y（%） - Measured on site /Calculated from measured data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	(1) Measured continuously and recorded once a month (2) Measured yearly, with the first measurement to be made at the time of installation.

	Data archive: electronic Length of archiving: the crediting period and two years after
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	ID number:5

Data / Parameter:	w_{CH4}
Data unit:	%
Description:	Methane fraction in the landfill gas
Source of data to be used:	Methane fraction meter Measured on site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50.0
Description of measurement methods and procedures to be applied:	Measured continuously and recorded once a month
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	Measured by continuous gas quality analyser. ID number:6

Data / Parameter:	T
Data unit:	K
Description:	Temperature of the landfill gas
Source of data to be used:	Thermo meter Measured on site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Measured continuously and recorded once a month
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	ID number:7

Data / Parameter:	P
Data unit:	Pa
Description:	Pressure of the landfill gas
Source of data to be used:	Pressure gauge Measured on site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Measured continuously and recorded once a month
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	Measured to determine the density of methane DCH_4. Using flow meters that automatically measure temperature and pressure. Expressing LFG volumes in normalized cubic meters. ID number:8

Data / Parameter:	$EL_{EX,LFG}$
Data unit:	MWh
Description:	Total amount of electricity exported out of the project boundary.
Source of data to be used:	Watt hour meter Measured on site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2,894MWh(2009) 5,789MWh（2010 ~2021）
Description of measurement methods and procedures to be applied:	Measured continuously and recorded once a month
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	Required to estimate the emission reductions from electricity generation from LFG. ID number:9

Data / Parameter:	EL_{IMP}
Data unit:	MWh
Description:	Total amount of electricity imported to meet project requirement.
Source of data to be used:	Watt hour meter Measured on site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Measured continuously and recorded once a month
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	Required to determine CO_2 emissions from use of electricity or other energy carriers to operate the project activity. ID number:10

Data / Parameter:	$CEF_{electricity}$
Data unit:	tCO_2 /MWh
Description:	CO_2 emissions intensity of the electricity displaced
Source of data to be used:	Data received from the DNA in Georgia
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.093
Description of measurement methods and procedures to be applied:	Data received once a year, on regular basis As specified in AMS.1.D
QA/QC procedures to be applied:	-
Any comment:	If it cannot be obtained from the previous year's data, used the latest available data. ID number:11

Data / Parameter:	Regulatory requirements relating to landfill gas projects
Data unit:	Test
Description:	The information though recorded annually, is used for changes to the adjustment factor (AF) or directly $MD_{reg,y}$ at renewal of the credit period.
Source of data to be used:	Information received from the Government of Georgia
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.000
Description of measurement methods and procedures to be applied:	Information received once a year, on regular basis
QA/QC procedures to be applied:	-
Any comment:	ID number:13

Data / Parameter:	Operation of the energy equipment
Data unit:	Hours
Description:	This is monitored to ensure methane destruction is claimed for methane used in electricity equipment when it is operational.
Source of data to be used:	Watt hour meter Measured on site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Once a year, on regular basis
QA/QC procedures to be applied:	-
Any comment:	From the cumulative amount of electric energy, estimate the operating time of generating equipment and make sure it is consistent with the destroyed amount of methane gas actually measured. ID number:14

B.7.2 Description of the monitoring plan:

>>Figure 4 shows the monitoring plan in the Project.

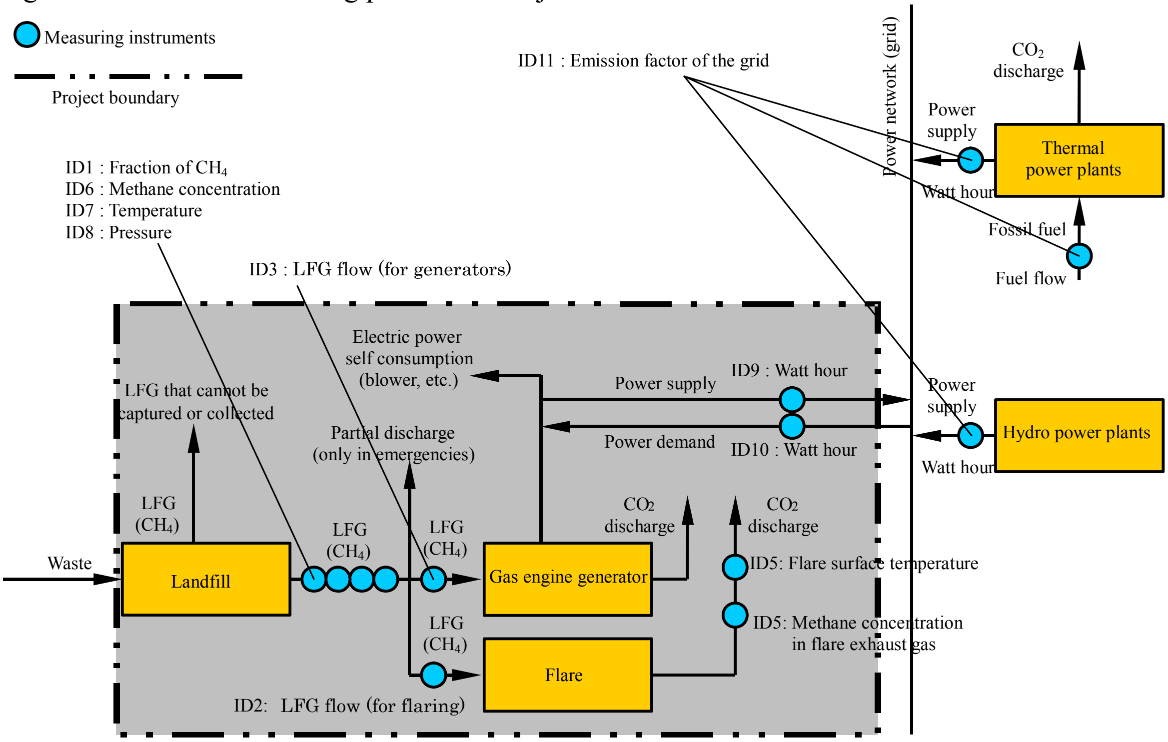

Figure 4 Flow chart of monitoring plan

(Blue circles indicate measuring instruments, ID numbers correspond to the monitoring items in the consolidated methodology ACM0001, and staggered line indicates the project boundaries).

The amount of sold electricity (ID9) measured in this monitoring plan is the amount obtained after subtracting electricity used in the GEG and LFG collection systems (i.e. the amount consumed within the system) from the amount of electric energy generated in the GEG on the network.

The actual operating company for the project will be the company that is designated by Tbilisi Municipal Government. This company will be responsible for all affairs from the project initial investment (ordering of construction works) through to project operation and management (monitoring, facilities operation and maintenance, accounting, CER control, subcontracting, personnel affairs, reporting, etc.). The project participants on the Japan side will contribute to the realization and maintenance of the project through providing initial investment (ordering the construction works) and offering advice on project management.

In the project, quality control and quality assurance shall be carried out by the following methods. Here, "management" refers to the employees of the project operating company. Meanwhile, "operating personnel" refers to said company employees who conduct monitoring, or the employees of contractors that are subcontracted by this company.

○ The project implementing organization will consist of operating personnel and management.
○ Management will prepare written procedures for operating facilities.
○ Written procedures, containing daily work contents, periodic maintenance methods and judgment criteria, etc., will be compiled according to appropriate formats.
○ Management will check reports from operating personnel and determine there are no problems according to the procedures. If problems are found in such checks, management will implement the appropriate countermeasures with appropriate timing.
○Management will everyday file and store reports from operating personnel according to the procedures.
○ In the event of accidents (including the unforeseen release of GHG), management will ascertain the causes, implement and instruct countermeasures to the operating personnel.
○ In cases of emergency (including the unforeseen release of GHG), operating personnel will take stopgap measures and implement countermeasures according to instructions from management.
○ Measuring instruments will be periodically and appropriately calibrated according to the procedures. Calibration timing and methods will be in accordance with "the monitoring plan".
○ Measured data will be disclosed and open to public comment. Received comments and the steps taken in response to them will also be disclosed.
○ Measured data will also be subject to audit by government agencies in the host country.

From the results of the monitoring, the following method is used to calculate emission reductions in the Project.

(1') $ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + EL_y * CEF_{electricity,y}$

Explanation: ER_y is the greenhouse gas emission reduction achieved by the project activity during a given year "y". This formula makes it possible to directly calculate the quantity of emissions reductions in the Project. In Chapter 1, from the amount of methane actually destroyed/combusted during the year ($MD_{project,y}$), the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{reg,y}$) is deducted and then Global Warming Potential value for methane (GWP_{CH4}) is multiplied. This corresponds to Phase A described in Section B. Item 2 is obtaining by subtracting the amount of imported electricity (EL_{IMP} = ID10) required for the project activities from the amount of electricity exported outside of the project boundary ($EL_{EX,LFG}$ = ID9) and multiplying by the grid emission coefficient ($CEF_{electricity,y}$). This corresponds to the Phase C described in Section B. Concerning the grid emission coefficient ($CEF_{electricity,y}$), thr value provided by the DNA in Georgia is used.

(2) $MD_{reg,y} = MD_{project,y} * AF$

Explanation: The amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{reg,y}$)is the product of the amount of methane actually destroyed/combusted during the year ($MD_{project,y}$)and an "Adjustment Factor" (AF = ID11).

(3') $MD_{project,y} = MD_{flared,y} + MD_{electricity,y}$

Explanation: The amount of methane actually destroyed/combusted during the year ($MD_{project,y}$)is the sum of the quantity of methane destroyed by flaring ($MD_{flared,y}$)and the quantity of methane destroyed by generation of electricity ($MD_{electricity,y}$).

(4) $MD_{flared,y} = LFG_{flare,y} * w_{CH4,y} * D_{CH4} * FE$

Explanation: The quantity of methane destroyed by flaring ($MD_{flared,y}$) is the quantity of landfill gas flared during the year measured in cubic meters ($LFG_{flare,y}$ = ID6), the average methane fraction of the landfill gas as measured during the year and expressed as a fraction ($w_{CH4,y}$ = ID4), the methane density expressed in tonnes of methane per cubic meter of methane (D_{CH4}) and the flare efficiency (FE = ID5).

(5) $MD_{electricity,y} = LFG_{electricity,y} * w_{CH4,y} * D_{CH4}$

Explanation: The quantity of methane destroyed by generation of electricity ($MD_{electricity,y}$)is the quantity of landfill gas fed into electricity generator ($LFG_{electricity,y}$ = ID3), the average methane fraction of the landfill gas as measured during the year and expressed as a fraction ($w_{CH4,y}$ = ID6)and the methane density expressed in tonnes of methane per cubic meter of methane (D_{CH4}).

(12) FE = FTf * Fwf

Explanation: Flare efficiency (FE)is calculated from the flare operating rate (FTf)and the destruction efficiency of flaring (Fwf).

(13) FTf $= f$(Tf)

Explanation: The flare operating rate (FTf)is determined by continuously measuring the flare stack surface temperature (Tf) and judging whether or not the flare has gone out. See Annex 4 MONITORING INFORMATION for details.

(14) $Fwf = (P * w_{CH4,y} * LFG_{flared,y} / R / T - P_{EX} * w_{EX,CH4,y} * (LFG_{flared,y} + AIR_{flared,y}) / R / T_{EX}) / (P * w_{CH4,y} * LFG_{flared,y} / R / T)$

Explanation: The destruction efficiency of flaring (Fwf), measured during flare combustion, is calculated from the number of methane moles in flare exhaust gas and number of methane moles in LFG fed to the flare obtained based on the equation of state of the ideal gas (PV = nRT) (gas constant R = 0.082). Moreover, the air used in the flare ($Air_{flared,y}$) is calculated as follows.

Methane gas in the LFG fuses with oxygen in combustion to produce carbon dioxide and water.

(a) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

The number of methane moles reduced by flaring Δmol_{CH4} and the number of oxygen moles used in flaring Δmol_{O2} are calculated as shown below.
Moreover, the methane concentration, oxygen concentration, temperature and pressure of LFG are assumed to be $w_{CH4,y}$, $w_{O2,y}$, T and P; the oxygen concentration, pressure and temperature of air used in flaring are $w_{AIR,O2,y}$, P_{AIR} and T_{AIR}; and the methane concentration, oxygen concentration, temperature and pressure of flare exhaust gas are $w_{EX,CH4,y}$, $w_{EX,O2,y}$, P_{EX} and T_{EX} respectively.

$$\Delta mol_{CH4} = P * w_{CH4,y} * LFG_{flared,y} / R / T - P_{EX} * w_{EX,CH4,y} * (LFG_{flared,y} + AIR_{flared,y}) / R / T_{EX}$$

$$\Delta mol_{O2} = (P * w_{O2,y} * LFG_{flared,y} / R / T + P_{AIR} * w_{AIR,O2,y} * AIR_{flared,y} / R / T_{AIR}) - P_{EX} * w_{EX,O2,y} * (LFG_{flared,y} + AIR_{flared,y}) / R / T_{EX}$$

Here, as a result of formula (a):

$$2 * \Delta mol_{CH4} = \Delta mol_{O2}$$

Therefore,

$$2 * (P * w_{CH4,y} * LFG_{flared,y} / R / T - P_{EX} * w_{EX,CH4,y} * (LFG_{flared,y} + AIR_{flared,y}) / R / T_{EX}) = (P * w_{O2,y} * LFG_{flared,y} / R / T + P_{AIR} * w_{AIR,O2,y} * AIR_{flared,y} / R / T_{AIR}) - P_{EX} * w_{EX,O2,y} * (LFG_{flared,y} + AIR_{flared,y}) / R / T_{EX}$$

By changing the expression to the following,

$$AIR_{flared,y} = LFG_{flared,y} * ((2 * w_{CH4,y} - w_{O2,y}) * P / T - (2 * w_{EX,CH4,y} - w_{EX,O2,y}) * P_{EX} / T_{EX}) / (w_{AIR,O2,y} * P_{AIR} / T_{AIR} + (2 * w_{EX,CH4,y} - w_{EX,O2,y}) * P_{EX} / T_{EX})$$

It is possible to obtain $AIR_{flared,y}$.

Moreover, carbon monoxide may be generated in cases of incomplete combustion, however, according to the system maker, the amount of carbon monoxide produced in system operation here is negligible at 50 mg/m3 (around 0.004%vol% when converted to standard gas). Generation of Nox from N2 contained in the air used in LFG flaring can also be considered, however, the system maker says that this can also be ignored as 150 mg/m3 (around

0.007~0.01vol% when converted to standard gas). Accordingly, oxygen consumption in the combustion of these gases can be ignored here.

(15) $D_{CH4} = 0.0007168 * (P/101.3) * (273.15/T)$

Explanation: The methane density expressed in tonnes of methane per cubic meter of methane (D_{CH4}) is the specific gravity (0.0007168t/Nm^3) (according to the consolidated monitoring method) of methane gas in the standard state (101.3kPa, 0℃ = 273.15K) with correction for actual temperature (T = ID7) and pressure (P = ID8).

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>General Manager : Kurita Hiroyuki, and
Manager : Maruyama Kazuhide
Manager: Yashio Akira
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GHG Project Department
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（English HP）http://www.shimz.co.jp/english/index.html

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:

>> The project start date is 01/01/2008.

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

>> The expected operational lifetime of the project is set at 14 years 0 months.

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:

>> 01/01/2008

C.2.1.2. Length of the first crediting period:

>> 7 years 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>N/A

C.2.2.2. Length:

>>N/A

SECTION D. Environmental impacts

>> Describe in below

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

>>The following paragraphs describe the results of environmental impact analysis.

Since the project intends to collect LFG that is currently released into the atmosphere, it has the following beneficial impacts on the environment and in no way has an adverse impact:

○ Environmental improvement effect via landfill site odor prevention
○ Environmental improvement effect through prevention of landfill site fires
○ Substitution of deteriorated power generation systems

Having said that, concern also exists over the following impacts, so the measures described will need to be taken in order to minimize their impact.

○**Noise and vibration:** Installation of the blowers for LFG collection and the GEG will create noise and vibration. However, since these facilities will be located sufficiently apart from houses around the landfill site, there shouldn't be any problems. Rather, the only problem will be that concerning the working environment (impact on hearing, etc.) for operators on the site. This can be resolved by installing appropriate soundproof covers and vibration-proof frames.

○**Air pollution resulting from GEG exhaust gases:** It is possible that operation of the GEG will lead to pollution of the atmosphere by SOx and NOx contained in the exhaust gases. However, since these facilities will be located sufficiently apart from houses around the landfill site, they shouldn't pose any problems. Having said that, it will be necessary to install appropriate LFG desulfurization equipment and NOx reduction technology (on the generating machinery side) to avert any pollution.

○**Risk of fire from installation of flaring equipment:** Installation of flaring equipment and the artificial collection of methane gas may increase the risk of fires occurring along pipe routes and around the flaring equipment. This can be resolved by measuring and monitoring oxygen concentration inside LFG collection pipes, stopping the system when the oxygen concentration becomes too high, and stabilizing flame by means of burner combustion control of the flare equipment.

D.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:

>>Upon referring to the Georgian Ministry of Environmental Protection and Natural Resources, it was confirmed that because the Project will improve the environment, there is no need to implement environmental impact assessment that is stipulated by the government. However, in cases where discharge of air pollutants in excess of standards prescribed in the Georgian air pollution prevention law is recognized as a result of monitoring, this will be subjected to environmental tax based on Georgian law and it will be necessary to take improvement measures.

SECTION E. Stakeholders' comments

>> Describe in below

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

>> The Ministry of Nature Protection of Republic of Georgia is the DNA (Designated National Authority) that has oversight over approval of CDM projects and adjustments in undertaking CDM projects, and the decision on what parties are stakeholders in this project will be made by this Ministry of Nature Protection. (Three Ministries and two NGO-s are decided as stakeholders)

There are currently no particular rules on the method of collecting comments from stakeholders in the Republic of Georgia. The Ministry of Nature Protection that is the DNA will probably determine an appropriate method in the future.

According to the decision on what parties are stakeholders, Tbilisi City Cleaning Department collected comments from all stakeholders and sent them to the project participants.

At the same time, Tbilisi City Cleaning Department showed the draft of project design document on their web site, and collected comments from public.

E.2. Summary of the comments received:

>> The following is a summary of the comments that have been provided.

MINISTRY OF ECONOMIC DEVELOPMENT OF GEORGIA

Henry Muradiani, Deputy Minister

The Department of Urbanization and Construction of the Ministry of Economic Development of Georgia has considered the Environmental Protection and Economical type FS Project " Landfill Gas Capture and Power Generation Project in Tbilisi "

The main task of Project – to reduce GHG , mostly methane, emissions into atmosphere from solid waste landfill sites of Tbilisi (Gldani, Jagludja, Lilo). The reduction of GHG emissions will support to solve some environmental problems. It is important also, that the Project foresees generation of electricity by burning of methane. By realization of Project, Georgia will receive ecological and environmental benefits.

The submitted FS of the Project is worked out at a high level and will receive a good rating.

MINISTRY OF LABOR, HEALTH AND SOCIAL AFFAIRS OF GEORGIA

Varlam Mosidze, Deputy Minister

We are informing that the Ministry welcomes elaboration of Project " Landfill Gas Capture and Power Generation Project in Tbilisi"

The realization of the Project will considerably contribute to reducing GHG emissions into atmosphere from solid waste landfills of Tbilisi, and will help improvement of urban air quality in the city, that is necessary condition for improvement of indicators of public (social) health.

The Ministry of Labor, Health and Social Affairs of Georgia is ready for farther collaboration.

MINISTRY OF ENERGY OF GEORGIA

Alexander Khetaduri, First Deputy Minister

The Ministry of Energy of Georgia considered Georgian – Japanese CDM Project " Landfill Gas Capture and Power Generation Project in Tbilisi " – Feasibility Study.
In spite, that capacity of power generation units will be very small from energy point of view, Ministry welcomes elaboration and implementation of very important for Tbilisi City environmental protection type project.
At the same time we would like to inform you, that in case of need, Ministry is ready to take party in farther development of the Project.

CENN - CAUCASUS ENVIRONMENTAL NGO NETWORK (NGO)
Nika Malazonia, Project Manager, CENN

We would like to express our thanks for collaboration and sending this draft of Project Design Document for comments.
The idea of Project is very good. Independently from generation of electricity and economic benefit for Georgia, the implementation of Project will make positive impact on the environment as local, as well global.
We have desire: it will be useful to organize a meeting with project responsible parties where we can ask questions, for more detailed acquaintance with the project. (The Meeting may be organized in our Conference Hall)
Our comment is follow: It is known, that generation of electricity on the landfill site is possible if landfill is operating. According to our information the existing landfills of Tbilisi will closed after 3 years (if no plans of their extension), but the Project foresees a longer period of activities.

Energy Efficiency Centre Georgia (NGO)
George Abulashvuli, Director of the Centre

We have acquainted with the Georgian – Japanese CDM Project "Landfill Gas Capture and Power Generation Project in Tbilisi"– Feasibility Study.
We welcome the realization of CDM Project in Georgia. It is important that this Project will be the first precedent for real using of the unique opportunities that gives Kyoto Protocol for developing countries.

Our comments on the presented Project are following:

1. The Project is environmental protection type. But it will be very desirable if there will be economical benefit too for the country. On the page 2 of PDD is considered information about power generation system, but not fully fixed and explained which amount of GHG emissions are sufficient for electricity generation and why?
2. In the chart 7, "Description of the monitoring plan" is mentioned about the Company which will organize by the Tbilisi Municipality. This Company will have quit wide functions .We think that only advices from Japans side not will be enough ; it will be foresee more technical supports for Municipality (capacity building of specialists, technical support act)
3. In the end we would like to say, that by big volume of PDD and actuality of Project we have not enough time for more detailed acquaintance with the Project.

It is desirable if Japans experts in future organize the information meeting for interesting organizations.

*Reference: No comment had been received from the web site.

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

>> According to the comments that have been provided, all stakeholders are positive about this project and it is believed that no particular measures are necessary with respect to the comments that have been received.

To some questions included in the comments, explanation has been provided by project participant.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project Participant 1

Organization:	Shimizu Corporation
Street/P.O.Box:	1-2-3, Shibaura
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City:	Minato-ku
State/Region:	Tokyo
Postfix/ZIP:	105-8007
Country:	Japan
Telephone:	81-3-5441-1111 03-5441-1111
FAX:	- -
E-Mail:	- -
URL:	http://www.shimz.co.jp/english/index.html http://www.shimz.co.jp/
Represented by:	-
Title:	General Manager
Salutation:	Mr.
Last Name:	Kurita
Middle Name:	- -
First Name:	Hiroyuki
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Mobile:	- -
Direct FAX:	+81-3-5441-0469
Direct tel:	+81-3-5441-0137
Personal E-Mail:	kurita@shimz.co.jp

Project Participant 2

Organization:	The Bank of Tokyo-Mitsubishi UFJ, Ltd.
Street/P.O.Box:	1-1-1, Otemachi
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State/Region:	Tokyo
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Country:	Japan
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FAX:	-
E-Mail:	-
URL:	http://www.bk.mufg.jp/english/
Represented by:	-
Title:	Senior Manager
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Middle Name:	
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Project Participant 3

Organization:	The Chugoku Electric Power Co., Inc.
Street/P.O.Box:	4-33 Komachi, Naka-ku
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State/Region:	Hiroshima
Postfix/ZIP:	730-8701
Country:	Japan
Telephone:	+81-82-241-0211
FAX:	- -
E-Mail:	- -
URL:	http://www.energia.co.jp/energiae/index.html http://www.energia.co.jp/
Represented by:	-
Title:	Manager
Salutation:	Mr.
Last Name:	Takeyama
Middle Name:	- -
First Name:	Takayoshi
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Mobile:	- -
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Direct tel:	+81-82-523-6424
Personal E-Mail:	451268@pnet.energia.co.jp

Project Participant 4

Organization:	Tbilisi City Municipality

Street/P.O.Box:	Leonidze street
Building:	Buildimg 2
City:	Tbilisi
State/Region:	-
Postfix/ZIP:	01-05
Country:	Georgia
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FAX:	+995-32-92-04-09
E-Mail:	-
URL:	-
Represented by:	-
Title:	Director of City Cleaning service Department
Salutation:	Mr.
Last Name:	Khizaneishvili
Middle Name:	- -
First Name:	Tariel
Department:	City Cleaning Service Department
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project has obtained no ODA fund from Japanese Government, and is completely irrelevant to Japanese funding obligation.

Annex 3

BASELINE INFORMATION

Table 1 Preconditions and parameters for calculation of IRR and emissions

1. Unit Conversion Values

Symbol	Item	Adopted Value	Unit	Source
-	Electric power ⇔ Horse power	0.7457	kW/HP	Science Almanac
-	Joules ⇔ Calories	4.1868	J/cal	Science Almanac
-	Electric power ⇔ Calories	860	kcal/h/kW	Science Almanac
-	Electric energy ⇔ Joules	3.6×10^{6}	J/kWh	Science Almanac

2. Exchange Rate

Symbol	Item	Adopted Value	Unit	Source
-	Yen ⇔ US$	116.00	Yen/US$	
-	Lari ⇔ US$	1.75	Lari/US$	

3. Parameters Key to Determining the Baseline

Symbol	Item	Adopted Value	Unit	Source
GWP_{CH4}	Methane Global Warming Potential	21.0	-	IPCC Second Assessment Report: Climate Change 1995
$CEF_{electricit,y}$	CO_2 emissions intensity of the electricity displaced	0.093	tCO_2/MWh	Data provided by the Georgian Ministry of Environmental Protection and Natural Resources (DNA)
AF	Adjustment factor	0.000	-	Collection of LFG is not legally required in Georgia.
$w_{CH4,y}$	Average methane fraction of the landfill gas	50.0	%	Revised 1996 IPCC Guidelines for National Green house Gas Inventories : Reference Manual CHAPTER 6 WASTE）
D_{CH4} (standard state)	Methane density at standard temperature and pressure	0.7168	t/Nm^3	Consolidated monitoring methodology for landfill gas project activities）
FTf	Flare operating rate	1.000	-	Assumed value (Because of high performance flare, the possibility of accident fire off is not expected.)
Fwf	Destruction efficiency of flaring	0.995	-	According to flare equipment specifications
FE	Flare efficiency	0.995	-	FTf×Fwf
EqC	Landfill gas collection efficiency	60.0	%	NEDO Overseas Report 811, Shimizu Corporation, Feasibility Study on The Utilization of Methane (CH_4) Gas and Power Generation of Municipal Wastes in Yerevan Armenia 2002, P2-45、P2-46
k	Methane generation rate	0.0750	1/y	McBean, Rovers & Farquhar 1995 "Solid Waste Landfill Engineering And Design, Englewood Cliffs, New Jersey : Prentice Hall PTR," NEDO & Techno Consultants Co., Ltd. Research on Waste Power Generation System Utilizing Landfill Gases in Samarkand 2000, pp. 4-9, 4-15, Shimizu Corporation, Feasibility Study on The Utilization of Methane(CH_4) Gas and Power Generation of Municipal Wastes in Yerevan Armenia 2002, P2-41
L_0	Methane generation potential	100	Nm^3/Mg	Revised 1996 IPCC Guidelines for National Green house Gas Inventories : Reference Manual CHAPTER 6 WASTE）
L_1	LFG generation potential	200	Nm^3/Mg	Calculated value from above （$L_0 \div w_{CH4,y} \times 100$）

4. Constants

Symbol	Item	Adopted Value	Unit	Source
LHV	Methane lower heating value	8,560	kcal/Nm^3	
－	Ditto	35,839	kJ/Nm^3	Calculated value from above

5. Gas Engine Generator Specifications

Symbol	Item	Adopted Value	Unit	Source
－	Equipment capacity	800	kW	Estimated value from the project design
－	Ditto	1,073	HP	Estimated value from the project design
－	NOX emissions	0.002000	t/h per unit	Estimated value from the project design
－	EqE: GEG generating efficiency at LHV	35.0	%	Estimated value from the project design
－	Rated methane gas consumption	230	Nm^3/h	Estimated value from the project design
－	Ditto	2,011,642	Nm^3/y	Estimated value from the project design
－	In-house power consumption rate	10.0	%	Estimated value from the project design

6. Energy Unit Rates

Symbol	Item	Adopted Value	Unit	Basis, etc.
-	Power sales	0.045	Lari/kWh	Determined in discussions with Tbilisi City
-	Ditto	2.543	US$cent/kWh	Calculated value from above
-	Estimated inflation rate	0.0	%/year	Assumed to be the same as the commodity price growth rate

7. Tax

Symbol	Item	Adopted value	Unit	Ground, etc.
Profits tax	For current earnings	25.0	%	Government of Georgia

8. Other Economic Indicators

Symbol	Item	Adopted Value	Unit	Basis, etc.
–	Inflation rate in Georgia (reference value for reflecting in the inflation rate of energy unit prices and running costs)	6.0	%	Japanese Ministry of Foreign Affairs HP (CIS Statistics Committee 2004) http://www.mofa.go.jp/mofaj/area/uzbekistan/data.html, 5.7%. Rounded off to 6.0%.

9. Initial Cost and Running Cost

<Total>

Symbol	Item	Adopted Value	Unit	Basis, etc.
–	Total initial cost (construction cost)	5,199,308	US$	Estimated value from the project design
–	Running cost (operation) + verification cost	72,497	US$/year	Estimated value from the project design
–	Running cost (maintenance)	0.86	US$cent/kWh	General value

Note) Verification cost of 20,000 US$/year is added to the total running cost.

<Gldani2>

Symbol	Item	Adopted Value	Unit	Basis, etc.
–	Total initial cost (construction cost)	3,772,478	US$	Estimated value from the project design
–	Running cost (operation)	27,711	US$/Year	Estimated value from the project design
–	Running cost (maintenance)	0.86	US$cent/kWh	General value

<Iagulja>

Symbol	Item	Adopted Value	Unit	Basis, etc.
–	Total initial cost (construction cost)	1,426,830	US$	Estimated value from the project design
–	Running cost (operation)	24,786	US$/Year	Estimated value from the project design
–	Running cost (maintenance)	-	US$cent/kWh	There is no power generation by gas engines

Commentary

x: the year in which waste was carried in (y), and Rx: the quantity of waste carried in year x (Mg/y)

In this project, there is no accurate past data on the quantity of waste carried in up to 2002. In addition, there is no accurate forecast on the quantity of waste carried in. But it is very important and essential to know the quantity of waste carried in (Rx), in order to estimate the amount of LFG by applying "First Order Decay Model".

However, data concerning past disposal quantities are unreliable in the Project. Therefore, it is necessary to estimate both past and future disposal quantities. The urban improvement department of Tbilisi estimates the average quantity of waste generated in the city every day to be 3,000m^3/day, so the ratios carried into Gldani 2 and Iagulja landfill sites were estimated based on this.

Furthermore, we implemented a sensibility analysis to evaluate the uncertainty of baseline. In other words, we evaluated the change of lifestyle. Because when the lifestyle changes, the amount of waste shall increase obviously. This evaluation was implemented according to increase or decrease in the generation of LFG.

Table 2 Rx Forecast Value

<Total>

Year	Disposed Quantity
x	Rx
-	Tons/year
2003	192,720
2004	192,720
2005	240,900
2006	240,900
2007	240,900
2008	240,900
2009	240,900
2010	240,900
2011	240,900
2012	240,900
2013	0
2014	0
2015	0
2016	0
2017	0
2018	0
2019	0
2020	0
2021	0

Note: Shaded parts indicate actual disposed quantities.

<Gldani2>

Year	Disposed Quantity
x	Rx
-	Tons/year
2003	144,540
2004	144,540
2005	144,540
2006	144,540
2007	144,540
2008	144,540
2009	144,540
2010	144,540
2011	144,540
2012	144,540

2013	0
2014	0
2015	0
2016	0
2017	0
2018	0
2019	0
2020	0
2021	0

Note: Shaded parts indicate actual disposed quantities.

<Iagulja>

Year	Disposed Quantity
x	Rx
-	Tons/year
2003	48,180
2004	48,180
2005	96,360
2006	96,360
2007	96,360
2008	96,360
2009	96,360
2010	96,360
2011	96,360
2012	96,360
2013	0
2014	0
2015	0
2016	0
2017	0
2018	0
2019	0
2020	0
2021	0

Note: Shaded parts indicate actual disposed quantities.

○L_0: Methane generation potential (N m^3/Mg, where Mg is the quantity of waste)

Survey of solid waste composition in Tbilisi was carried out in the past (World Bank), and Table 3 shows the findings of this.

Table 3 Composition of waste

Waste category	Mass portion %	Component code
Food waste	39	C
Paper, cardboard	34	A
Wood	3	D
Ferrous and non-ferrous metal	5	-
Textiles	5	A
Bones	-	B
Glass	3	-
Leather, rubber	1	B
Stones	1	-
Plastic	2	-
Other	7	B
Screening (less than 15 mm)	0	B
Total	100.0	

Note: The types of waste are based on IPCC Guideline classifications.

Referring to Expressions 1 and 3 from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories : Reference Manual CHAPTER 6 WASTE, the following expression can be derived.

$$L_0 = MCF \times DOC \times DOC_F \times F \times 16 \div 12 \div D_{CH4}$$

Where,
- MCF : methane correction factor (default value 1.0 in case of a managed landfill)
- DOC : fraction of degradable organic carbon
- DOC_F : raction DOC dissimilated
- F (=W_{CH}) : ratio of methane gas in landfill gas (default value is 0.5)

Moreover,

$$DOC = 0.4 \times (A) + 0.17 \times (B) + 0.15 \times (C) + 0.30 \times (D)$$

Where,
- (A) : rate of paper and textiles in solid waste (%)
- (B) : rate of waste in garden, park, other perishable waste other than food in solid waste (%)
- (C) : rate of food in solid waste (%)
- (D) : rate of wood and straw in solid waste (%)

By calculating the value following the composition shown in Table 3, the results are;

(A)=39，(B)=8，(C)=39，(D)=3

So,

DOC=0.237

The IPCC recommends that 0.77 be used for DOC_F. However, in recent research, since it is claimed that 0.77 can only be used when the lignin in MSW is removed from the calculation in advance, while it I appropriate to use a value of between 0.5~0.6 in cases where lignin cannot be removed, the following setting was made.

Therefore,

L_0=0.237×0.55×0.5×16÷12÷0.7168×1000=121.28m^3/Mg

In the IPCC Guideline, the general value of L_0 is from 100m^3/Mg to 200m^3/Mg, and the calculation here falls within this scope. Accordingly, in the project, it has been decided to adopt the lower limit value of 100m/Mg for general landfill sites based on the IPCC Guidelines.

○k: methane generation rate (l/y)

k are factors that have a major impact on the generated quantity of LFG, and they are affected by the type of waste and climate (temperature, humidity, rainfall, etc.). It was decided to determine them based on the following literature:

① "McBean, Rovers & Farquhar 1995 (Solid Waste Landfill Engineering And Design, Englewood Cliffs, New Jersey : Prentice Hall PTR)"

② "2002 P4-9, P4-15 Research on Waste Power Generation System Utilizing Landfill Gases in Samarkand, NEDO & Techno Consultants Co., Ltd. "

As a result of carefully considering the type of solid waste and climate in Tbilisi according to the above sources, the following figures were found to be appropriate: k = 0.075

○EqC: LFG collection rate (-)

According to NEDO Overseas Report 811, "It was predicted that the gas extraction efficiency would be 60% or more." Also, according to the 2002 P3-6 NEDO & Shimizu Corporation, Feasibility Study on The Utilization of Methane (CH_4) Gas and Power Generation of Municipal Wastes in Yerevan Armenia, EqC of 60% minimum can be secured. This figure expresses the performance of the LFG collection system (the technology to be introduced) and is set at 60% based on the system specifications and past experience.

○w_{CH4}: Methane concentration in LFG (%)

According to NEDO Overseas Report 811, "The average methane content of landfill gases is 57%." Also, according to the Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual CHAPTER 6 WASTE, the methane concentration 50% is a default value. Here, 50% is adopted to be on the conservative side.

The above paragraphs have summarized the basis for selection of the various parameters (x, Rx, L0, k, EqC, w_{CH4}) pertaining to LFG (methane). In the project, the quantity of CER will be determined by LFG (methane) monitoring. In other words, since the size of these parameters does not determine the quantity of CER derived from LFG (methane) collection, the size of parameters will not harm the transparency or conservativeness of the methodology.

○**Concerning the CO_2 emissions intensity of the electricity displaced ($CEF_{electricity}$)**, the value provided by the DNA of the host country is used. Calculation is carried out according to the method shown in AMS1.D (see ACM0002).

Table 4-1 Emissions Calculation Results (In case with power generation)

<Total>

項目 item	記号 mark	単位 unit	1	2	3	4	5	6	7		1st 7y
年 year	y	year	2008	2009	2010	2011	2012	2013	2014		
潜在的LFG発生量 LFG generation potential	L_1	Nm^3/Mg	200	200	200	200	200	200	200		-
LFG中のメタンガスの含有率 average methane fraction of the landfill gas	wCH4,y	%	50	50	50	50	50	50	50		-
潜在的メタンガス発生量 methane generation potential	L_0	Nm^3/Mg	100	100	100	100	100	100	100		-
メタンガス収集効率 landfill gas collection efficiency	EqC	%	60	60	60	60	60	60	60		-
メタンガス発生率 methane generation rate	k	1/y	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500		-
x年に搬入された廃棄物量 amont of waste disposed in year x	R_x	ton	2.41E+05	2.41E+05	2.41E+05	2.41E+05	2.41E+05	0.00E+00	0.00E+00		1.20E+06
標準状態におけるメタンガスの比重 methane density at standard temperature and pressure	D_{CH4}	g/Nm^3	716.80	716.80	716.80	716.80	716.80	716.80	716.80		-
フレア効率 flare efficiency	FE	%	99.50	99.50	99.50	99.50	99.50	99.50	99.50		-
フレア処理により破壊されるメタンの量 quantity of methane destroyed by flaring	$MD_{flared,y}$	$t\text{-}CH_4$	1.86E+03	1.07E+03	2.86E+02	2.99E+03	2.67E+03	3.77E+03	3.40E+03		1.61E+04
発電により破壊されるメタンの量 quantity of methane destroyed by generation of electricity	$MD_{electricity,y}$	$t\text{-}CH_4$	0.00E+00	6.62E+02	1.32E+03	1.32E+03	1.32E+03	1.32E+03	1.32E+03		7.28E+03
プロジェクトにより破壊・燃焼されるメタンの量 amount of methane actually destroyed/combusted	$MD_{project,y}$	$t\text{-}CH_4$	1.86E+03	1.73E+03	1.61E+03	4.31E+03	4.00E+03	5.09E+03	4.73E+03		2.33E+04
調整係数 adjustment factor	AF	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity	$MD_{reg,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
メタンの地球温暖化係数 global Warming Potential value for methane	GWP_{CH4}	-	21	21	21	21	21	21	21		-
発電により代替された系統の電力量 net quantity of electricity displaced	EG_y	MWh	0.00E+00	2.89E+03	5.79E+03	5.79E+03	5.79E+03	5.79E+03	5.79E+03		3.18E+04
系統の排出係数 CO2 emissions intensity of the electricity displaced	$CEF_{electricit,y}$	tCO_2/MWh	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928		-
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	ER_y	$t\text{-}CO_2$	3.91E+04	3.66E+04	3.43E+04	9.10E+04	8.45E+04	1.07E+05	9.98E+04		4.93E+05

項目 item	記号 mark	単位 unit	8	9	10	11	12	13	14		2nd 7y	Total
年 year	y	year	2015	2016	2017	2018	2019	2020	2021			
潜在的LFG発生量 LFG generation potential	L_1	Nm^3/Mg	200	200	200	200	200	200	200		-	-
LFG中のメタンガスの含有率 average methane fraction of the landfill gas	wCH4,y	%	50	50	50	50	50	50	50		-	-
潜在的メタンガス発生量 methane generation potential	L_0	Nm^3/Mg	100	100	100	100	100	100	100		-	-
メタンガス収集効率 landfill gas collection efficiency	EqC	%	60	60	60	60	60	60	60		-	-
メタンガス発生率 methane generation rate	k	1/y	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500		-	-
x年に搬入された廃棄物量 amont of waste disposed in year x	R_x	ton	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	1.20E+06
標準状態におけるメタンガスの比重 methane density at standard temperature and pressure	D_{CH4}	g/Nm^3	716.80	716.80	716.80	716.80	716.80	716.80	716.80		-	-
フレア効率 flare efficiency	FE	%	99.50	99.50	99.50	99.50	99.50	99.50	99.50		-	-
フレア処理により破壊されるメタンの量 quantity of methane destroyed by flaring	$MD_{flared,y}$	$t\text{-}CH_4$	3.06E+03	2.74E+03	2.45E+03	2.18E+03	1.93E+03	1.69E+03	1.47E+03		1.55E+04	3.16E+04
発電により破壊されるメタンの量 quantity of methane destroyed by generation of electricity	$MD_{electricity,y}$	$t\text{-}CH_4$	1.32E+03	1.32E+03	1.32E+03	1.32E+03	1.32E+03	1.32E+03	1.32E+03		9.26E+03	1.65E+04
プロジェクトにより破壊・燃焼されるメタンの量 amount of methane actually destroyed/combusted	$MD_{project,y}$	$t\text{-}CH_4$	4.38E+03	4.07E+03	3.77E+03	3.50E+03	3.25E+03	3.02E+03	2.80E+03		2.48E+04	4.81E+04
調整係数 adjustment factor	AF	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-	-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity	$MD_{reg,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
メタンの地球温暖化係数 global Warming Potential value for methane	GWP_{CH4}	-	21	21	21	21	21	21	21		-	-
発電により代替された系統の電力量 net quantity of electricity displaced	EG_y	MWh	5.79E+03	5.79E+03	5.79E+03	5.79E+03	5.79E+03	5.79E+03	5.79E+03		4.05E+04	7.24E+04
系統の排出係数 CO2 emissions intensity of the electricity displaced	$CEF_{electricit,y}$	tCO_2/MWh	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928		-	-
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	ER_y	$t\text{-}CO_2$	9.26E+04	8.60E+04	7.98E+04	7.41E+04	6.88E+04	6.39E+04	5.93E+04		5.24E+05	1.02E+06

項目 item	記号 mark	単位 unit	1	2	3	4	5	6	7		1st 7y
年 year	y	year	2008	2009	2010	2011	2012	2013	2014		
発生するメタンの量 methan generated		t-CH_4	4.83E+03	5.68E+03	6.47E+03	7.21E+03	7.89E+03	8.52E+03	7.90E+03		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	1.01E+05	1.19E+05	1.36E+05	1.51E+05	1.66E+05	1.79E+05	1.66E+05		-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity		t-CH_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
グリッド発電所で排出されるCO2の量 CO2 emission at the power plants in the grid		t-CO_2	0.00E+00	2.69E+02	5.37E+02	5.37E+02	5.37E+02	5.37E+02	5.37E+02		-
ベースライン排出量 Baseline emission		**t-CO_2**	**1.01E+05**	**1.20E+05**	**1.36E+05**	**1.52E+05**	**1.66E+05**	**1.79E+05**	**1.67E+05**		**1.02E+06**
回収できるメタンの量 Methane captured		t-CH_4	1.87E+03	1.74E+03	1.61E+03	4.32E+03	4.01E+03	5.11E+03	4.74E+03		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	3.93E+04	3.65E+04	3.38E+04	9.08E+04	8.42E+04	1.07E+05	9.96E+04		-
フレアから排出されるメタンの量 Methane emission from the flare stack		t-CH_4	9.36E+00	5.37E+00	1.44E+00	1.50E+01	1.34E+01	1.89E+01	1.71E+01		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	1.97E+02	1.13E+02	3.02E+01	3.15E+02	2.82E+02	3.98E+02	3.59E+02		-
プロジェクト排出量 Project emission		**t-CO_2**	**6.23E+04**	**8.30E+04**	**1.02E+05**	**6.09E+04**	**8.17E+04**	**7.20E+04**	**6.68E+04**		**5.29E+05**
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	**ER_y**	**t-CO_2**	**3.91E+04**	**3.66E+04**	**3.43E+04**	**9.10E+04**	**8.45E+04**	**1.07E+05**	**9.98E+04**		**4.93E+05**

項目 item	記号 mark	単位 unit	8	9	10	11	12	13	14		2nd 7y	Total
年 year	y	-	2015	2016	2017	2018	2019	2020	2021			
発生するメタンの量 methan generated		t-CH_4	7.33E+03	6.80E+03	6.31E+03	5.86E+03	5.43E+03	5.04E+03	4.68E+03		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	1.54E+05	1.43E+05	1.33E+05	1.23E+05	1.14E+05	1.06E+05	9.82E+04		-	-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity		t-CH_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
グリッド発電所で排出されるCO2の量 CO2 emission at the power plants in the grid		t-CO_2	5.37E+02	5.37E+02	5.37E+02	5.37E+02	5.37E+02	5.37E+02	5.37E+02		-	-
ベースライン排出量 Baseline emission		**t-CO_2**	**1.55E+05**	**1.43E+05**	**1.33E+05**	**1.23E+05**	**1.15E+05**	**1.06E+05**	**9.87E+04**		**8.74E+05**	**1.90E+06**
回収できるメタンの量 Methane captured		t-CH_4	4.40E+03	4.08E+03	3.79E+03	3.51E+03	3.26E+03	3.02E+03	2.81E+03		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	9.24E+04	8.57E+04	7.95E+04	7.38E+04	6.84E+04	6.35E+04	5.89E+04		-	-
フレアから排出されるメタンの量 Methane emission from the flare stack		t-CH_4	1.54E+01	1.38E+01	1.23E+01	1.09E+01	9.68E+00	8.50E+00	7.41E+00		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	3.23E+02	2.90E+02	2.59E+02	2.30E+02	2.03E+02	1.79E+02	1.56E+02		-	-
プロジェクト排出量 Project emission		**t-CO_2**	**6.19E+04**	**5.74E+04**	**5.33E+04**	**4.94E+04**	**4.58E+04**	**4.25E+04**	**3.94E+04**		**3.50E+05**	**8.78E+05**
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	**ER_y**	**t-CO_2**	**9.26E+04**	**8.60E+04**	**7.98E+04**	**7.41E+04**	**6.88E+04**	**6.39E+04**	**5.93E+04**		**5.24E+05**	**1.02E+06**

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項目 item	記号 mark	単位 unit	1	2	3	4	5	6	7		1st 7y
年 year	y	year	2008	2009	2010	2011	2012	2013	2014		
潜在的LFG発生量 LFG generation potential	L_1	Nm^3/Mg	200	200	200	200	200	200	200		-
LFG中のメタンガスの含有率 average methane fraction of the landfill gas	$w_{CH4,y}$	%	50	50	50	50	50	50	50		-
潜在的メタンガス発生量 methane generation potential	L_0	Nm^3/Mg	100	100	100	100	100	100	100		-
メタンガス収集効率 landfill gas collection efficiency	EqC	%	60	60	60	60	60	60	60		-
メタンガス発生率 methane generation rate	k	1/y	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500		-
x年に搬入された廃棄物量 amont of waste disposed in year x	R_x	ton	1.45E+05	1.45E+05	1.45E+05	1.45E+05	1.45E+05	0.00E+00	0.00E+00		7.23E+05
標準状態におけるメタンガスの比重 methane density at standard temperature and pressure	D_{CH4}	g/Nm^3	716.80	716.80	716.80	716.80	716.80	716.80	716.80		-
フレア効率 flare efficiency	FE	%	99.50	99.50	99.50	99.50	99.50	99.50	99.50		-
フレア処理により破壊されるメタンの量 quantity of methane destroyed by flaring	$MD_{flared,y}$	$t\text{-}CH_4$	1.86E+03	1.07E+03	2.86E+02	1.37E+03	1.18E+03	1.83E+03	1.60E+03		9.19E+03
発電により破壊されるメタンの量 quantity of methane destroyed by generation of electricity	$MD_{electricity,y}$	$t\text{-}CH_4$	0.00E+00	6.62E+02	1.32E+03	1.32E+03	1.32E+03	1.32E+03	1.32E+03		7.28E+03
プロジェクトにより破壊・燃焼されるメタンの量 amount of methane actually destroyed/combusted	$MD_{project,y}$	$t\text{-}CH_4$	1.86E+03	1.73E+03	1.61E+03	2.69E+03	2.50E+03	3.15E+03	2.92E+03		1.65E+04
調整係数 adjustment factor	AF	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity	$MD_{reg,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
メタンの地球温暖化係数 global Warming Potential value for methane	GWP_{CH4}	-	21	21	21	21	21	21	21		-
発電により代替された系統の電力量 net quantity of electricity displaced	EG_y	MWh	0.00E+00	2.89E+03	5.79E+03	5.79E+03	5.79E+03	5.79E+03	5.79E+03		3.18E+04
系統の排出係数 CO2 emissions intensity of the electricity displaced	$CEF_{electricit,y}$	tCO_2/MWh	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928		-
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	ER_y	$t\text{-}CO_2$	3.91E+04	3.66E+04	3.43E+04	5.71E+04	5.30E+04	6.67E+04	6.19E+04		3.49E+05

項目 item	記号 mark	単位 unit	8	9	10	11	12	13	14		2nd 7y	Total
年 year	y	year	2015	2016	2017	2018	2019	2020	2021			
潜在的LFG発生量 LFG generation potential	L_1	Nm^3/Mg	200	200	200	200	200	200	200		-	-
LFG中のメタンガスの含有率 average methane fraction of the landfill gas	$w_{CH4,y}$	%	50	50	50	50	50	50	50		-	-
潜在的メタンガス発生量 methane generation potential	L_0	Nm^3/Mg	100	100	100	100	100	100	100		-	-
メタンガス収集効率 landfill gas collection efficiency	EqC	%	60	60	60	60	60	60	60		-	-
メタンガス発生率 methane generation rate	k	1/y	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500		-	-
x年に搬入された廃棄物量 amont of waste disposed in year x	R_x	ton	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	7.23E+05
標準状態におけるメタンガスの比重 methane density at standard temperature and pressure	D_{CH4}	g/Nm^3	716.80	716.80	716.80	716.80	716.80	716.80	716.80		-	-
フレア効率 flare efficiency	FE	%	99.50	99.50	99.50	99.50	99.50	99.50	99.50		-	-
フレア処理により破壊されるメタンの量 quantity of methane destroyed by flaring	$MD_{flared,y}$	$t\text{-}CH_4$	1.39E+03	1.19E+03	1.01E+03	8.43E+02	6.87E+02	5.42E+02	4.08E+02		6.07E+03	1.53E+04
発電により破壊されるメタンの量 quantity of methane destroyed by generation of electricity	$MD_{electricity,y}$	$t\text{-}CH_4$	1.32E+03	1.32E+03	1.32E+03	1.32E+03	1.32E+03	1.32E+03	1.32E+03		9.26E+03	1.65E+04
プロジェクトにより破壊・燃焼されるメタンの量 amount of methane actually destroyed/combusted	$MD_{project,y}$	$t\text{-}CH_4$	2.71E+03	2.52E+03	2.33E+03	2.17E+03	2.01E+03	1.87E+03	1.73E+03		1.53E+04	3.18E+04
調整係数 adjustment factor	AF	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-	-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity	$MD_{reg,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
メタンの地球温暖化係数 global Warming Potential value for methane	GWP_{CH4}	-	21	21	21	21	21	21	21		-	-
発電により代替された系統の電力量 net quantity of electricity displaced	EG_y	MWh	5.79E+03	5.79E+03	5.79E+03	5.79E+03	5.79E+03	5.79E+03	5.79E+03		4.05E+04	7.24E+04
系統の排出係数 CO2 emissions intensity of the electricity displaced	$CEF_{electricit,y}$	tCO_2/MWh	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928		-	-
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	ER_y	$t\text{-}CO_2$	5.75E+04	5.34E+04	4.96E+04	4.60E+04	4.28E+04	3.97E+04	3.69E+04		3.26E+05	6.75E+05

項目 item	記号 mark	単位 unit	1	2	3	4	5	6	7		1st 7y
年 year	y	year	2008	2009	2010	2011	2012	2013	2014		
発生するメタンの量 methan generated		t-CH_4	3.12E+03	3.62E+03	4.08E+03	4.50E+03	4.90E+03	5.26E+03	4.88E+03		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	6.55E+04	7.59E+04	8.56E+04	9.45E+04	1.03E+05	1.11E+05	1.03E+05		-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity		t-CH_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
グリッド発電所で排出されるCO2の量 CO2 emission at the power plants in the grid		t-CO_2	0.00E+00	2.69E+02	5.37E+02	5.37E+02	5.37E+02	5.37E+02	5.37E+02		-
ベースライン排出量 Baseline emission		**t-CO_2**	**6.55E+04**	**7.62E+04**	**8.61E+04**	**9.51E+04**	**1.03E+05**	**1.11E+05**	**1.03E+05**		**6.40E+05**
回収できるメタンの量 Methane captured		t-CH_4	1.87E+03	1.74E+03	1.61E+03	2.70E+03	2.51E+03	3.16E+03	2.93E+03		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	3.93E+04	3.65E+04	3.38E+04	5.67E+04	5.26E+04	6.63E+04	6.15E+04		-
フレアから排出されるメタンの量 Methane emission from the flare stack		t-CH_4	9.36E+00	5.37E+00	1.44E+00	6.89E+00	5.91E+00	9.18E+00	8.03E+00		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	1.97E+02	1.13E+02	3.02E+01	1.45E+02	1.24E+02	1.93E+02	1.69E+02		-
プロジェクト排出量 Project emission		**t-CO_2**	**2.64E+04**	**3.96E+04**	**5.18E+04**	**3.80E+04**	**5.03E+04**	**4.44E+04**	**4.12E+04**		**2.92E+05**
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	**ER_y**	**t-CO_2**	**3.91E+04**	**3.66E+04**	**3.43E+04**	**5.71E+04**	**5.30E+04**	**6.67E+04**	**6.19E+04**		**3.49E+05**

項目 item	記号 mark	単位 unit	8	9	10	11	12	13	14		2nd 7y	Total
年 year	y	-	2015	2016	2017	2018	2019	2020	2021			
発生するメタンの量 methan generated		t-CH_4	4.53E+03	4.20E+03	3.90E+03	3.62E+03	3.36E+03	3.11E+03	2.89E+03		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	9.51E+04	8.83E+04	8.19E+04	7.60E+04	7.05E+04	6.54E+04	6.07E+04		-	-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity		t-CH_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
グリッド発電所で排出されるCO2の量 CO2 emission at the power plants in the grid		t-CO_2	5.37E+02	5.37E+02	5.37E+02	5.37E+02	5.37E+02	5.37E+02	5.37E+02		-	-
ベースライン排出量 Baseline emission		**t-CO_2**	**9.57E+04**	**8.88E+04**	**8.24E+04**	**7.65E+04**	**7.10E+04**	**6.59E+04**	**6.12E+04**		**5.42E+05**	**1.18E+06**
回収できるメタンの量 Methane captured		t-CH_4	2.72E+03	2.52E+03	2.34E+03	2.17E+03	2.01E+03	1.87E+03	1.73E+03		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	5.71E+04	5.30E+04	4.91E+04	4.56E+04	4.23E+04	3.92E+04	3.64E+04		-	-
フレアから排出されるメタンの量 Methane emission from the flare stack		t-CH_4	6.98E+00	5.99E+00	5.08E+00	4.24E+00	3.45E+00	2.73E+00	2.05E+00		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	1.46E+02	1.26E+02	1.07E+02	8.90E+01	7.25E+01	5.72E+01	4.30E+01		-	-
プロジェクト排出量 Project emission		**t-CO_2**	**3.82E+04**	**3.54E+04**	**3.29E+04**	**3.05E+04**	**2.83E+04**	**2.62E+04**	**2.43E+04**		**2.16E+05**	**5.07E+05**
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	**ER_y**	**t-CO_2**	**5.75E+04**	**5.34E+04**	**4.96E+04**	**4.60E+04**	**4.28E+04**	**3.97E+04**	**3.69E+04**		**3.26E+05**	**6.75E+05**

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項目 item	記号 mark	単位 unit	1	2	3	4	5	6	7		1st 7y
年 year	y	year	2008	2009	2010	2011	2012	2013	2014		
潜在的LFG発生量 LFG generation potential	L_1	Nm^3/Mg	200	200	200	200	200	200	200		-
LFG中のメタンガスの含有率 average methane fraction of the landfill gas	$w_{CH4,y}$	%	50	50	50	50	50	50	50		-
潜在的メタンガス発生量 methane generation potential	L_0	Nm^3/Mg	100	100	100	100	100	100	100		-
メタンガス収集効率 landfill gas collection efficiency	EqC	%	60	60	60	60	60	60	60		-
メタンガス発生率 methane generation rate	k	1/y	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500		-
x年に搬入された廃棄物量 amont of waste disposed in year x	R_x	ton	9.64E+04	9.64E+04	9.64E+04	9.64E+04	9.64E+04	0.00E+00	0.00E+00		4.82E+05
標準状態におけるメタンガスの比重 methane density at standard temperature and pressure	D_{CH4}	g/Nm^3	716.80	716.80	716.80	716.80	716.80	716.80	716.80		-
フレア効率 flare efficiency	FE	%	99.50	99.50	99.50	99.50	99.50	99.50	99.50		-
フレア処理により破壊されるメタンの量 quantity of methane destroyed by flaring	$MD_{flared,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	1.62E+03	1.50E+03	1.94E+03	1.80E+03		6.86E+03
発電により破壊されるメタンの量 quantity of methane destroyed by generation of electricity	$MD_{electricity,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
プロジェクトにより破壊・燃焼されるメタンの量 amount of methane actually destroyed/combusted	$MD_{project,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	1.62E+03	1.50E+03	1.94E+03	1.80E+03		6.86E+03
調整係数 adjustment factor	AF	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity	$MD_{reg,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
メタンの地球温暖化係数 global Warming Potential value for methane	GWP_{CH4}	-	21	21	21	21	21	21	21		-
発電により代替された系統の電力量 net quantity of electricity displaced	EG_y	MWh	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
系統の排出係数 CO2 emissions intensity of the electricity displaced	$CEF_{electricit,y}$	tCO_2/MWh	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928		-
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	ER_y	$t\text{-}CO_2$	0.00E+00	0.00E+00	0.00E+00	3.39E+04	3.15E+04	4.08E+04	3.79E+04		1.44E+05

項目 item	記号 mark	単位 unit	8	9	10	11	12	13	14		2nd 7y	Total
年 year	y	year	2015	2016	2017	2018	2019	2020	2021			
潜在的LFG発生量 LFG generation potential	L_1	Nm^3/Mg	200	200	200	200	200	200	200		-	-
LFG中のメタンガスの含有率 average methane fraction of the landfill gas	$w_{CH4,y}$	%	50	50	50	50	50	50	50		-	-
潜在的メタンガス発生量 methane generation potential	L_0	Nm^3/Mg	100	100	100	100	100	100	100		-	-
メタンガス収集効率 landfill gas collection efficiency	EqC	%	60	60	60	60	60	60	60		-	-
メタンガス発生率 methane generation rate	k	1/y	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500		-	-
x年に搬入された廃棄物量 amont of waste disposed in year x	R_x	ton	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	4.82E+05
標準状態におけるメタンガスの比重 methane density at standard temperature and pressure	D_{CH4}	g/Nm^3	716.80	716.80	716.80	716.80	716.80	716.80	716.80		-	-
フレア効率 flare efficiency	FE	%	99.50	99.50	99.50	99.50	99.50	99.50	99.50		-	-
フレア処理により破壊されるメタンの量 quantity of methane destroyed by flaring	$MD_{flared,y}$	$t\text{-}CH_4$	1.67E+03	1.55E+03	1.44E+03	1.34E+03	1.24E+03	1.15E+03	1.07E+03		9.46E+03	1.63E+04
発電により破壊されるメタンの量 quantity of methane destroyed by generation of electricity	$MD_{electricity,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
プロジェクトにより破壊・燃焼されるメタンの量 amount of methane actually destroyed/combusted	$MD_{project,y}$	$t\text{-}CH_4$	1.67E+03	1.55E+03	1.44E+03	1.34E+03	1.24E+03	1.15E+03	1.07E+03		9.46E+03	1.63E+04
調整係数 adjustment factor	AF	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-	-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity	$MD_{reg,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
メタンの地球温暖化係数 global Warming Potential value for methane	GWP_{CH4}	-	21	21	21	21	21	21	21		-	-
発電により代替された系統の電力量 net quantity of electricity displaced	EG_y	MWh	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
系統の排出係数 CO2 emissions intensity of the electricity displaced	$CEF_{electricit,y}$	tCO_2/MWh	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928		-	-
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	ER_y	$t\text{-}CO_2$	3.51E+04	3.26E+04	3.02E+04	2.80E+04	2.60E+04	2.41E+04	2.24E+04		1.99E+05	3.43E+05

項目 item	記号 mark	単位 unit	1	2	3	4	5	6	7		1st 7y
年 year	y	year	2008	2009	2010	2011	2012	2013	2014		
発生するメタンの量 methan generated		t-CH_4	1.71E+03	2.07E+03	2.40E+03	2.71E+03	2.99E+03	3.26E+03	3.02E+03		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	3.59E+04	4.34E+04	5.04E+04	5.68E+04	6.28E+04	6.84E+04	6.34E+04		-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity		t-CH_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
グリッド発電所で排出されるCO2の量 CO2 emission at the power plants in the grid		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
ベースライン排出量 Baseline emission		**t-CO_2**	**3.59E+04**	**4.34E+04**	**5.04E+04**	**5.68E+04**	**6.28E+04**	**6.84E+04**	**6.34E+04**		**3.81E+05**
回収できるメタンの量 Methane captured		t-CH_4	0.00E+00	0.00E+00	0.00E+00	1.62E+03	1.51E+03	1.95E+03	1.81E+03		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	3.41E+04	3.16E+04	4.10E+04	3.81E+04		-
フレアから排出されるメタンの量 Methane emission from the flare stack		t-CH_4	0.00E+00	0.00E+00	0.00E+00	8.12E+00	7.53E+00	9.77E+00	9.06E+00		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	1.70E+02	1.58E+02	2.05E+02	1.90E+02		-
プロジェクト排出量 Project emission		**t-CO_2**	**3.59E+04**	**4.34E+04**	**5.04E+04**	**2.29E+04**	**3.13E+04**	**2.75E+04**	**2.56E+04**		**2.37E+05**
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	**ER_y**	**t-CO_2**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**3.39E+04**	**3.15E+04**	**4.08E+04**	**3.79E+04**		**1.44E+05**

項目 item	記号 mark	単位 unit	8	9	10	11	12	13	14		2nd 7y	Total
年 year	y	-	2015	2016	2017	2018	2019	2020	2021			
発生するメタンの量 methan generated		t-CH_4	2.80E+03	2.60E+03	2.41E+03	2.24E+03	2.08E+03	1.93E+03	1.79E+03		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	5.88E+04	5.46E+04	5.06E+04	4.70E+04	4.36E+04	4.04E+04	3.75E+04		-	-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity		t-CH_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
グリッド発電所で排出されるCO2の量 CO2 emission at the power plants in the grid		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
ベースライン排出量 Baseline emission		**t-CO_2**	**5.88E+04**	**5.46E+04**	**5.06E+04**	**4.70E+04**	**4.36E+04**	**4.04E+04**	**3.75E+04**		**3.33E+05**	**7.14E+05**
回収できるメタンの量 Methane captured		t-CH_4	1.68E+03	1.56E+03	1.45E+03	1.34E+03	1.25E+03	1.16E+03	1.07E+03		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	3.53E+04	3.28E+04	3.04E+04	2.82E+04	2.62E+04	2.43E+04	2.25E+04		-	-
フレアから排出されるメタンの量 Methane emission from the flare stack		t-CH_4	8.41E+00	7.80E+00	7.23E+00	6.71E+00	6.23E+00	5.78E+00	5.36E+00		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	1.77E+02	1.64E+02	1.52E+02	1.41E+02	1.31E+02	1.21E+02	1.13E+02		-	-
プロジェクト排出量 Project emission		**t-CO_2**	**2.37E+04**	**2.20E+04**	**2.04E+04**	**1.89E+04**	**1.76E+04**	**1.63E+04**	**1.51E+04**		**1.34E+05**	**3.71E+05**
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	**ER_y**	**t-CO_2**	**3.51E+04**	**3.26E+04**	**3.02E+04**	**2.80E+04**	**2.60E+04**	**2.41E+04**	**2.24E+04**		**1.99E+05**	**3.43E+05**

Table 4-2 Emissions Calculation Results
(In case the real amount of generated LFG is found to be too small or too unstable, and project participant will give up installing GEG)

Remarks : The calculation result of this Table 4-2 is a revised one of the calculation result of Table 4-1, considering that project participants will give up installing GEG (that is to say "GEG=0kW") in case the real amount of generated LFG is found to be too small or too unstable. But the amount of generated LFG in the Table4-2 is as same as that in Table 4-1, because we can know the real amount of generated LFG only after the fact.

<Total>

項目 item	記号 mark	単位 unit	1	2	3	4	5	6	7		1st 7y
年 year	y	year	2008	2009	2010	2011	2012	2013	2014		
潜在的LFG発生量 LFG generation potential	L_1	Nm^3/Mg	200	200	200	200	200	200	200		-
LFG中のメタンガスの含有率 average methane fraction of the landfill gas	wCH4,y	%	50	50	50	50	50	50	50		-
潜在的メタンガス発生量 methane generation potential	L_0	Nm^3/Mg	100	100	100	100	100	100	100		-
メタンガス収集効率 landfill gas collection efficiency	EqC	%	60	60	60	60	60	60	60		-
メタンガス発生率 methane generation rate	k	1/y	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500		-
x年に搬入された廃棄物量 amont of waste disposed in year x	R_x	ton	2.41E+05	2.41E+05	2.41E+05	2.41E+05	2.41E+05	0.00E+00	0.00E+00		1.20E+06
標準状態におけるメタンガスの比重 methane density at standard temperature and pressure	D_{CH4}	g/Nm^3	716.80	716.80	716.80	716.80	716.80	716.80	716.80		-
フレア効率 flare efficiency	FE	%	99.50	99.50	99.50	99.50	99.50	99.50	99.50		-
フレア処理により破壊されるメタンの量 quantity of methane destroyed by flaring	$MD_{flared,y}$	$t\text{-}CH_4$	1.86E+03	1.73E+03	1.60E+03	4.30E+03	3.99E+03	5.09E+03	4.72E+03		2.33E+04
発電により破壊されるメタンの量 quantity of methane destroyed by generation of electricity	$MD_{electricity,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
プロジェクトにより破壊・燃焼されるメタンの量 amount of methane actually destroyed/combusted	$MD_{project,y}$	$t\text{-}CH_4$	1.86E+03	1.73E+03	1.60E+03	4.30E+03	3.99E+03	5.09E+03	4.72E+03		2.33E+04
調整係数 adjustment factor	AF	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity	$MD_{reg,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
メタンの地球温暖化係数 global Warming Potential value for methane	GWP_{CH4}	-	21	21	21	21	21	21	21		-
発電により代替された系統の電力量 net quantity of electricity displaced	EG_y	MWh	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
系統の排出係数 CO2 emissions intensity of the electricity displaced	$CEF_{electricit,y}$	tCO_2/MWh	0.4540	0.4540	0.4540	0.4540	0.4540	0.4540	0.4540		-
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	ER_y	$t\text{-}CO_2$	3.91E+04	3.63E+04	3.37E+04	9.04E+04	8.38E+04	1.07E+05	9.91E+04		4.89E+05

項目 item	記号 mark	単位 unit	8	9	10	11	12	13	14		2nd 7y	Total
年 year	y	year	2015	2016	2017	2018	2019	2020	2021			
潜在的LFG発生量 LFG generation potential	L_1	Nm^3/Mg	200	200	200	200	200	200	200		-	-
LFG中のメタンガスの含有率 average methane fraction of the landfill gas	$w_{CH4,y}$	%	50	50	50	50	50	50	50		-	-
潜在的メタンガス発生量 methane generation potential	L_0	Nm^3/Mg	100	100	100	100	100	100	100		-	-
メタンガス収集効率 landfill gas collection efficiency	EqC	%	60	60	60	60	60	60	60		-	-
メタンガス発生率 methane generation rate	k	1/y	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500		-	-
x年に搬入された廃棄物量 amont of waste disposed in year x	R_x	ton	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	1.20E+06
標準状態におけるメタンガスの比重 methane density at standard temperature and pressure	D_{CH4}	g/Nm^3	716.80	716.80	716.80	716.80	716.80	716.80	716.80		-	-
フレア効率 flare efficiency	FE	%	99.50	99.50	99.50	99.50	99.50	99.50	99.50		-	-
フレア処理により破壊されるメタンの量 quantity of methane destroyed by flaring	$MD_{flared,y}$	$t\text{-}CH_4$	4.38E+03	4.06E+03	3.77E+03	3.50E+03	3.24E+03	3.01E+03	2.79E+03		2.47E+04	4.80E+04
発電により破壊されるメタンの量 quantity of methane destroyed by generation of electricity	$MD_{electricity,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
プロジェクトにより破壊・燃焼されるメタンの量 amount of methane actually destroyed/combusted	$MD_{project,y}$	$t\text{-}CH_4$	4.38E+03	4.06E+03	3.77E+03	3.50E+03	3.24E+03	3.01E+03	2.79E+03		2.47E+04	4.80E+04
調整係数 adjustment factor	AF	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-	-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity	$MD_{reg,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
メタンの地球温暖化係数 global Warming Potential value for methane	GWP_{CH4}	-	21	21	21	21	21	21	21		-	-
発電により代替された系統の電力量 net quantity of electricity displaced	EG_y	MWh	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
系統の排出係数 CO2 emissions intensity of the electricity displaced	$CEF_{electricit,y}$	tCO_2/MWh	0.4540	0.4540	0.4540	0.4540	0.4540	0.4540	0.4540		-	-
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	ER_y	$t\text{-}CO_2$	9.19E+04	8.53E+04	7.91E+04	7.34E+04	6.81E+04	6.32E+04	5.86E+04		5.20E+05	1.01E+06

項目 item	記号 mark	単位 unit	1	2	3	4	5	6	7		1st 7y
年 year	y	year	2008	2009	2010	2011	2012	2013	2014		
発生するメタンの量 methan generated		t-CH_4	4.83E+03	5.68E+03	6.47E+03	7.21E+03	7.89E+03	8.52E+03	7.90E+03		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	1.01E+05	1.19E+05	1.36E+05	1.51E+05	1.66E+05	1.79E+05	1.66E+05		-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity		t-CH_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
グリッド発電所で排出されるCO2の量 CO2 emission at the power plants in the grid		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
ベースライン排出量 **Baseline emission**		**t-CO_2**	**1.01E+05**	**1.19E+05**	**1.36E+05**	**1.51E+05**	**1.66E+05**	**1.79E+05**	**1.66E+05**		**1.02E+06**
回収できるメタンの量 Methane captured		t-CH_4	1.87E+03	1.74E+03	1.61E+03	4.32E+03	4.01E+03	5.11E+03	4.74E+03		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	3.93E+04	3.65E+04	3.38E+04	9.08E+04	8.42E+04	1.07E+05	9.96E+04		-
フレアから排出されるメタンの量 Methane emission from the flare stack		t-CH_4	9.36E+00	8.68E+00	8.06E+00	2.16E+01	2.01E+01	2.56E+01	2.37E+01		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	1.97E+02	1.82E+02	1.69E+02	4.54E+02	4.21E+02	5.37E+02	4.98E+02		-
プロジェクト排出量 **Project emission**		**t-CO_2**	**6.23E+04**	**8.30E+04**	**1.02E+05**	**6.10E+04**	**8.18E+04**	**7.21E+04**	**6.69E+04**		**5.29E+05**
プロジェクトによる排出削減量 **greenhouse gas emission reduction achieved by the project activity**	**ER_y**	**t-CO_2**	**3.91E+04**	**3.63E+04**	**3.37E+04**	**9.04E+04**	**8.38E+04**	**1.07E+05**	**9.91E+04**		**4.89E+05**

項目 item	記号 mark	単位 unit	8	9	10	11	12	13	14		2nd 7y	Total
年 year	y	-	2015	2016	2017	2018	2019	2020	2021			
発生するメタンの量 methan generated		t-CH_4	7.33E+03	6.80E+03	6.31E+03	5.86E+03	5.43E+03	5.04E+03	4.68E+03		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	1.54E+05	1.43E+05	1.33E+05	1.23E+05	1.14E+05	1.06E+05	9.82E+04		-	-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity		t-CH_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
グリッド発電所で排出されるCO2の量 CO2 emission at the power plants in the grid		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
ベースライン排出量 **Baseline emission**		**t-CO_2**	**1.54E+05**	**1.43E+05**	**1.33E+05**	**1.23E+05**	**1.14E+05**	**1.06E+05**	**9.82E+04**		**8.70E+05**	**1.89E+06**
回収できるメタンの量 Methane captured		t-CH_4	4.40E+03	4.08E+03	3.79E+03	3.51E+03	3.26E+03	3.02E+03	2.81E+03		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	9.24E+04	8.57E+04	7.95E+04	7.38E+04	6.84E+04	6.35E+04	5.89E+04		-	-
フレアから排出されるメタンの量 Methane emission from the flare stack		t-CH_4	2.20E+01	2.04E+01	1.89E+01	1.76E+01	1.63E+01	1.51E+01	1.40E+01		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	4.62E+02	4.29E+02	3.98E+02	3.69E+02	3.42E+02	3.18E+02	2.95E+02		-	-
プロジェクト排出量 **Project emission**		**t-CO_2**	**6.21E+04**	**5.76E+04**	**5.34E+04**	**4.96E+04**	**4.60E+04**	**4.27E+04**	**3.96E+04**		**3.51E+05**	**8.80E+05**
プロジェクトによる排出削減量 **greenhouse gas emission reduction achieved by the project activity**	**ER_y**	**t-CO_2**	**9.19E+04**	**8.53E+04**	**7.91E+04**	**7.34E+04**	**6.81E+04**	**6.32E+04**	**5.86E+04**		**5.20E+05**	**1.01E+06**

<Gldani2>

項目 item	記号 mark	単位 unit	1	2	3	4	5	6	7		1st 7y
年 year	y	year	2008	2009	2010	2011	2012	2013	2014		
潜在的LFG発生量 LFG generation potential	L_1	Nm^3/Mg	200	200	200	200	200	200	200		-
LFG中のメタンガスの含有率 average methane fraction of the landfill gas	$w_{CH4,y}$	%	50	50	50	50	50	50	50		-
潜在的メタンガス発生量 methane generation potential	L_0	Nm^3/Mg	100	100	100	100	100	100	100		-
メタンガス収集効率 landfill gas collection efficiency	EqC	%	60	60	60	60	60	60	60		-
メタンガス発生率 methane generation rate	k	1/y	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500		-
x年に搬入された廃棄物量 amont of waste disposed in year x	R_x	ton	1.45E+05	1.45E+05	1.45E+05	1.45E+05	1.45E+05	0.00E+00	0.00E+00		7.23E+05
標準状態におけるメタンガスの比重 methane density at standard temperature and pressure	D_{CH4}	g/Nm^3	716.80	716.80	716.80	716.80	716.80	716.80	716.80		-
フレア効率 flare efficiency	FE	%	99.50	99.50	99.50	99.50	99.50	99.50	99.50		-
フレア処理により破壊されるメタンの量 quantity of methane destroyed by flaring	$MD_{flared,y}$	$t\text{-}CH_4$	1.86E+03	1.73E+03	1.60E+03	2.69E+03	2.49E+03	3.14E+03	2.92E+03		1.64E+04
発電により破壊されるメタンの量 quantity of methane destroyed by generation of electricity	$MD_{electricity,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
プロジェクトにより破壊・燃焼されるメタンの量 amount of methane actually destroyed/combusted	$MD_{project,y}$	$t\text{-}CH_4$	1.86E+03	1.73E+03	1.60E+03	2.69E+03	2.49E+03	3.14E+03	2.92E+03		1.64E+04
調整係数 adjustment factor	AF	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity	$MD_{reg,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
メタンの地球温暖化係数 global Warming Potential value for methane	GWP_{CH4}	-	21	21	21	21	21	21	21		-
発電により代替された系統の電力量 net quantity of electricity displaced	EG_y	MWh	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
系統の排出係数 CO2 emissions intensity of the electricity displaced	$CEF_{electricit,y}$	tCO_2/MWh	0.4540	0.4540	0.4540	0.4540	0.4540	0.4540	0.4540		-
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	ER_y	$t\text{-}CO_2$	3.91E+04	3.63E+04	3.37E+04	5.64E+04	5.24E+04	6.60E+04	6.12E+04		3.45E+05

項目 item	記号 mark	単位 unit	8	9	10	11	12	13	14		2nd 7y	Total
年 year	y	year	2015	2016	2017	2018	2019	2020	2021			
潜在的LFG発生量 LFG generation potential	L_1	Nm^3/Mg	200	200	200	200	200	200	200		-	-
LFG中のメタンガスの含有率 average methane fraction of the landfill gas	$w_{CH4,y}$	%	50	50	50	50	50	50	50		-	-
潜在的メタンガス発生量 methane generation potential	L_0	Nm^3/Mg	100	100	100	100	100	100	100		-	-
メタンガス収集効率 landfill gas collection efficiency	EqC	%	60	60	60	60	60	60	60		-	-
メタンガス発生率 methane generation rate	k	1/y	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500		-	-
x年に搬入された廃棄物量 amont of waste disposed in year x	R_x	ton	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	7.23E+05
標準状態におけるメタンガスの比重 methane density at standard temperature and pressure	D_{CH4}	g/Nm^3	716.80	716.80	716.80	716.80	716.80	716.80	716.80		-	-
フレア効率 flare efficiency	FE	%	99.50	99.50	99.50	99.50	99.50	99.50	99.50		-	-
フレア処理により破壊されるメタンの量 quantity of methane destroyed by flaring	$MD_{flared,y}$	$t\text{-}CH_4$	2.70E+03	2.51E+03	2.33E+03	2.16E+03	2.00E+03	1.86E+03	1.72E+03		1.53E+04	3.17E+04
発電により破壊されるメタンの量 quantity of methane destroyed by generation of electricity	$MD_{electricity,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
プロジェクトにより破壊・燃焼されるメタンの量 amount of methane actually destroyed/combusted	$MD_{project,y}$	$t\text{-}CH_4$	2.70E+03	2.51E+03	2.33E+03	2.16E+03	2.00E+03	1.86E+03	1.72E+03		1.53E+04	3.17E+04
調整係数 adjustment factor	AF	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-	-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity	$MD_{reg,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
メタンの地球温暖化係数 global Warming Potential value for methane	GWP_{CH4}	-	21	21	21	21	21	21	21		-	-
発電により代替された系統の電力量 net quantity of electricity displaced	EG_y	MWh	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
系統の排出係数 CO2 emissions intensity of the electricity displaced	$CEF_{electricit,y}$	tCO_2/MWh	0.4540	0.4540	0.4540	0.4540	0.4540	0.4540	0.4540		-	-
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	ER_y	$t\text{-}CO_2$	5.68E+04	5.27E+04	4.89E+04	4.54E+04	4.21E+04	3.90E+04	3.62E+04		3.21E+05	6.66E+05

項目 item	記号 mark	単位 unit	1	2	3	4	5	6	7		1st 7y
年 year	y	year	2008	2009	2010	2011	2012	2013	2014		
発生するメタンの量 methan generated		t-CH_4	3.12E+03	3.62E+03	4.08E+03	4.50E+03	4.90E+03	5.26E+03	4.88E+03		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	6.55E+04	7.59E+04	8.56E+04	9.45E+04	1.03E+05	1.11E+05	1.03E+05		-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity		t-CH_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
グリッド発電所で排出されるCO2の量 CO2 emission at the power plants in the grid		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
ベースライン排出量 Baseline emission		**t-CO_2**	**6.55E+04**	**7.59E+04**	**8.56E+04**	**9.45E+04**	**1.03E+05**	**1.11E+05**	**1.03E+05**		**6.37E+05**
回収できるメタンの量 Methane captured		t-CH_4	1.87E+03	1.74E+03	1.61E+03	2.70E+03	2.51E+03	3.16E+03	2.93E+03		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	3.93E+04	3.65E+04	3.38E+04	5.67E+04	5.26E+04	6.63E+04	6.15E+04		-
フレアから排出されるメタンの量 Methane emission from the flare stack		t-CH_4	9.36E+00	8.68E+00	8.06E+00	1.35E+01	1.25E+01	1.58E+01	1.47E+01		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	1.97E+02	1.82E+02	1.69E+02	2.84E+02	2.63E+02	3.32E+02	3.08E+02		-
プロジェクト排出量 Project emission		**t-CO_2**	**2.64E+04**	**3.96E+04**	**5.19E+04**	**3.81E+04**	**5.05E+04**	**4.46E+04**	**4.13E+04**		**2.92E+05**
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	**ER_y**	**t-CO_2**	**3.91E+04**	**3.63E+04**	**3.37E+04**	**5.64E+04**	**5.24E+04**	**6.60E+04**	**6.12E+04**		**3.45E+05**

項目 item	記号 mark	単位 unit	8	9	10	11	12	13	14		2nd 7y	Total
年 year	y	-	2015	2016	2017	2018	2019	2020	2021			
発生するメタンの量 methan generated		t-CH_4	4.53E+03	4.20E+03	3.90E+03	3.62E+03	3.36E+03	3.11E+03	2.89E+03		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	9.51E+04	8.83E+04	8.19E+04	7.60E+04	7.05E+04	6.54E+04	6.07E+04		-	-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity		t-CH_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
グリッド発電所で排出されるCO2の量 CO2 emission at the power plants in the grid		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
ベースライン排出量 Baseline emission		**t-CO_2**	**9.51E+04**	**8.83E+04**	**8.19E+04**	**7.60E+04**	**7.05E+04**	**6.54E+04**	**6.07E+04**		**5.38E+05**	**1.18E+06**
回収できるメタンの量 Methane captured		t-CH_4	2.72E+03	2.52E+03	2.34E+03	2.17E+03	2.01E+03	1.87E+03	1.73E+03		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	5.71E+04	5.30E+04	4.91E+04	4.56E+04	4.23E+04	3.92E+04	3.64E+04		-	-
フレアから排出されるメタンの量 Methane emission from the flare stack		t-CH_4	1.36E+01	1.26E+01	1.17E+01	1.09E+01	1.01E+01	9.34E+00	8.67E+00		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	2.85E+02	2.65E+02	2.46E+02	2.28E+02	2.11E+02	1.96E+02	1.82E+02		-	-
プロジェクト排出量 Project emission		**t-CO_2**	**3.83E+04**	**3.56E+04**	**3.30E+04**	**3.06E+04**	**2.84E+04**	**2.64E+04**	**2.44E+04**		**2.17E+05**	**5.09E+05**
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	**ER_y**	**t-CO_2**	**5.68E+04**	**5.27E+04**	**4.89E+04**	**4.54E+04**	**4.21E+04**	**3.90E+04**	**3.62E+04**		**3.21E+05**	**6.66E+05**

<Iagulja>（Since there is no plan to conduct power generation, contents are the same as Table 4-1）.

項目 item	記号 mark	単位 unit	1	2	3	4	5	6	7		1st 7y
年 year	y	year	2008	2009	2010	2011	2012	2013	2014		
潜在的LFG発生量 LFG generation potential	L_1	Nm^3/Mg	200	200	200	200	200	200	200		-
LFG中のメタンガスの含有率 average methane fraction of the landfill gas	wCH4,y	%	50	50	50	50	50	50	50		-
潜在的メタンガス発生量 methane generation potential	L_0	Nm^3/Mg	100	100	100	100	100	100	100		-
メタンガス収集効率 landfill gas collection efficiency	EqC	%	60	60	60	60	60	60	60		-
メタンガス発生率 methane generation rate	k	1/y	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500		-
x年に搬入された廃棄物量 amont of waste disposed in year x	R_x	ton	9.64E+04	9.64E+04	9.64E+04	9.64E+04	9.64E+04	0.00E+00	0.00E+00		4.82E+05
標準状態におけるメタンガスの比重 methane density at standard temperature and pressure	D_{CH4}	g/Nm^3	716.80	716.80	716.80	716.80	716.80	716.80	716.80		-
フレア効率 flare efficiency	FE	%	99.50	99.50	99.50	99.50	99.50	99.50	99.50		-
フレア処理により破壊されるメタンの量 quantity of methane destroyed by flaring	$MD_{flared,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	1.62E+03	1.50E+03	1.94E+03	1.80E+03		6.86E+03
発電により破壊されるメタンの量 quantity of methane destroyed by generation of electricity	$MD_{electricity,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
プロジェクトにより破壊・燃焼されるメタンの量 amount of methane actually destroyed/combusted	$MD_{project,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	1.62E+03	1.50E+03	1.94E+03	1.80E+03		6.86E+03
調整係数 adjustment factor	AF	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity	$MD_{reg,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
メタンの地球温暖化係数 global Warming Potential value for methane	GWP_{CH4}	-	21	21	21	21	21	21	21		-
発電により代替された系統の電力量 net quantity of electricity displaced	EG_y	MWh	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
系統の排出係数 CO2 emissions intensity of the electricity displaced	$CEF_{electricit,y}$	tCO_2/MWh	0.4540	0.4540	0.4540	0.4540	0.4540	0.4540	0.4540		-
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	ER_y	$t\text{-}CO_2$	0.00E+00	0.00E+00	0.00E+00	3.39E+04	3.15E+04	4.08E+04	3.79E+04		1.44E+05

項目 item	記号 mark	単位 unit	8	9	10	11	12	13	14		2nd 7y	Total
年 year	y	year	2015	2016	2017	2018	2019	2020	2021			
潜在的LFG発生量 LFG generation potential	L_1	Nm^3/Mg	200	200	200	200	200	200	200		-	-
LFG中のメタンガスの含有率 average methane fraction of the landfill gas	wCH4,y	%	50	50	50	50	50	50	50		-	-
潜在的メタンガス発生量 methane generation potential	L_0	Nm^3/Mg	100	100	100	100	100	100	100		-	-
メタンガス収集効率 landfill gas collection efficiency	EqC	%	60	60	60	60	60	60	60		-	-
メタンガス発生率 methane generation rate	k	1/y	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500	0.07500		-	-
x年に搬入された廃棄物量 amont of waste disposed in year x	R_x	ton	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	4.82E+05
標準状態におけるメタンガスの比重 methane density at standard temperature and pressure	D_{CH4}	g/Nm^3	716.80	716.80	716.80	716.80	716.80	716.80	716.80		-	-
フレア効率 flare efficiency	FE	%	99.50	99.50	99.50	99.50	99.50	99.50	99.50		-	-
フレア処理により破壊されるメタンの量 quantity of methane destroyed by flaring	$MD_{flared,y}$	$t\text{-}CH_4$	1.67E+03	1.55E+03	1.44E+03	1.34E+03	1.24E+03	1.15E+03	1.07E+03		9.46E+03	1.63E+04
発電により破壊されるメタンの量 quantity of methane destroyed by generation of electricity	$MD_{electricity,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
プロジェクトにより破壊・燃焼されるメタンの量 amount of methane actually destroyed/combusted	$MD_{project,y}$	$t\text{-}CH_4$	1.67E+03	1.55E+03	1.44E+03	1.34E+03	1.24E+03	1.15E+03	1.07E+03		9.46E+03	1.63E+04
調整係数 adjustment factor	AF	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-	-
プロジェクトがなかった場合に破壊・燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity	$MD_{reg,y}$	$t\text{-}CH_4$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
メタンの地球温暖化係数 global Warming Potential value for methane	GWP_{CH4}	-	21	21	21	21	21	21	21		-	-
発電により代替された系統の電力量 net quantity of electricity displaced	EG_y	MWh	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	0.00E+00
系統の排出係数 CO2 emissions intensity of the electricity displaced	$CEF_{electricit,y}$	tCO_2/MWh	0.4540	0.4540	0.4540	0.4540	0.4540	0.4540	0.4540		-	-
プロジェクトによる排出削減量 greenhouse gas emission reduction achieved by the project activity	ER_y	$t\text{-}CO_2$	3.51E+04	3.26E+04	3.02E+04	2.80E+04	2.60E+04	2.41E+04	2.24E+04		1.99E+05	3.43E+05

項目 item	記号 mark	単位 unit	1	2	3	4	5	6	7		1st 7y
年 year	y	year	2008	2009	2010	2011	2012	2013	2014		
発生するメタンの量 methan generated		t-CH_4	1.71E+03	2.07E+03	2.40E+03	2.71E+03	2.99E+03	3.26E+03	3.02E+03		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	3.59E+04	4.34E+04	5.04E+04	5.68E+04	6.28E+04	6.84E+04	6.34E+04		-
プロジェクトがなかった場合に破壊･燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity		t-CH_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
グリッド発電所で排出されるCO2の量 CO2 emission at the power plants in the grid		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-
ベースライン排出量 **Baseline emission**		**t-CO_2**	**3.59E+04**	**4.34E+04**	**5.04E+04**	**5.68E+04**	**6.28E+04**	**6.84E+04**	**6.34E+04**		**3.81E+05**
回収できるメタンの量 Methane captured		t-CH_4	0.00E+00	0.00E+00	0.00E+00	1.62E+03	1.51E+03	1.95E+03	1.81E+03		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	3.41E+04	3.16E+04	4.10E+04	3.81E+04		-
フレアから排出されるメタンの量 Methane emission from the flare stack		t-CH_4	0.00E+00	0.00E+00	0.00E+00	8.12E+00	7.53E+00	9.77E+00	9.06E+00		-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	1.70E+02	1.58E+02	2.05E+02	1.90E+02		-
プロジェクト排出量 **Project emission**		**t-CO_2**	**3.59E+04**	**4.34E+04**	**5.04E+04**	**2.29E+04**	**3.13E+04**	**2.75E+04**	**2.56E+04**		**2.37E+05**
プロジェクトによる排出削減量 **greenhouse gas emission reduction achieved by the project activity**	**ER_y**	**t-CO_2**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**3.39E+04**	**3.15E+04**	**4.08E+04**	**3.79E+04**		**1.44E+05**

項目 item	記号 mark	単位 unit	8	9	10	11	12	13	14		2nd 7y	Total
年 year	y	-	2015	2016	2017	2018	2019	2020	2021			
発生するメタンの量 methan generated		t-CH_4	2.80E+03	2.60E+03	2.41E+03	2.24E+03	2.08E+03	1.93E+03	1.79E+03		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	5.88E+04	5.46E+04	5.06E+04	4.70E+04	4.36E+04	4.04E+04	3.75E+04		-	-
プロジェクトがなかった場合に破壊･燃焼されるはずだったメタンの量 amount of methane that would have been destroyed/combusted during the year in the absence of the project activity		t-CH_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
グリッド発電所で排出されるCO2の量 CO2 emission at the power plants in the grid		t-CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		-	-
ベースライン排出量 **Baseline emission**		**t-CO_2**	**5.88E+04**	**5.46E+04**	**5.06E+04**	**4.70E+04**	**4.36E+04**	**4.04E+04**	**3.75E+04**		**3.33E+05**	**7.14E+05**
回収できるメタンの量 Methane captured		t-CH_4	1.68E+03	1.56E+03	1.45E+03	1.34E+03	1.25E+03	1.16E+03	1.07E+03		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	3.53E+04	3.28E+04	3.04E+04	2.82E+04	2.62E+04	2.43E+04	2.25E+04		-	-
フレアから排出されるメタンの量 Methane emission from the flare stack		t-CH_4	8.41E+00	7.80E+00	7.23E+00	6.71E+00	6.23E+00	5.78E+00	5.36E+00		-	-
同上CO2等量 Ditto CO2 equivalent		t-CO_2	1.77E+02	1.64E+02	1.52E+02	1.41E+02	1.31E+02	1.21E+02	1.13E+02		-	-
プロジェクト排出量 **Project emission**		**t-CO_2**	**2.37E+04**	**2.20E+04**	**2.04E+04**	**1.89E+04**	**1.76E+04**	**1.63E+04**	**1.51E+04**		**1.34E+05**	**3.71E+05**
プロジェクトによる排出削減量 **greenhouse gas emission reduction achieved by the project activity**	**ER_y**	**t-CO_2**	**3.51E+04**	**3.26E+04**	**3.02E+04**	**2.80E+04**	**2.60E+04**	**2.41E+04**	**2.24E+04**		**1.99E+05**	**3.43E+05**

Table 5 Sensitivity Analysis Results

Remarks : The range of parameters on cost and price at this sensitivity analysis is set to cover the inflation rate of Georgia. Plus, the range of amount of generated LFG can be said to be as same as the range of L0 (methane generation potential). On the other hand, if amount of generated LFG changes, possible capacity of generator will also change. But, the purpose of this sensitivity analysis is to demonstrate that the project scenario is not the baseline scenario under the planned capacity and without CER. So, it is no use expanding the range of amount of generated LFG needlessly. The following range is set as the table below.

Variable: Construction cost

			Reference		
Variation rate	-10%	-5%	±0%	+5%	+10%
IRR	Minus	Minus	Minus	Minus	Minus

Variable: Running cost

			Reference		
Variation rate	-10%	-5%	±0%	+5%	+10%
IRR	Minus	Minus	Minus	Minus	Minus

Variable: Power sale price

			Reference		
Variation rate	-10%	-5%	±0%	+5%	+10%
IRR	Minus	Minus	Minus	Minus	Minus

Variable: Amount of generated LFG

			Reference		
Variation rate	-20%	-10%	±0%	+10%	+10%
IRR	Minus	Minus	Minus	Minus	Minus

Variable: Cost inflation rate

			Reference		
Variation rate	-10%	-5%	±0%	+5%	+10%
IRR	Minus	Minus	Minus	Minus	Minus

Annex 4

MONITORING INFORMATION

Below is indicated the monitoring plan for each item based on the monitoring methodology.

○ID1 LFG_{total} Collected amount of LFG
○ID2 LFG_{flare}, Flared amount of LFG
○ID3 $LFG_{electricity}$ Amount of LFG used in power generation

There are various types of flow meters; meanwhile, the target measurements here are the instantaneous flow rate and integrated flow rate for volumetric flow rate of a gas. The instantaneous volumetric flow rate of a gas can be measured by a differential pressure type flow meter (orifice, etc.), an area type flow meter (float, etc.), an ultrasonic type flow meter or a vortex type flow meter. The performance requirements for the flow meter here are relatively low price (i.e. a widely available type), accuracy, no major loss in precision even if the flow rate varies somewhat, durability and easy maintenance. The vortex type flow meter fulfils these requirements. As is explained below, the flow meter must be capable of outputting to a computing unit.

The vortex type flow meter measures instantaneous flow rate, however, this is the flow rate at that pressure and temperature and not the rate in the normal state (standard condition). Here, it is necessary to measure pressure and temperature at the same time with flow rate, in order to correct the measurement to the normal state value, and thereby assess volumetric flow using the same scale. Accordingly, a pressure gage and thermometer are required as well as a computing unit for correcting values into the normal state.

The features of the vortex type flow meter are that it has no movable parts and there is almost no fear of accuracy deteriorating over time. However, it is essential to make sure that no foreign objects get caught in the vortex generator. Accordingly, although there is no need to periodically calibrate the flow meter unit, it is necessary to check for foreign objects and also make sure that output and input signals between the transmitting terminal attached to the flow meter and the receiving terminal attached to the computing unit are being transmitted accurately. This calibration can be done by inputting mock signals to the transmitter to check and adjust the accuracy of output signals from the transmitter, and likewise inputting mock signals to the computing unit to check and adjust the accuracy of flow rate display on the computing unit side.

Measurement of flow is made possible by connecting the above flow meter, pressure gage, thermometer and computing unit by wiring. The computing unit shall be capable of displaying the instantaneous flow rate as well as the integrated flow rate.

The flow rate is continuously measured and automatically integrated by the computing unit. Since the accumulated integrated flow and not the instantaneous flow rate needs to be known, there is no need to make frequent visual checks and record value. As a rule, checking for abnormalities in the display shall be conducted at least once per week and records shall be taken once per month.

○ID5 FE Flare efficiency

The flare efficiency FE is calculated from the flare operating rate (FTf) and the flare destruction efficiency (Fwf).

First, the flare operating rate FTf is calculated from the flare surface temperature. Usually if the flare is operating, there is no major variation in the flare surface temperature, however, once the flame goes out, the temperature drops rapidly. From this it is possible to judge whether the flare is operating or the flame has gone out. In other words, the flare operating rate FTf shows the ratio of flare operating time.

Next, the flare destruction efficiency Fwf can be obtained from the methane concentration in flare exhaust gas and methane concentration in LFG. Based on the above:

Flare operating rate FTf = Flare operating time ÷ (Flare operating time + Flare flame out time)

Flare destruction efficiency Fwf = (Methane concentration in LFG – Methane concentration in flare exhaust gas) ÷ Methane concentration in LFG

Flare efficiency FE = Flare operating rate FTf x Flare destruction efficiency Fwf

Flare efficiency FE is calculated once per month based on data obtained at this frequency.

○ID5 Tf Flare surface temperature
○ID5 T_{AIR} Temperature of air used in LFG flaring
○ID5 T_{EX} Flare exhaust gas temperature
○ID7 T Temperature of LFG

Concerning thermometers, there are again various types, for example, thermocouple, resistance type, thermistor type, radiation type, glass pipe type, filled type, bimetal type, crystal oscillating type, fluorescent type, optical fibre distribution type and magnetic type. The performance requirements for the thermometer here are relatively low price (i.e. a widely available type), accuracy, no major loss in precision even if temperature varies somewhat, durability, easy maintenance and ability to output to a computing unit (i.e. fitting with a terminal). The resistance type thermometer fulfils these requirements.

Concerning the thermometer, since a temperature sensor uses a resistive element made from platinum, etc., there is a risk that resistive element degradation will diminish the accuracy of temperature measurements. Therefore, it is necessary to calibrate the thermometer by preparing liquid of known temperature with a thermostatic chamber and reference thermometer. It is also necessary to make sure that output and input signals between the thermometer terminal and the computing unit terminal are being transmitted accurately. This calibration can be done by inputting mock signals to the computing unit to check and adjust the accuracy of temperature display on the computing unit side.

The temperature of LFG is continuously measured. As a rule, the display is checked for no abnormalities once per week, while the temperature is recorded once per month.

Concerning the flare stack surface temperature, a thermocouple is preferable to a resistance thermometer. Since the flare stack surface temperature reaches many hundreds of degrees, a thermocouple with high heat resistance is suitable.

The flare surface temperature is recorded in a recorder (pen recorder or data logger). In other words, automatic recording is performed continuously. As a rule, recording shall be performed to coincide with recording of the LFG flow rate, and checking for abnormalities in records shall be conducted at least once per week and records shall be taken once per month.

The temperature of air used in LFG flaring, and the temperature of flare exhaust gas, shall be measured when the flare equipment is installed and once per year after that.

○ID5 P_{AIR} Pressure of air used in LFG flaring
○ID5 P_{EX} Flare exhaust gas pressure
○ID8 P Pressure of LFG

Different types of pressure gage are the liquid column type, the plumb bob type and the elasticity type. The performance requirements for the pressure gage here are relatively low price (i.e. a widely available type), accuracy, no major loss in precision even if the pressure varies somewhat, durability, easy maintenance and ability to output to a computing unit (fitted with a transmitter). The elasticity type pressure gage fulfils these requirements.

As for the pressure gage, since this uses a pressure transmitter that utilizes a diaphragm, there is a risk that diaphragm degradation shall diminish the accuracy of pressure measurements. Therefore, it is necessary to calibrate the pressure gage by preparing liquid of known pressure with a mobile pump. It is also necessary to make sure that output and input signals between the pressure transmitter terminal and the computing unit terminal are being transmitted accurately. This calibration can be done by inputting mock signals to the computing unit to check and adjust the accuracy of pressure display on the computing unit side.

The pressure of LFG is continuously measured. As a rule, the display is checked for no abnormalities once per week, while the pressure is recorded once per month.

The pressure of air used in LFG flaring, and the pressure of flare exhaust gas, shall be measured when the flare equipment is installed and once per year after that.

○ID5 wf_{CH4} Methane concentration in flare exhaust gas
○ID6 w_{CH4} Methane concentration in LFG

Methods for measuring the volumetric concentration of methane in gas include gas chromatograph analysis, solid sensor gas analyser, optical sensor gas analyser, hydrogen flame ionisation detector, and so on. The performance requirements for the gas analyser here are relatively low price (i.e. a widely available type), accuracy, no major loss in precision even if the concentration level varies somewhat, durability and easy maintenance. Measured concentration here is in the order of 0~70% and are not measured in ppm. Easy measurement and easy calibration are also desired. The optical sensor gas analyser fulfils these requirements, and in particular the infrared type is appropriate.

The infrared methane gas analyser can be easily calibrated. It is possible to calibrate an infrared methane gas analyser by preparing a cylinder of reference methane gas of known concentration and a cylinder of zero methane concentration for zero calibration purposes. In other words, the infrared methane gas analyser can be calibrated in any place that is accessible to gas cylinders.

It is desirable that the infrared methane gas analyser can also measure the oxygen concentration. This is because, although not directly linked to the monitoring, since there is risk of explosion if the oxygen concentration of LFG rises to abnormal levels, it is necessary to stop the system.

Checking of the methane concentration of LFG shall be implemented based on the same timing as LFG flow rate recording. As a rule, checking for abnormalities in the display shall be conducted at least once per week and records shall be taken once per month.

The methane concentration in flare exhaust gas, assuming flare efficiency to be 99% and air ratio to be 1.0, is no more than 0.1% (1,000 ppm), whereas the concentration that needs to be measured is less than this. For example, as a realistic value, when flare efficiency is assumed to be 99.5% and air ratio to be 1.2, the methane concentration of flare exhaust gas works out to be 0.03% (300 ppm). Accordingly, since this cannot be measured in the same range as methane concentration in LFG, care is needed.

Meanwhile, according to the monitoring methodology, the monitoring frequency of methane concentration in flare exhaust gas can be far less than that for the methane concentration in LFG. The infrared methane gas analyser helps stabilize measurements by being in constant use, and its life is affected if start and stop are frequently repeated. For this reason, it is not suited to low frequency measurements such as methane concentration in flare exhaust gas. Since this measuring instrument needs to be kept constantly on even though measuring frequency is low, it is more costly than it needs to be. From the cost cutting viewpoint, rather than purchasing an infrared methane gas analyser, the methane concentration in flare exhaust gas can be measured by analysing with a gas chromatograph whenever required. Moreover, the host country Georgia has agencies and operators that can implement gas chromatograph analysis.

In this project, it shall be possible to select analysis either by the infrared methane gas analyser or by the gas chromatograph.

Methane concentration in flare exhaust gas shall be recorded once per month. (If the infrared methane gas analyser is adopted, as a rule, recording shall be performed to coincide with recording of the LFG flow rate, and checking for abnormalities in the display shall be conducted at least once per week and records shall be taken once per month).

○ID5 $w_{O2,y}$ **LFG oxygen concentration**
○ID5 $w_{AIR,O2,y}$ **Oxygen concentration of air used in LFG flaring LFG**
○ID5 $w_{EX,O2,y}$ **Oxygen concentration of flare exhaust gas**

Methods for measuring the volumetric concentration of oxygen in gas include portable chemical gas analyser (Orsat gas analyser), magnetic oxygen analyser used for continuous analysis, and electro-chemical zirconia oxygen analyser and electrode oxygen analyser also used for continuous analysis.
The performance requirements for the oxygen analyser here are relatively low price (i.e. a widely available type), accuracy, no major loss in precision even if the concentration level varies somewhat, durability and easy maintenance. Easy measurement and easy calibration are also desired.

The above methods are widely used in Japan and satisfy the above conditions, however, they have the following features. Orsat gas analyser is portable and can be used to make timely measurements. Since it is not absolutely necessary to conduct continuous measurements here, this method is particularly advantageous. However, since the oxygen concentration measured here is for dry gas concentration, it will be necessary to separately measure water content in order to obtain accurate measurements of concentration. The magnetic oxygen analyser utilizes the fact that oxygen molecules have far stronger paramagnetic properties than other gases, however, it is basically used for continuous measurements. The electro-chemical zirconia oxygen analyser and electrode oxygen analyser also basically used for continuous analysis, and errors are apt to occur when the gas contains combustible gases (methane gas, etc.) that react with oxygen at high temperatures or sulphur dioxide, which causes electrode elements to corrode.
Accordingly, the Orsat gas analyser or magnetic oxygen analyser is considered to be preferable for the measurements here. Moreover, a methane gas analyser with inbuilt oxygen concentration anayser can also be selected.

In the project, it shall be possible to select from either an Orsat gas analyser or a magnetic oxygen analyser.

Oxygen concentration in the air used in flaring , and oxygen concentration in flare exhaust gas shall be measured on installation of the flare equipment and once per year thereafter . (If the magnetic oxygen analyser is adopted, as a rule, checking for abnormalities in the display shall be conducted at least once per week and records shall be taken once per month).

○ID9 $EL_{EX,LFG}$ **Amount of electricity exported outside of the project boundary**
○ID10 EL_{IMP} **Amount of imported electricity required for the project activity**

The watt-hour meter shall be used for selling and purchasing electricity as well as monitoring in the CDM project. Accordingly, the meter demanded or provided by the grid owner shall be installed, and the calibrations that are required or implemented by the grid owner shall be carried out.

Electric energy is continuously measured and automatically integrated. Since the integrated electricity and not the instantaneous electricity needs to be known, there is no need to make frequent visual checks and record values. As a rule, recording shall be performed to coincide with recording of the LFG flow rate, and checking for abnormalities in the display shall be conducted at least once per week and records shall be taken once per month.

○ID11 $CEF_{electricity}$ CO_2 emissions intensity of the electricity displaced

The necessary data shall be received from the DNA of the Government of Georgia once per year.

○ID13 AF Adjustment factor

The AF is the ratio, adjustment factor between the amount of LFG that should be collected under the law and the amount of LFG that is collected in the Project. The necessary data shall be received from the Government of Georgia once per year.

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