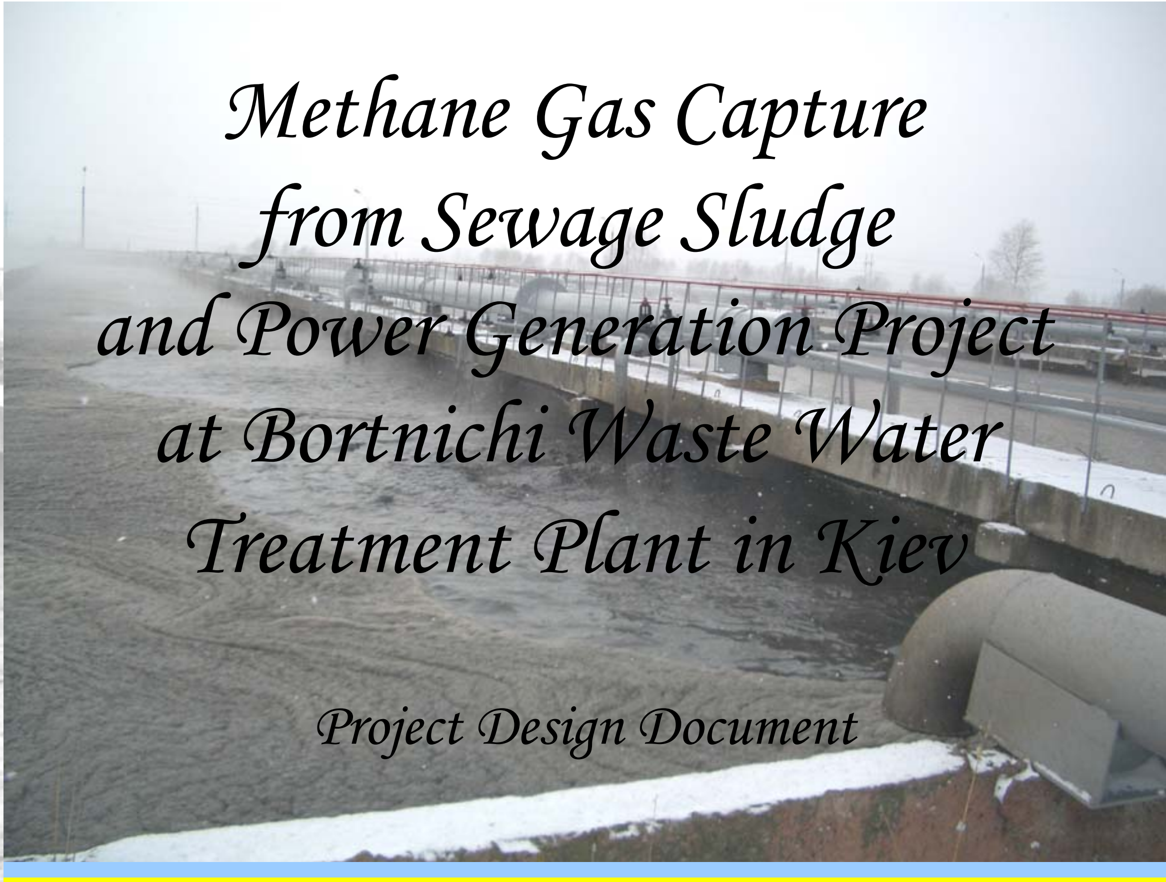
Version 001

Methane Gas Capture from Sewage Sludge and Power Generation Project at Bortnichi Waste Water Treatment Plant in Kiev

Project Design Document



10th March 2006

Shimizu Corporation

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

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Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>>Methane Gas Capture from Sewage Sludge and Power Generation Project at Bortnichi Waste Water Treatment Plant in Kiev

Version001

10/03/2006

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 2002, Shimizu Corporation, working in cooperation with the Government of Ukraine, has conducted a feasibility study (FS) into a number of joint implementation (JI) projects. One of these, the project in hand, proposes to reduce emissions of CH_4 from the sludge field at a water treatment plant in Kiev, the capital city of Ukraine, and at the same time to utilize CH_4 generated in the digestion and decomposition of sludge as fuel in a cogeneration system.

The project crediting period is 15 years, and the aggregate reduction of emissions during this period is estimated as 2.25 x 10^6 ton-CO_2 (where ton-CO_2 expresses ton-CO_2 equivalent).

In addition to realizing reduced emissions of greenhouse gases (GHG) in Kiev City, it is anticipated the project will have various environmental benefits around the site including mitigation of odor from the sludge field, beautification, and reduction of risk of fire and explosions, and effective utilization of land, etc. The project also has the potential to stimulate similar JI undertakings not only in Ukraine, 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)
Ukraine (host)	Public entity / Municipality of Kiev City (Open joint stock company "Kievvodokanal")	No
Japan	Private entity / Shimizu Corporation	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

>>

A.4.1.1. Host Party(ies):

>>Host Party
Ukraine

ERU Recipient
Japan

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

>>Kiev City (is also written as "Kyiv City")

A.4.1.3. City/Town/Community etc:

>>Kiev City

Figure 1 indicates the location of Ukraine and Kiev City.

Figure-1: Location of Kiev City

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

>>Kiev is the capital city of Ukraine. Sewage in the city is treated at Bortnichi Water Treatment Plant, which is operated by the open joint stock company "Kievvodokanal." This treatment plant has equipment capacity of 1,800,000 m3/day, whereas it currently treats wastewater of 1,300,000 m3/day. Treated effluent is discharged in Dnepr River.

Large quantities of sludge are generated in line with wastewater treatment at Bortnichi Water Treatment Plant . This sludge consists of primary sludge or raw sediments discharged from primary settlement tanks, and surplus sludge (surplus of activated sludge) that is propagated in the aeration tanks and is discharged from the secondary settlement tanks.

Some of the primary sludge is treated in the existing closed anaerobic digester, whereas all the surplus sludge (including raw sediments not treated in the closed anaerobic digester) is decomposed by oxidation in an aerobic stabilizer. The treated sludge is then conveyed by pumps to a sludge field covering an area of 272 ha.

The inherent purpose of the sludge field is to dry out the sludge. Usually, sludge is removed from the sludge field when the water content of sludge reaches 70~80%, however, in reality the sludge is left as it is in the field. The reason for this is because Ukraine currently does not possess the technology to effectively utilize sludge as organic fertilizer, etc., i.e. composting technology, nor the social institutions for this.

As a result, sludge in the sludge field is left to ferment in the field, thereby generating odor. The fermentation process in the sludge field specifically consists of an aerobic reaction on the sludge field surface and an anaerobic reaction inside the field, and these reactions result in the generation of CH_4, which has an adverse impact in contributing to global warming.

The project aims to install a new closed anaerobic digester with a view to treating all the sludge that cannot currently be handled by the existing closed anaerobic digester, and thereby reducing the volume of sludge transported to the sludge field. At the same time, the project proposes to utilize CH_4 (digestion gas/bio gas) generated in digestion as fuel in a cogeneration system. Electric power and heat produced in the said system will then be used in the water treatment plant. By utilizing electric power generated in cogeneration, the plant will purchase less electricity from the grid, and this will contribute to reduction in consumption of fossil fuels and emission of greenhouse gases at grid power stations.

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

>>Fugitive gas capture and alternative / renewable energy
Out of the 15 Sectoral Scopes, 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:

>>**- Sludge digestion technology**
Bortnichi Water Treatment Plant already possesses a closed anaerobic digester and sludge digestion technology. However, the digestion efficiency of this equipment is low compared to the same technology in Japan. For example, digestion efficiency at Bortnichi Water Treatment Plant is only between 30~40%, Japanese technology (appropriate reaction tank shape, mixing method, temperature maintenance, etc.) can realize 60% efficiency.

- Small-scale GEG technology utilizing digestion gas/bio gas

The GEG system is composed of a gas engine, generator, control panel, system inter-connection line and instrumentation that allow stable operation using even sparse methane gas such as CH_4. The gas engine will have generating efficiency of 30~40%, equivalent to or better than the conventional types of steam turbine that currently exist in Ukraine. In addition, high-level technology will be needed to stably operate the gas engine using sparse gas fuel such as digestion gas/bio gas.

Low-efficiency conventional steam turbines that were constructed during the Soviet era are still used in Ukraine today, and decline in operating efficiency can be seen due to fund shortages and lack of maintenance. Moreover, Ukraine has no experience of introducing digestion gas/biogas collection systems to waste disposal sites using its own technology and funding. In other words, Ukraine has no experience whatsoever of independently implementing the abovementioned sludge digestion technology and GEG technology utilizing digestion gas/biogas. Having said that, these technologies have been commonly applied in Japan and other advanced countries.

Therefore, when introducing such technologies to Ukraine, it will be necessary to provide appropriate training and education opportunities.

Moreover, since these technologies have reached a fairly advanced stage of maturation in recent years, there is little likelihood they will be superseded by superior technology during the project period.

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

>>To reaffirm the information described so far, current conditions in the host country Ukraine and the target city Kiev can be summarized as follows:

- In Kiev, almost all sewage is carried into Bortnichi Water Treatment Plant for treatment.
- Bortnichi Water Treatment Plant does not have the means to manage, control or collect CH_4 generated from its sludge field due to lack of funds, insufficient technology and inadequate social systems.
- Legislation requiring the compulsory collection of CH_4 from sludge fields does not exist either in Ukraine or Kiev City.
- In Ukraine, deteriorated and low-efficiency thermal power plants are operated as an important source of energy.

It is under these circumstances that the project aims to install a new closed anaerobic digester with a view to treating all the sludge that cannot currently be handled by the existing closed anaerobic digester, and thereby reducing the volume of sludge transported to the sludge field. At the same time, the project proposes to utilize CH_4 (digestion gas/bio gas) generated in digestion as fuel in a cogeneration system. Electric power and heat produced in the said system will then be used in the water treatment plant. By utilizing electric power generated in cogeneration, the plant will purchase less electricity from the grid, and this will contribute to reduction in consumption of fossil fuels and emission of greenhouse gases at grid power stations.

The baseline for the project, judging from analysis of the baseline scenarios, is the scenario of maintenance of status quo. In other words, maintenance of status quo refers to the case where CH_4 generated at Bortnichi Water Treatment Plant is allowed to escape into the atmosphere without implementing any management of CH_4 generation, collection or utilization, nor treating more sludge than present in a closed anaerobic digester. Accordingly, without the project, there will be no reduction of

GHG emissions at all. Detailed explanation concerning why maintenance of status quo is the baseline for the project is given in Section B (Application of a baseline methodology).

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

Phase A: as a result of operating a new high-efficiency closed anaerobic digester, the amount of organic sludge carried to the sludge field will be greatly reduced, and this will lead to reduction of CH_4 emissions from the sludge field.
Phase B: reduction of CO_2 emissions through GEG operation as a substitute for existing thermal power plants.

The project crediting period is 15 years, and the aggregate reduction of emissions during this period is estimated as 2.25 x 10^6 ton-CO_2 (where ton-CO_2 expresses ton-CO_2 equivalent).

In addition to realizing environmental improvement of the water treatment plant and sludge field, the project will benefit the ageing energy systems of Ukraine and contribute to sustainable development.
- Environmental improvement effect via sludge field odor prevention
- Environmental improvement effect through prevention of fires and explosions on the sludge field
- Environmental improvement effect through beautification of the sludge field
- Social effect through promotion of effective utilization of land on the sludge field
- Substitution of deteriorated power generation systems
- Effective utilization of energy
- Upgrading of human resources through introduction of new technology

In this way, because the project will contribute to sustainable development of the host country Ukraine, Kiev City is demonstrating strong interest in the project as a JI undertaking.

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

>>

Years	Annual estimation of emission reduction in tonnes of CO_2e
2009	1.56E+05
2010	1.55E+05
2011	1.55E+05
2012	1.54E+05
2013	1.53E+05
2014	1.52E+05
2015	1.51E+05
2016	1.50E+05
2017	1.49E+05
2018	1.48E+05
2019	1.47E+05
2020	1.46E+05
2021	1.45E+05
2022	1.44E+05
2023	1.43E+05
Total estimated reductions (tonnes of CO_2e)	2.25E+06
Total number of crediting years	15
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	1.50E+05

A.4.5. Public funding of the project activity:

>>Because this project is a JI project, this item can be skipped. (It is not yet confirmed whether the fund of this project is diversion of ODA fund from Japanese Government or not, or is completely irrelevant to Japanese funding obligation or not.)

SECTION B. Application of a baseline methodology

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

>>Baseline methodology for open anaerobic digestion of sewage sludge

This is a new methodology that has not even received approval in the CDM Executive Board nor the Article 6 Supervisory Committee.

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

>>The project activity viewed in terms of the conditions of applicability of the methodology is described as follows:

(1) The existing Bortnichi Water Treatment Plant treats generated sludge (raw sediments and surplus sludge) in an open anaerobic digester (sludge field) and discharges CH_4 into the atmosphere. Before sludge is inserted into the open anaerobic digester, some of the sludge undergoes pretreatment (closed anaerobic digestion), although the pretreatment rate is only 14.7%. None of the CH_4 that is discharged into the atmosphere from the sludge field is collected.

(2) In the project, all sludge will be treated in a closed anaerobic digester, and all digestion gas/biogas including CH_4 that is generated from the closed anaerobic digester will be collected.
(3) Sludge that undergoes ample treatment in the project closed anaerobic digester will undergo further treatment in an open anaerobic digester.
(4) The digestion gas/biogas including CH_4 that is collected from the closed anaerobic digester will be used as fuel in a cogeneration system. Moreover, digestion gas/bio gas that cannot be used as fuel for cogeneration will be combusted in flaring equipment.
(5) Electric power obtained from the cogeneration system, apart from the power consumed in the project system, will be transmitted to the water treatment plant, where it will all be consumed. As a result, power purchased from the grid by the water treatment plant will be reduced and emissions saved at power plants on the grid will be claimed.
(6) Waste heat obtained from the cogeneration system, apart from the heat consumed in the project system, will be transmitted to the wastewater treatment plant, where it will all be consumed. However, even if utilization of this alternative energy leads to reduction in consumption of fossil fuels, the resulting reduction in emissions will not be claimed.
(7) The specific emission factor per unit amount of sludge in the open anaerobic digester is known beforehand. Moreover, the ex-ante period of measurement of this emission factor must not exceed the actual treatment period of sludge in the open anaerobic digester. The unit of sludge when measuring ex-ante will be aligned with the unit of sludge during monitoring.

Therefore, because the project satisfies all the conditions for application of Baseline methodology for open anaerobic digestion of sewage sludge, this methodology can be applied.

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

>>Here, the baseline methodology is applied in the following manner.

(1) Identify the baseline scenario.
(2) Demonstrate additionality.
(3) State the method for calculating baseline emissions.
(4) State the method for calculating project emissions.
(5) State the method for calculating leakage.

(1) Identify the baseline scenario.

(1-1) List all scenarios that are legal and plausible in Ukraine. Include the project scenario among these.

Based on the baseline methodology, list the following possible scenarios. Out of the following scenarios, state those that can be disregarded as the baseline without having to conduct barrier analysis, and also state the reasons why.

Scenario No.	Scenario Contents	Scenarios that can be disregarded as the baseline without going as far as barrier analysis, and reasons why.
Scenario 0	Maintenance of status quo. That is, out of sludge generated at the water treatment plant, only treat the 14.7% that is treated in the existing closed anaerobic digester, and after treatment carry to the sludge field for disposal. As for the large proportion of sludge that cannot be treated in the existing digester, carry in the untreated state to the sludge field for disposal.	(Since this can be considered as a possible baseline, it needs to be examined in the next process).
Scenario 1	Plan to introduce a thickening process. Introduce a new sludge thickener and implement sludge thickening.	There are no means of treating thickened sludge. There are no economic benefits to thickening sludge. This plan cannot be considered as the baseline because it offers no returns on the investment.
Scenario 2 (the project)	Plan to introduce a digestion process. Introduce a new sludge digester and implement sludge digestion. Also utilize the digestion gas/bio gas that is obtained from digestion. This plan also includes sludge thickening in order to boost digestion efficiency.	(Since this can be considered as a possible baseline, it needs to be examined in the next process).
Scenario 3	Plan to introduce a dewatering process. Introduce a new sludge dewatering unit and implement sludge dewatering.	There are no means of treating dewatered sludge. There are no economic benefits to dewatering sludge. This plan cannot be considered as the baseline because it offers no returns on the investment.
Scenario 4	Plan to introduce a composting process. Introduce a new composting unit and make compost out of sludge. This plan also includes effectively utilizing the fertilizer obtained from composting.	(Since this can be considered as a possible baseline, it needs to be examined in the next process).
Scenario 5	Plan to introduce a drying process. Introduce a new sludge drier and	There are no means of treating dried sludge. There are no economic benefits to drying

	implement sludge drying.	sludge. This plan cannot be considered as the baseline because it offers no returns on the investment.
Scenario 6	Plan to introduce an incineration process. Introduce a new sludge incinerator and implement sludge incineration.	(Since this can be considered as a possible baseline, it needs to be examined in the next process).
Scenario 7	Plan to introduce a melting process. Introduce a new sludge melting unit and implement sludge melting.	There are no means of treating melted sludge. There are no economic benefits to melting sludge. This plan cannot be considered as the baseline because it offers no returns on the investment.
Scenario 8	Plan to introduce a landfill process. Transport sludge to a solid waste landfill site for disposal.	Since the status quo of transporting sludge to the sludge field entails less cost and effort, this plan cannot be considered as the baseline

(1-2) Conduct barrier analysis on the listed scenarios; then conduct investment analysis on the scenarios with the fewest barriers, and adopt the baseline scenario from the one that has the highest investment effect.

Based on the baseline methodology, the results of conducting barrier analysis are shown below.

Scenario No.	Scenario Contents	Plausible Barriers
Scenario 0	Maintenance of status quo. That is, out of sludge generated at the water treatment plant, only treat the 14.7% that is treated in the existing closed anaerobic digester, and after treatment carry to the sludge field for disposal. As for the large proportion of sludge that cannot be treated in the existing digester, carry in the untreated state to the sludge field for disposal.	Since this is maintenance of the status quo, there are no barriers.
Scenario 2 (the project)	Plan to introduce a digestion process. Introduce a new sludge digester and implement sludge digestion. Also utilize the digestion gas/bio gas that is obtained from digestion. This plan also includes sludge thickening in order to boost digestion efficiency.	There are no technical barriers. It is necessary to examine the economic feasibility.
Scenario 4	Plan to introduce a composting process. Introduce a new composting unit and make compost out of sludge. This plan also includes effectively utilizing the fertilizer obtained from composting.	Barriers exist. Composting of sludge is not implemented at all in Ukraine, because the technologies and social systems for this are not in place.

	It also includes sludge thickening, drying and dewatering in order to enhance composting efficiency.	
Scenario 6	Plan to introduce an incineration process. Introduce a new sludge incinerator and implement sludge incineration.	There are no technical barriers. It is necessary to examine the economic feasibility.

The results of conducting investment analysis on scenarios 0, 2 and 6 are shown below.

Scenario No.	Scenario Contents	Additional Expenditure	Additional Revenue	After Tax IRR (calculated over 2 years for construction and 15 years operation)
Scenario 0	Maintenance of status quo. That is, out of sludge generated at the water treatment plant, only treat the 14.7% that is treated in the existing closed anaerobic digester, and after treatment carry to the sludge field for disposal. As for the large proportion of sludge that cannot be treated in the existing digester, carry in the untreated state to the sludge field for disposal.	None	None	-
Scenario 2 (the project)	Plan to introduce a digestion process. Introduce a new sludge digester and implement sludge digestion. Also utilize the digestion gas/bio gas that is obtained from digestion. This plan also includes sludge thickening in order to boost digestion efficiency.	Initial construction cost: 28,363,000 Euro Operation cost: 3,072,503 Euro/year	Reduction in power and gas purchase costs through effective utilization of digestion gas/bio gas: 2,742,570 Euro/year	IRR cannot be calculated. (Revenue is too small to recover the investment).
Scenario 6	Plan to introduce an incineration process. Introduce a new sludge incinerator and implement sludge incineration.	Initial construction cost: 137,863,000 Euro Operation cost: 8,149,417 Euro/year	Reduction in power and gas purchase costs through effective utilization of digestion gas/bio gas: 10,372,496	IRR cannot be calculated. (Revenue is too small to recover the investment).

			Euro/year	

As a result of the above examination, it was determined that maintenance of the status quo is the baseline scenario.

(2) Demonstrate additionality.
The project is Scenario 2. Since it has been shown that Scenario 2 is not the baseline, this already means that the project is additional; however, based on the methodology, it is demonstrated here that Scenario 2 is additional (that GHG emissions can be additionally reduced).

According to the methodology, if the following can be demonstrated:

(Equation-6) Sum MSByi > Sum MSPyi

Then the following is self-evident:

(Equation-1) Baseline emissions + Baseline leakage > Project emissions + Project Leakage

Accordingly, in terms of the system characteristics, if Equation-6 can be demonstrated even in qualitative terms, then it can be demonstrated that Equation-1 is valid and the project is additional.

Here, the project proposes to treat all sludge in the digester before transporting it to the sludge field. Therefore, the amount of sludge carried to the sludge field will definitely be less than in the baseline (status quo), by the amount that organic materials contained in sludge treated in the digester are treated and decomposed and converted to digestion gas/bio gas.

Therefore, the project is additional.

(3) State the method for calculating baseline emissions.
Baseline emissions are calculated as follows by means of the following Equation-2.

(Equation-2) Baseline emissions (ton-CO_2/y) = Sum (MSByi * EFsi) * GWPm

Where,
MSByi: Sludge i mass exhausted from the baseline system into the sludge field in the year y (ton-RDS/y)
EFsi: Emission factor of the sludge i (ton-CH_4/ton- RDS)
GWPm: Global warming potential of CH_4 (no dimension) = 21

(4) State the method for calculating project emissions.
Project emissions are calculated by means of Equation-4 as follows:

(Equation-4) Project emissions (ton-CO_2/y) = MSPy * EFs * GWPm

Where,
MSPyi: Sludge i mass exhausted from the project system into the sludge field in the year y (ton-RDS/y)
EFsi: Emission factor of the sludge i (ton-CH_4/ton- RDS)
GWPm: Global warming potential of CH_4 (no dimension) = 21

(5) State the method for calculating leakage.

Greenhouse gases emitted outside of the project boundary include emissions from the grid generating electric power that is substituted by the cogeneration system. These emissions are regarded as leakage in the baseline. In contrast, no leakage exists in the project. To sum up, leakage in the baseline and leakage in the project can be calculated as follows:

(Equation-3) Baseline leakage (ton-CO_2/y) = EFPy * Py

(Equation-5) Project Leakage (ton-CO_2/y) = 0

Where,
EFPy: Emission factor of the baseline grid in the year y (ton-CO_2/MWh)
Py: Net supplied power by the project co-generation system (or generator) in the year y (MWh/y)

Concerning EFPy, the value given in the "Operational Guidelines for Project Design Documents of Joint Implementation Projects Volume 1": General Guidelines Version 2.3 Ministry of Economic Affairs of the Netherlands May 2004, P42 Table B1, shall be adopted. These guidelines are equivalent to the "EFPy that an investing country's government has developed and published for CDM and/or JI" as stated in section (3-3). As for the emissions factor from 2013 that is not given in these guidelines, it is set on the conservative side in line with the purport of the guidelines.

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

>>The examination so far has determined that the baseline scenario is maintenance of status quo. This means that, out of sludge generated at the water treatment plant, only the 14.7% that is treated in the existing closed anaerobic digester is treated, and after treatment is carried to the sludge field for disposal. As for the large proportion of sludge that cannot be treated in the existing digester, this is carried in the untreated state to the sludge field for disposal.

On the other hand, the project aims to apply digestion in the closed anaerobic digestion tank (currently only implemented partially) to all sludge with a view to reducing the volume of sludge that is carried to the sludge field.

Accordingly, implementation of the project will enable emissions of CH_4 from the sludge field to be greatly reduced. This is obvious from the demonstration of additionality described in Section B.2.

At the same time, the CH_4 (digestion gas/bio gas) generated in the digestion process is a reusable source of energy that will be used as fuel for the cogeneration system. Then electric power and heat generated in cogeneration will be used within the water treatment plant. By utilizing electric power generated in cogeneration, the plant will purchase less electricity from the grid, and this will contribute to reduction in consumption of fossil fuels and emission of greenhouse gases at grid power stations.

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

>>In accordance with the methodology, the project boundary is set as follows.

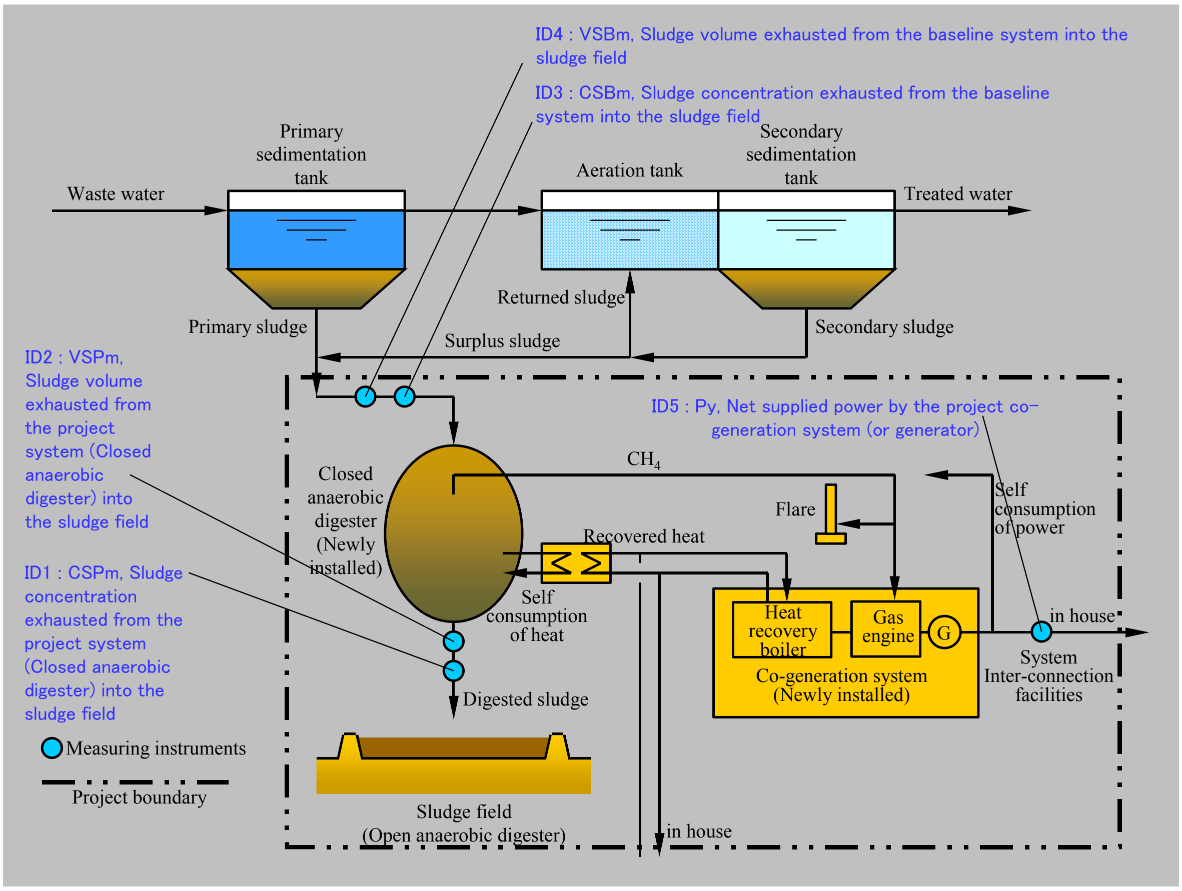

Figure-2: Project boundary

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

>>10/03/2006
General Manager : Kurita Hiroyuki, and
Engineer : Arumu Take
Shimizu Corporation
Energy Solutions Department
SEAVANS SOUTH, 1-2-3
Shibaura, Minato-ku, Tokyo 105-8007
03-5441-0137 (from inside Japan)
+81-3-5441-0137 (from outside Japan)
(Japanese HP) http://www.shimz.co.jp/
(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:

>>According to the UNFCCC Clean Development Mechanism Guidelines for Completing the Project Design Document (CDM-PDD): "The starting date of a CDM project activity is the date at which the implementation or construction or real action of a project activity begins."

In this project, it is estimated that the construction period before the project actually goes into operation will be 2 years, and that the project starting date will be 01/01/2007.

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

>>The expected operational lifetime of the project is set at 15 years in consideration of the service life of equipment.

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:

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>According to the UNFCCC Clean Development Mechanism Guidelines for Completing the Project Design Document (CDM-PDD): "The crediting period for a CDM project activity is the period for which reductions from the baseline are verified and certified by a designated operational entity for the purpose of issuance of certified emission reductions (CERs). Project participants shall choose the starting date of a crediting period to be after the date the first emission reductions are generated by the CDM project activity. A crediting period shall not extend beyond the operational lifetime of the project activity."

GHG emission reductions will be realized with completion of the project construction works and start of project operation. Accordingly, the date of the first emission reductions achieved by the project will be the day on which project construction works are finished and project operation is started, i.e. January 1, 2009.

01/01/2007	Start of construction
01/01/2009	Start of the crediting period

C.2.2.2. Length:

>>The project shall last for 15 years without renewal.

SECTION D. Application of a monitoring methodology and plan

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

>> Monitoring methodology for open anaerobic digestion of sewage sludge

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

>>The project activity viewed in terms of the conditions of applicability of the methodology is described as follows:

(1) The existing Bortnichi Water Treatment Plant treats generated sludge (raw sediments and surplus sludge) in an open anaerobic digester (sludge field) and discharges CH_4 into the atmosphere. Before sludge is inserted into the open anaerobic digester, some of the sludge undergoes pretreatment (closed anaerobic digestion), although the pretreatment rate is only 14.7%. None of the CH_4 that is discharged into the atmosphere from the sludge field is collected.
(2) In the project, all sludge will be treated in a closed anaerobic digester, and all digestion gas/bio gas including CH_4 that is generated from the closed anaerobic digester will be collected.
(3) Sludge that undergoes ample treatment in the project closed anaerobic digester will undergo further treatment in the open anaerobic digester.
(4) The digestion gas/biogas including CH_4 that is collected from the closed anaerobic digester will be used as fuel in a cogeneration system. Moreover, digestion gas/bio gas that cannot be used as fuel for cogeneration will be combusted in flaring equipment.
(5) Electric power obtained from the cogeneration system, apart from the power consumed in the project system, will be transmitted to the water treatment plant, where it will all be consumed. As a result, power purchased from the grid by the water treatment plant will be reduced and emissions saved at power plants on the grid will be claimed.
(6) Waste heat obtained from the cogeneration system, apart from the heat consumed in the project system, will be transmitted to the wastewater treatment plant, where it will all be consumed. However, even if utilization of this alternative energy leads to reduction in consumption of fossil fuels, the resulting reduction in emissions will not be claimed.
(7) The specific emission factor per unit amount of sludge in the open anaerobic digester is known beforehand. Moreover, the ex-ante period of measurement of this emission factor must not exceed the actual treatment period of sludge in the open anaerobic digester. The unit of sludge when measuring ex-ante will be aligned with the unit of sludge during monitoring.

Therefore, because the project satisfies all the conditions for application of Monitoring methodology for open anaerobic digestion of sewage sludge, this methodology can be applied.

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

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

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	*CSPim Sludge i concentration exhausted from the project system (Closed anaerobic digester) into the sludge field in the period m*	*RDS or COD or TOC or BOD_5 analysis method*	*ton-RDS/m3*	*m*	*Once a month (if unstable, once a week (if unstable once a day))*	*Monitored only once a month or once a week or once a day*	*Electric Monitored data shall be archived for 2 years following end of the crediting period.*	*If the weekly monitored data are not different by 5%, this item can be monitored once a month. If the daily monitored data are not different by 5%, this item can be monitored once a week.*
2	*VSPim Sludge i volume exhausted from the project system (Closed anaerobic digester) into the sludge field in the period m*	*Flow meter*	*m3/month or m3/week or m3/day*	*m*	*Once a month (if unstable, once a week (if unstable once a day))*	*100%*	*Electric Monitored data shall be archived for 2 years following end of the crediting period.*	*This item should be monitored at the same time as ID1*

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

>>Project activity emissions are calculated by means of Equation-4 and Equation-8 as follows:

(Equation-4) Project emissions (ton-CO_2/y) = Sum (MSPyi * EFsi) * GWPm

(Equation-8) MSPyi = Sum (CSPim * VSPim)

Where,
MSPyi: Sludge i mass exhausted from the project system into the sludge field in the year y (ton-RDS/y)
EFsi: Emission factor of the sludge i (ton-CH_4/ton- RDS)
GWPm: Global warming potential of CH_4 (no dimension) = 21
CSPim: Sludge i concentration exhausted from the project system (Closed anaerobic digester) into the sludge field in the period m (ton-RDS/m^3)
VSPim: Sludge i volume exhausted from the project system (Closed anaerobic digester) into the sludge field in the period m (m^3/month)

CSPm (instantaneous concentration) and VSPm (aggregate flow) are determined ex-post upon monitoring these items every month.
Concerning EFs, as a result of conducting measurement on the project site, this is set at 2.42×10^{-2} ton -CH_4/ton-RDS.
GWPm is a constant, set at 21 in this case.

Figure 3 gives a graphical representation of the above monitoring plan.

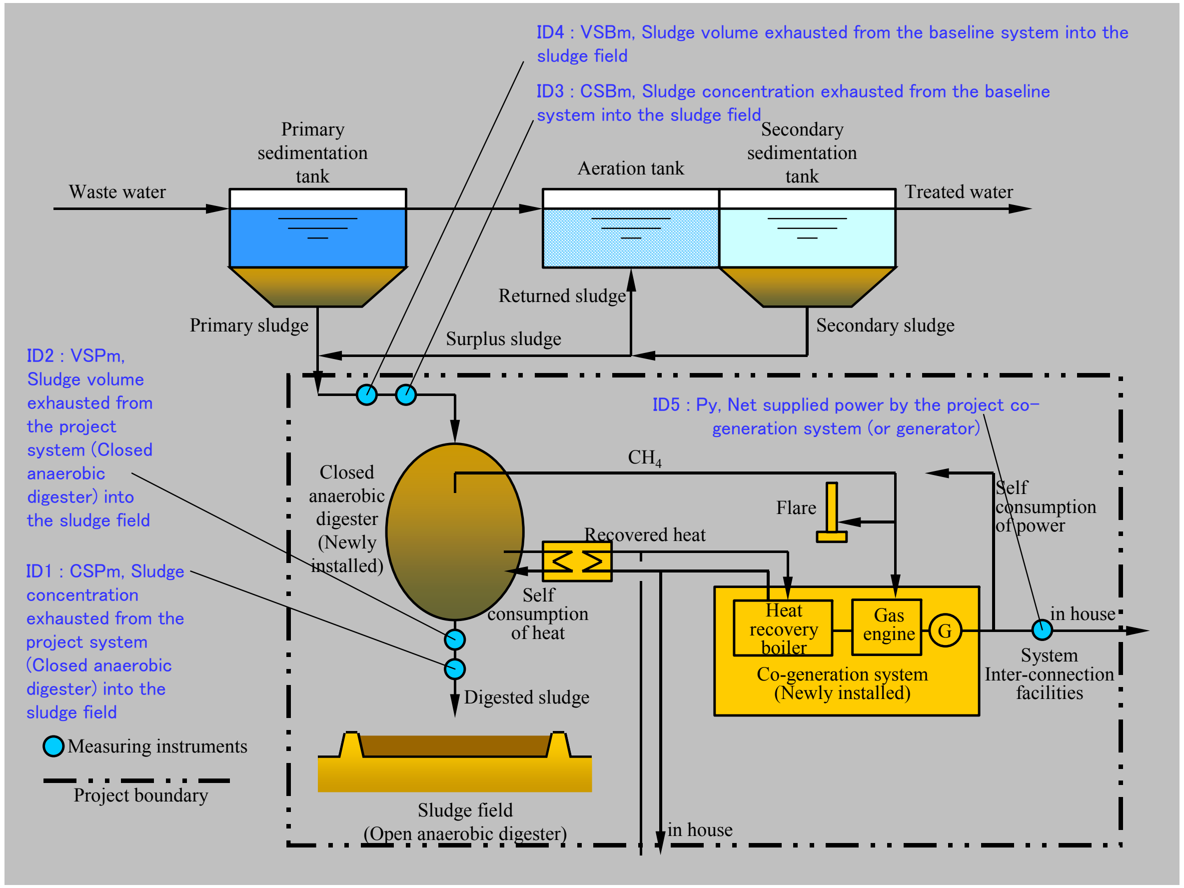

Figure-3: Flow chart of monitoring plan

(Blue circles indicate measuring instruments, ID numbers in the figure correspond to the ID numbers in the tables, and chained line indicates boundaries)

Note: The electric energy measured in this monitoring plan is obtained by deducting power used in the co-generations and closed anaerobic digesters (i.e. portions consumed by the system itself) from the generated electric energy from the co-generations.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
3	*CSBim Sludge i concentration exhausted from the baseline system into the sludge field in the period m*	*RDS or COD or TOC or BOD_5 analysis method*	*ton-RDS/m3*	*m*	*Once a month (if unstable, once a week (if unstable once a day))*	*Monitored only once a month or once a week or once a day*	*Electric Monitored data shall be archived for 2 years following end of the crediting period.*	*If the weekly monitored data are not different by 5%, this item can be monitored once a month. If the daily monitored data are not different by 5%, this item can be monitored once a week.*
4	*VSBim Sludge i volume exhausted from the baseline system into the sludge field in the period m*	*Flow meter*	*m3/month or m3/week or m3/day*	*m*	*Once a month (if unstable, once a week (if unstable once a day))*	*100%*	*Electric Monitored data shall be archived for 2 years following end of the crediting period.*	*This item should be monitored at the same time as ID3*

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

>>Baseline emissions are calculated by means of Equation-2 and Equation-7 a follows:

(Equation-2) Baseline emissions (ton-CO_2/y) = Sum (MSByi * EFsi) * GWPm

(Equation-7) MSByi = Sum (CSBim * VSBim)

Where,
MSByi: Sludge i mass exhausted from the baseline system into the sludge field in the year y (ton-RDS/y)
EFsi: Emission factor of the sludge i (ton-CH_4/ton- RDS)
GWPm: Global warming potential of CH_4 (no dimension) = 21
CSBim: Sludge i concentration exhausted from the baseline system into the sludge field in the period m (ton-RDS/m3)
VSBim: Sludge i volume exhausted from the baseline system into the sludge field in the period m (m3/month)

CSPm (instantaneous concentration) and VSPm (aggregate flow) are determined ex-post upon monitoring these items every month.
Concerning EFs, as a result of conducting measurement on the project site, this is 2.42×10^{-2} ton-CH_4/ton-RDS for sludge treated in the existing digester and 7.80×10^{-2} ton -CH_4/ton-RDS for untreated sludge.
GWPm is a constant, set at 21 in this case.

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

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

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

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

>>

D.2.3. Treatment of leakage in the monitoring plan

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

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
5	*Py Net supplied power by the project co-generation system (or generator)*	*Watt hour meter*	*MWh*	*m*	*Once a year*	*100%*	*Electric Monitored data shall be archived for 2 years following end of the crediting period.*	*This item can be measured by using watt hour meter for sold power and watt hour meter for bought power. In order to know net supplied power, calculate as follows, net supplied power = sold power - bought power*
7	*EFPy Emission factor of the baseline grid*	*Data calculated in accordance with the baseline methodology*	*ton-CO_2/MWh*	*c*	*Once a year*	*100%*	*Electric Monitored data shall be archived for 2 years following end of the crediting period.*	*This item shall be acquired by adopting the following documents, (3-3) of the methodology below.*

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

>>Greenhouse gases emitted outside of the project boundary include emissions from the grid generating electric power that is substituted by the cogeneration system. These emissions are regarded as leakage in the baseline. In contrast, no leakage exists in the project. To sum up, leakage in the baseline and leakage in the project can be calculated as follows:

(Equation-3) Baseline leakage (ton-CO_2/y) = EFPy * Py + EFHy * Hy

(Equation-5) Project Leakage (ton-CO_2/y) = 0

Where,
EFPy: Emission factor of the baseline grid in the year y (ton-CO_2/MWh)
Py: Net supplied power by the project co-generation system (or generator) in the year y (MWh/y)

Concerning EFPy, the value given in the "Operational Guidelines for Project Design Documents of Joint Implementation Projects Volume 1": General Guidelines Version 2.3 Ministry of Economic Affairs of the Netherlands May 2004, P42 Table B1, shall be adopted. These guidelines are equivalent to the "EFPy that an investing country's government has developed and published for CDM and/or JI" as stated in section (3-3). As for the emissions factor from 2013 that is not given in these guidelines, it is set on the conservative side in line with the purport of these guidelines.

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

>>

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1	*Medium*	*Measuring devices will be regularly tested to secure accuracy. It is planned to be monitored monthly, but monitored weekly or daily if the data is unstable.*
2	*Low*	*Measuring devices will be regularly tested to secure accuracy.*
3	*Medium*	*Measuring devices will be regularly tested to secure accuracy. It is planned to be monitored monthly, but monitored weekly or daily if the data is unstable.*
4	*Low*	*Measuring devices will be regularly tested to secure accuracy.*
5	*Low*	*Measuring devices will be regularly tested to secure accuracy.*
7	*Low*	*Data calculated in accordance with the baseline methodology.*

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

>>In the project, quality control and quality assurance will be carried out by the following methods. Incidentally, 'management' here refers to employees of the Kievvodokanal management organization. Also, 'operating personnel' refers to operators of the Bortnich Waste Water Treatment Plant, who execute monitoring activities under the instructions of the management.

- 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.
- Operating personnel will be assured regular opportunities to receive training and education, in order to enable them to carry out work according to the above procedures.
- Operating personnel will implement work according to the above procedures and will report results to management.
- 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.
- Management will regularly patrol and visit work areas to audit that work is being appropriately implemented by operating personnel according to the procedures. If problems are found in such audits, management will implement appropriate countermeasures with appropriate timing.
- 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 the event of emergencies (including the unforeseen release of GHG), the operating personnel will take emergency steps and implement countermeasures according to the instructions given by 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.

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

>>General Manager : Kurita Hiroyuki, and
Engineer : Arumu Take
Shimizu Corporation
Energy Solutions Department
SEAVANS SOUTH, 1-2-3
Shibaura, Minato-ku, Tokyo 105-8007
03-5441-0137 (from inside Japan)
+81-3-5441-0137 (from outside Japan)
(Japanese HP) http://www.shimz.co.jp/
(English HP) http://www.shimz.co.jp/english/index.html

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>Project activity emissions are calculated by means of Equation-4 as follows:

(Equation-4) Project emissions (ton-CO_2/y) = Sum (MSPyi * EFsi) * GWPm

Where,
MSPy1: Sludge 1 mass exhausted from the project system into the sludge field in the year y (ton-RDS/y) = 116,800
EFs1: Emission factor of the sludge 1 (ton-CH_4/ton- RDS) = $2.42*10^{-2}$
GWPm: Global warming potential of CH_4 (no dimension) = 21

Therefore,

Project emissions (ton-CO_2/y) = 116,800 * 2.42 * 10^{-2}* 21 = $5.93*10^4$

It should be noted, however, that these figures are estimate values and not actual emissions.

E.2. Estimated leakage:

>>Baseline leakage and project leakage can be calculated by means of the following equations:

(Equation-3) Baseline leakage (ton-CO_2/y) = EFPy * Py

(Equation-5) Project Leakage (ton-CO_2/y) = 0

Where,
EFPy: Emission factor of the baseline grid in the year y (ton-CO_2/MWh)
Py: Net supplied power by the project co-generation system (or generator) in the year y (MWh/y)

Concerning EFPy, the value given in the "Operational Guidelines for Project Design Documents of Joint Implementation Projects Volume 1": General Guidelines Version 2.3 Ministry of Economic Affairs of the Netherlands May 2004, P42 Table B1, shall be adopted. These guidelines are equivalent to the "EFPy that an investing country's government has developed and published for CDM and/or JI" as stated in section (3-3). As for the emissions factor from 2013 that is not given in these guidelines, it is set on the conservative side in line with the purport of these guidelines. These values are shown in the following table.

Concerning Py, assuming that cogeneration capacity is 8,900kW, annual operating time is 8,040 hours and own consumption rate is 10%, this is calculated as: 8,900kW 8,040 hr (1-0.1) = 64,400 MWh/y.

Accordingly, baseline leakage values are as shown in the following table.

Year	Emission factor of the grid	Net power supply	Baseline leakage
-	ton-CO_2/MWh	MWh/y	ton-CO_2/y
2009	6.80E-01	6.44E+04	4.38E+04
2010	6.66E-01	6.44E+04	4.29E+04
2011	6.51E-01	6.44E+04	4.19E+04
2012	6.36E-01	6.44E+04	4.10E+04
2013	6.21E-01	6.44E+04	4.00E+04
2014	6.06E-01	6.44E+04	3.90E+04
2015	5.91E-01	6.44E+04	3.81E+04
2016	5.76E-01	6.44E+04	3.71E+04
2017	5.61E-01	6.44E+04	3.61E+04
2018	5.46E-01	6.44E+04	3.52E+04
2019	5.31E-01	6.44E+04	3.42E+04
2020	5.16E-01	6.44E+04	3.32E+04
2021	5.01E-01	6.44E+04	3.23E+04
2022	4.86E-01	6.44E+04	3.13E+04
2023	4.71E-01	6.44E+04	3.03E+04
Total	-	9.66E+05	5.56E+05

It should be noted, however, that these figures are estimate values and not actual emissions.

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

>>To sum up, project activity emissions are calculated as follows:

$$\text{Project emissions (ton-}CO_2\text{/y)} = 5.93*10^4$$

It should be noted, however, that these figures are estimate values and not actual emissions.

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

>>Baseline emissions are calculated by means of Equation-2 as follows:

$$\text{(Equation-2) Baseline emissions (ton-}CO_2\text{/y)} = \text{Sum (MSByi * EFsi) * GWPm}$$

Where,
MSByi: Sludge i mass exhausted from the baseline system into the sludge field in the year y (ton-RDS/y)
EFsi: Emission factor of the sludge i (ton-CH_4/ton- RDS)
GWPm: Global warming potential of CH_4 (no dimension) = 21

In the baseline there are two types of sludge: the sludge that is treated in the existing digester, and sludge that is untreated. The treated sludge accounts for 14.7% of the total.

Sludge treated in the digester is as follows:
MSBy1 (ton-RDS/y) = 116,800 * 0.147
EFs1: (ton-CH_4/ton- RDS) = $2.42*10^{-2}$

Untreated sludge is as follows:
MSBy2 (ton-RDS/y) = 116,800 * (1-0.147)
EFs2: (ton-CH_4/ton- RDS) = $7.80*10^{-2}$

Therefore,

$$116{,}800 * 2.42 * 10^{-2} * 21 * 0.147 + 116{,}800 * 7.80 * 10^{-2} * 21 * (1-0.147)$$
$$= 8.72 * 10^{3} + 1.63*10^{5} = 1.72*10^{5}$$

When the baseline leakage is added to this, baseline emissions work out as shown in the following table.

Year	Baseline leakage	Methane emissions from sludge field (Methane emission from the sludge that is digested at the existing digester)	Methane emissions from sludge field (Methane emission from the sludge that is not digested at the existing digester)	Baseline emission
-	ton-CO_2/y	ton-CO_2/y	ton-CO_2/y	ton-CO_2/y
2009	4.38E+04	8.72E+03	1.63E+05	2.16E+05
2010	4.29E+04	8.72E+03	1.63E+05	2.15E+05
2011	4.19E+04	8.72E+03	1.63E+05	2.14E+05
2012	4.10E+04	8.72E+03	1.63E+05	2.13E+05
2013	4.00E+04	8.72E+03	1.63E+05	2.12E+05
2014	3.90E+04	8.72E+03	1.63E+05	2.11E+05
2015	3.81E+04	8.72E+03	1.63E+05	2.10E+05
2016	3.71E+04	8.72E+03	1.63E+05	2.09E+05
2017	3.61E+04	8.72E+03	1.63E+05	2.08E+05
2018	3.52E+04	8.72E+03	1.63E+05	2.07E+05
2019	3.42E+04	8.72E+03	1.63E+05	2.06E+05
2020	3.32E+04	8.72E+03	1.63E+05	2.05E+05
2021	3.23E+04	8.72E+03	1.63E+05	2.04E+05
2022	3.13E+04	8.72E+03	1.63E+05	2.03E+05
2023	3.03E+04	8.72E+03	1.63E+05	2.02E+05
Total	5.56E+05	1.31E+05	2.45E+06	3.14E+06

It should be noted, however, that these figures are estimate values and not actual emissions.

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

>>Emission reductions are as shown in the following table. It should be noted, however, that these figures are estimate values and not actual emissions.

Year	Emission reduction
-	ton-CO_2/y
2009	1.56E+05
2010	1.55E+05
2011	1.55E+05
2012	1.54E+05
2013	1.53E+05
2014	1.52E+05
2015	1.51E+05
2016	1.50E+05
2017	1.49E+05
2018	1.48E+05
2019	1.47E+05
2020	1.46E+05
2021	1.45E+05
2022	1.44E+05
2023	1.43E+05
Total	2.25E+06

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

>>The above calculation results are compiled in the following table. It should be noted, however, that these figures are estimate values and not actual emissions.

			Baseline emission			Project emission	
Year	Emission factor of the grid	Net power supply	CO_2 emission from the grid (Baseline leackage)	Methane emissions from sludge field (Methane emission from the sludge that is digested at the existing digester)	Methane emissions from sludge field (Methane emission from the sludge that is not digested at the existing digester)	Methane emissions from sludge field	Emission reduction
-	ton-CO_2/MWh	MWh/y	ton-CO_2/y	ton-CO_2/y	ton-CO_2/y	ton-CO_2/y	ton-CO_2/y
2009	6.80E-01	6.44E+04	4.38E+04	8.72E+03	1.63E+05	5.93E+04	1.56E+05
2010	6.66E-01	6.44E+04	4.29E+04	8.72E+03	1.63E+05	5.93E+04	1.55E+05
2011	6.51E-01	6.44E+04	4.19E+04	8.72E+03	1.63E+05	5.93E+04	1.55E+05
2012	6.36E-01	6.44E+04	4.10E+04	8.72E+03	1.63E+05	5.93E+04	1.54E+05
2013	6.21E-01	6.44E+04	4.00E+04	8.72E+03	1.63E+05	5.93E+04	1.53E+05
2014	6.06E-01	6.44E+04	3.90E+04	8.72E+03	1.63E+05	5.93E+04	1.52E+05
2015	5.91E-01	6.44E+04	3.81E+04	8.72E+03	1.63E+05	5.93E+04	1.51E+05
2016	5.76E-01	6.44E+04	3.71E+04	8.72E+03	1.63E+05	5.93E+04	1.50E+05
2017	5.61E-01	6.44E+04	3.61E+04	8.72E+03	1.63E+05	5.93E+04	1.49E+05
2018	5.46E-01	6.44E+04	3.52E+04	8.72E+03	1.63E+05	5.93E+04	1.48E+05
2019	5.31E-01	6.44E+04	3.42E+04	8.72E+03	1.63E+05	5.93E+04	1.47E+05
2020	5.16E-01	6.44E+04	3.32E+04	8.72E+03	1.63E+05	5.93E+04	1.46E+05
2021	5.01E-01	6.44E+04	3.23E+04	8.72E+03	1.63E+05	5.93E+04	1.45E+05
2022	4.86E-01	6.44E+04	3.13E+04	8.72E+03	1.63E+05	5.93E+04	1.44E+05
2023	4.71E-01	6.44E+04	3.03E+04	8.72E+03	1.63E+05	5.93E+04	1.43E+05
Total	-	9.66E+05	5.56E+05	1.31E+05	2.45E+06	8.90E+05	2.25E+06

SECTION F. Environmental impacts

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

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

(a) Legal framework

Legal framework concerning environmental impact analysis in the host country Ukraine includes the following legislation.

(1) The Law on the Protection of the Environment (June 1991)
(2) The Ukrainian Law on Protection of Ambient Air (June 21, 2001). This covers the conservation and improvement of air quality, environmental safety pertaining to the life of human activities, prevention

of environmental impacts by hazardous substances, and regulation of activities that have an impact on climate.
(3) The State Building Standard SBS A.2.2.-1-95, 2003 new version). This prescribes the contents of assessment when conducting environmental impact assessment on projects, construction, building and facilities.
(4) Law of Ukraine on Environmental Expertise: This was proposed in the Ukraine supreme parliament and signed by the President (N 45/95-BP) on September 2, 1995.

Incidentally, apart from the above legislation, there are no other local ordinances that apply to the project implementation site.

(b) Current environmental impacts of the water treatment plant
The water treatment plant current imparts the following negative impacts on the environment:

(1) Odor: The sludge field constantly emits odorous gases that have an adverse impact on the surrounding environment and also the health of people who work in the sludge field.
(2) Fire and explosions: There is risk of fire and explosions caused by CH_4 occurring in the sludge field.
(3) Global warming: Since CH_4 generated from the sludge field is not collected and treated, this contributes to global warming.
(4) Landscape: CH_4 gases and odor emitted from the sludge field detract from the surrounding landscape.

Moreover, in areas apart from the treatment plant, deteriorated and inefficient power plants that emit GHG and other harmful gases (NOx, etc.) into the atmosphere continue to be operated.

(c) Beneficial environmental impacts of the project
The project will impart the following beneficial impacts on the environment.

(1) Odor: Since project implementation will lead to a reduction in the amount of sludge carried into the sludge field, this will greatly reduce odor generation in the field. This is one of the beneficial environmental aspects of the project.
(2) Risk of fire and explosions: Similarly, project implementation will greatly reduce the risk of fires and explosions. This is another beneficial environmental aspect of the project.
(3) Global warming: Similarly, project implementation will lead to a major reduction in emissions of CH_4 (a greenhouse gas) into the atmosphere. This is another beneficial environmental aspect of the project.
(4) Landscape: As was indicated above, project implementation will lead to major reductions in emissions of CH_4 and odor from the sludge field, thereby contributing to improvement of landscape in the immediate area. This is another beneficial environmental aspect of the project.
(5) Substitution of deteriorated power generation systems: Since the cogeneration system planned for installation in the project will comprise standards and technology used in advanced countries, gas emissions from the system will also be cleaner. This is another beneficial environmental aspect of the project.

(d) Negative environmental impacts of the project
Potentially damaging environmental impacts of the project in terms of air, water and soil, and their countermeasures, are indicated below.

(1) Air environment: Since the project cogeneration system will use an internal combustion generator, exhaust gases will be generated. Therefore, it is possible that the air environment will be affected. However, this threat can be eliminated by adopting appropriate digestion gas/bio gas desulphurisation

equipment and NOx reduction technology (on the motor side) that comply with advanced country standards and technology and installing a stack of appropriate height.

(2) Water environment: Since the project does not entail generation of wastewater that could adversely affect the water environment, there is no chance of the water environment being adversely affected.

(3) Soil environment: Since the project does not entail the infiltration or discharge of wastewater that could contaminate soil, there is no chance of the soil environment being adversely affected.

(4) Noise and vibration. In the project, noise and vibration will be generated as a result of installing digestion gas/bio gas collection blowers and cogeneration equipment. However, since these equipments will be installed well away from residential areas, they will not be a problem. There is, however, a risk of problems arising in terms of the working environment for operators at the plant (impact on hearing, etc.). These problems can be resolved by installing appropriate soundproof covers and vibration-resistant frames.

(e) Conclusion of the project participants

In consideration of the above, the project participants have concluded that the project will not have any major adverse impact on the environment.

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

>>As was mentioned above, the project will not have any major adverse impact on the environment.

SECTION G. Stakeholders' comments

>>

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

>>In the case of JI projects in Ukraine, it is not obligatory for comments from stakeholders to be invited and compiled. Neither is this a requirement for the PDD. Accordingly, there are no stipulations in particular concerning who may become a stakeholder. Therefore, if it is decided to collect stakeholders' comments, the project participants are free to decide who the stakeholders are.

Concerning the method for collecting stakeholders' comments, prior to the determination by the Independent Entity (IE), one possibility is to disclose the proposed contents of the project on the internet and in mass media and to discuss the matter in a roundtable conference of NGO representatives and all related parties. In this case, sponsors of the roundtable conference (either the project participants on the Japanese side, i.e. Shimizu Construction, or the owner of the project site, i.e. Kiev City, or the counterparts, i.e. Kievvodokanal Co.) would record all the comments made.

G.2. Summary of the comments received:

>>Assuming the stakeholders to be Kiev City and Kievvodokanal Co., comments received from both parties were positive and supportive of project realization.

Moreover, the official viewpoint of Kiev City and Kievvodokanal Co. concerning the project has already been compiled into the following documents:

--Resolution #364/1774 of Kiev City Council (15.07.2004) "On amendments to "Programme of social-economic and cultural development of Kiev city for year 2004"

--Decree # 1973 of Kiev City State Administration (29.10.2004) "On elaboration of feasibility study of the project " Sewage sludge utilisation at Bortnichi WWTP of JSC "Kievvodokanal"

-- Proposals submitted for consideration of the Government of Ukraine for making decision on the feasibility of development of projects proposed for joint financing with international financial organizations. Project name: "Integrated Technology of Wastewater Sediment Treatment, Digestion, and Generation of Electric and Heat Energy of Biogas at Bortnichi Aeration Station of Open Joint Stock Company "Kievvodokanal"

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

>>No due account in particular is required concerning the comments received.

SECTION H. Financing plan

>>Although the PDD for JI projects in Ukraine does not require collection of comments from stakeholders, it does require description of the financing plan. Here, a summary of the project financing plan is given.

Concerning this project, Japanese party and Ukrainian party will sign on an agreement on ERU purchasing. This agreement would include unit price of ERU and amount of ERU to be purchased. This agreement would also include advanced ERU payment. In addition to this fund by this agreement, Ukrainian party will receive fund from Kiev city investment department. This fund is state budget and is being considered that it should be received from ODA fund such as soft loan like environmental yen loan.

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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State/Region:	Tokyo
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Country:	Japan
Telephone:	81-3-5441-1111
FAX:	-
E-Mail:	-
URL: HP address	http://www.shimz.co.jp/english/index.html http://www.shimz.co.jp/
Represented by:	Tetsuya Nomura
Title:	General Manager
Salutation:	Mr.
Last Name:	Kurita
Middle Name:	-
First Name:	Hiroyuki
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Direct tel:	+81-3-5441-0137
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Project Participant 2

Organization:	Open joint stock company "Kievvodokanal"
Street/P.O.Box:	Leipzigskaya str., 1A.
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State/Region:	Kiev City
Postfix/ZIP:	01015
Country:	Ukraine
Telephone:	+380-44-226-30-38
FAX:	+380-44-254-32-61
E-Mail:	okusch@aquamail.kiev.ua
URL:	-
Represented by:	Serdjuk Sergey Dmitrievich
Title:	Director of Bortnichi WWTP
Salutation:	Mr.
Last Name:	Sergeevich
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Because this project is a JI project, this item can be skipped. (It is not yet confirmed whether the fund of this project is diversion of ODA fund from Japanese Government or not, or is completely irrelevant to Japanese funding obligation or not.)

Annex 3

BASELINE INFORMATION

Preconditions and Parameters

Item	ID	Value	Unit	Source, basis, formula
Amount of sludge	RDS	116,800	ton-RDS/y	Bortnichi Wate Water Treatment Plant
Fraction of sludge that is digested at the existing anaerobic digesters	DF	0.147	-	Bortnichi Wate Water Treatment Plant

Unit conversion factor, etc

Item	ID	Value	Unit	Source, basis, formula
Density of methane	DM	0.7168	kg/Nm3	Consolidated baseline methodology for landfill gas project activities
Unit conversion factor	UCF1	4.1868	kJ/kcal	Science Almanac
Unit conversion factor	UCF2	860	kcal/kW	Science Almanac
Lower heating value of methane	LHV1	8,560	kcal/Nm3	Thermal and Nuclear Power Engineering Society, Ministry of International Trade and Industry, Agency for Natural Resources and Energy, "Companion for Thermal and Nuclear Power Generation", 1991、P158
Lower heating value of methane	LHV2	35.839	MJ/Nm3	LHV1*UCF1/1,000

Specification of co-generation system

Item	ID	Value	Unit	Source, basis, formula
Power efficiency of co-generation system	EFP	0.35	-	Value set by Project Participants
Heat recovery efficiency of co-generation	EFR	0.40	-	Value set by Project Participants
Total efficiency of co-generation system	EFT	0.75	-	EFP+EFR
Power capacity of co-generation system	CP	8,900	kW	MRP3*EFP
Heat recovery capacity of co-generation	CR	10,200	kW	MRP3*EFR
Yearly operation hours	YOH	8,040	hr/ y	Value set by Project Participants
Annual power generation	GP	71,556	MWh/y	CP*YOH/1,000
Annual heat recovery	GR	82,008	MWh/y	CR*YOH/1,000
Self power consumption rate	ESD	0.10	-	Value set by Project Participants
Net power supply	NETP	64,400	MWh/y	GP*(1-ESD)

Annex 4

MONITORING PLAN

Based on the monitoring methodology, the monitoring plan for the following items is demonstrated.

○**CSPm**
○**CSBm**

The concentration of sludge is measured by using one of the following items as a scale, i.e. RDS (raw dry solid), COD (chemical oxygen demand), TOC (total organized carbon), or BOD_5 (biochemical oxygen demand). Concerning the method of analysis, a method that is generally recognized (JIS in the case of Japan) in either the investing country (Japan) or host country (Ukraine) will be adopted.

○**VSPm**
○**VSBm**

There are various types of flow rate, however, the one targeted here is the volumetric flow rate of effluent containing a high concentration of sludge, measured as the instantaneous flow rate and the aggregate flow rate. The instantaneous volumetric flow rate of liquid can be measured using a differential flowmeter (orifice, etc.), an area flowmeter (float, etc.), an electromagnetic flowmeter, a supersonic type flowmeter, or a vortex flowmeter. The performance characteristics required of the flowmeter to be used here are relatively low price (meaning a widely available type), accuracy, little impact on precision even if there is some variation in flow rate, durability (against even corrosive liquids such as sludge), and low-maintenance. The electromagnetic type flowmeter or supersonic flowmeter fulfill these requirements. One of these two types shall be adopted in the project.

Furthermore, since it is necessary to have a computer in order to calculate the aggregate flow rate, it is also necessary for the flowmeter to have computer outputting capability (i.e. to have a transmitter).

Since it is necessary to know the accumulated flow rate rather than the instantaneous flow, it is not necessary to take and record frequent visual measurements. As a rule, the display shall be checked at least once per week for any abnormality, and records shall be taken once per month.

Features of the electromagnetic flowmeter and the supersonic flowmeter are that the flowmeter unit does not have any moving parts and there is hardly any risk of accuracy deteriorating over time. Accordingly, it is not necessary to implement periodic calibration of the flowmeter unit; rather checking will mainly focus on making sure that input/output signals are accurately transmitted between the transmitter terminal on the flowmeter side and the computer terminal. This is done by inputting mock signals to the computer to check and adjust the accuracy of pressure display on the computer side.

Because there are no international calibration standards concerning the calibration work described above, calibration will be implemented based on standards of the instrument makers.

○**Py**

The wattmeter is used for monitoring required in the JI project and also for power sale and purchase. Accordingly, wattmeters will be installed as required or provided by the electricity grid owner, and these will be calibrated as required.

Electric energy is consecutively measured and automatically summated. Since it is necessary to know the accumulated electric energy rather than the instantaneous electric energy, it is not necessary to take and record frequent visual measurements. As a rule, the display shall be checked at least once per week for any abnormality, and records shall be taken once per month to coincide with checking and recording of the LFG flow rate.

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CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: BASELINE (CDM-NMB)
Version 02 - in effect as of: 15 July 2005

CONTENTS
PROPOSED NEW METHODOLOGY: BASELINE (CDM-NMB)

SECTION A. Methodology title and summary description

Methodology title:

>>**The title of the proposed methodology**: Baseline methodology for open anaerobic digestion of sewage sludge

The version number of the document: Version001

The date of the document: 10/03/2006

Summary description:

>> **i. Description on how to choose the baseline scenario**

List plausible scenarios and carry out barrier analysis on them. Next conduct investment analysis on the scenarios that present the fewest barriers, and adopt the baseline scenario from the one that has the highest investment effect.

ii. Description on how to demonstrate additionality

Additionality is demonstrated by qualitatively showing that greenhouse gas (GHG) emissions in the project scenario are less than GHG emissions in the baseline scenario.

iii. Description on how to calculate baseline emissions

GHG emissions (only CH_4) in the baseline scenario are calculated as the product of the amount of sludge put into the open anaerobic digestion facilities (open anaerobic digester, sludge field) from the wastewater treatment plant and the emission factor of the unit amount of sludge.

iv. Description on how to calculate project emissions

GHG emissions (only CH_4) in the project scenario are calculated as the product of the amount of sludge put into the open anaerobic digestion facilities from the closed anaerobic digester and the emission factor of the unit amount of sludge.

v. Description on how to calculate leakage

Leakage (only CO_2) in the baseline scenario consists of emissions from the grid arising in order to supply electricity that will be alternatively generated in the project, as well as emissions from the heat supply system arising in order to supply heat that will also be alternatively generated in the project. These leakage amounts are calculated as the product of the amount of electric power and grid emission factor and the product of the recovered amount of heat and the emission factor of the heat supply system.
There is no leakage in the project scenario.

vi. Description on how to calculate emission reductions

Emission reductions are calculated by subtracting GHG emissions in the project scenario from the sum of GHG emissions and leakage in the baseline scenario.

If this methodology is a based on a previous submission, please state the previous reference number (NMXXXX/AMXXXX) here:

>>This methodology is not based on any previous submissions.

SECTION B. Applicability/ project activity

Methodology procedure:

>>**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).

Applicability conditions

This baseline methodology can be applied to projects for wastewater treatment plants that satisfy all the following conditions:

(1) The existing wastewater treatment plant treats all generated sludge in an open anaerobic digester (sludge field) and discharges CH4 into the atmosphere. Before sludge is inserted into the open anaerobic digester, it can undergo some form of pretreatment. If some of the CH_4 discharged into the atmosphere is collected at the open anaerobic digester, this methodology cannot be applied.
(2) In the project, sludge is treated in a closed anaerobic digester, and all digestion gas/biogas including CH_4 that is generated from the closed anaerobic digester is collected.
(3) Sludge that undergoes ample treatment in the project closed anaerobic digester undergoes further treatment in an open anaerobic digester. (In cases where sludge that is amply treated in the project closed anaerobic digester is not further treated in an open anaerobic digester but by a method that doesn't generate CH_4, this methodology can be applied by assuming project emissions to be zero).
(4) The digestion gas/biogas including CH_4 that is generated from the closed anaerobic digester is used as fuel in a cogeneration system or for a generator or boiler. Alternatively, it is combusted in flaring equipment.
(5) Electric power obtained from the cogeneration system or generator, apart from the power consumed in the project system, is transmitted to the wastewater treatment plant and/or power grid. As a result, power purchased from the grid by the wastewater treatment plant is reduced, and emissions saved at power plants on the grid can be claimed. (If they are not claimed, this methodology can be applied assuming the reduction to be zero).
(6) Waste heat obtained from the cogeneration system or boiler, apart from the heat consumed in the project system, is transmitted to the wastewater treatment plant and/or heat consumers. Since utilization of this alternative energy leads to reduction in consumption of fossil fuels, the resulting reduction in emissions can be claimed. (If they are not claimed, this methodology can be applied assuming the reduction to be zero).
(7) The specific emission factor per unit amount of sludge in the open anaerobic digester is known beforehand. The ex-ante period of measurement of this emission factor must not exceed the actual treatment period of sludge in the open anaerobic digester. The unit of sludge when measuring ex-ante should conform to the unit of sludge during monitoring.

Furthermore, this baseline methodology must be used in tandem with the "Monitoring methodology for open anaerobic digestion of sewage sludge."

Explanation/justification:

>>**Category(ies) of project activity**

This baseline methodology applies to reducing current emissions of CH_4 from open anaerobic digestion facilities by treating sludge in a closed anaerobic digester. It also entails effectively utilizing CH_4 recovered from the closed anaerobic digester as a renewable source of energy and claiming the resulting emission reductions. Accordingly, it is appropriate to select the above category.

Applicability conditions

Conditions (1) through (6) above directly express the project contents and are essential conditions. Moreover, in (7), since the specific discharge coefficient of sludge is adopted, this means that conditions specific to the project site such as the geographical area, climate, sewage composition, sewage treatment method, sludge field structure and soil conditions in the sludge field, etc. are already included.

SECTION C. Project Boundary

Methodology procedure:

>>The project boundary shall include the existing sludge field as well as the new closed anaerobic digester and cogeneration system (or generator, boiler and flare equipment). The following table lists sources of emissions from within the project boundary and states whether or not each emission is to be included in this methodology. Figure 1 gives an illustrated view of the project boundary.

Emissions sources included in or excluded from the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Sludge field (Open anaerobic digester)	CO_2	Excluded	CO_2 is emitted from the fermentation and decomposition of sludge; however, this is disregarded in order to be on the conservative side. Moreover, since this CO_2 is derived from biomass, it may be ignored.
		CH_4	Included	This is the most important emission source.
Project Activity	Sludge field (Open anaerobic digester)	CO_2	Excluded	CO_2 is emitted from the fermentation and decomposition of sludge, however, this is disregarded (since the amount of sludge put into the sludge field in the project is less than the said amount in the baseline, this may be disregarded and still a conservative outcome will be obtained Moreover, since this CO_2 is derived from biomass, it may be ignored.
		CH_4	Included	This is the most important emission source.
	Closed anaerobic digester	CO_2	Excluded	CO_2 leakage from the reaction tank is small enough to be ignored. Moreover, since this CO_2 is derived from biomass, it may be ignored.
		CH_4	Excluded	CH_4 leakage from the reaction tank is small enough to be ignored.
	Co-generation system (or generator or boiler, or flare)	CO_2	Excluded	Since this CO_2 is derived from biomass, it may be ignored.
		CH_4	Excluded	CH_4 emissions from fuel combustion are small enough to be ignored when compared to CO_2 emissions from the same source.
		N_2O	Excluded	N_2O emissions from fuel combustion are small enough to be ignored when compared to CO_2 emissions from the same source.

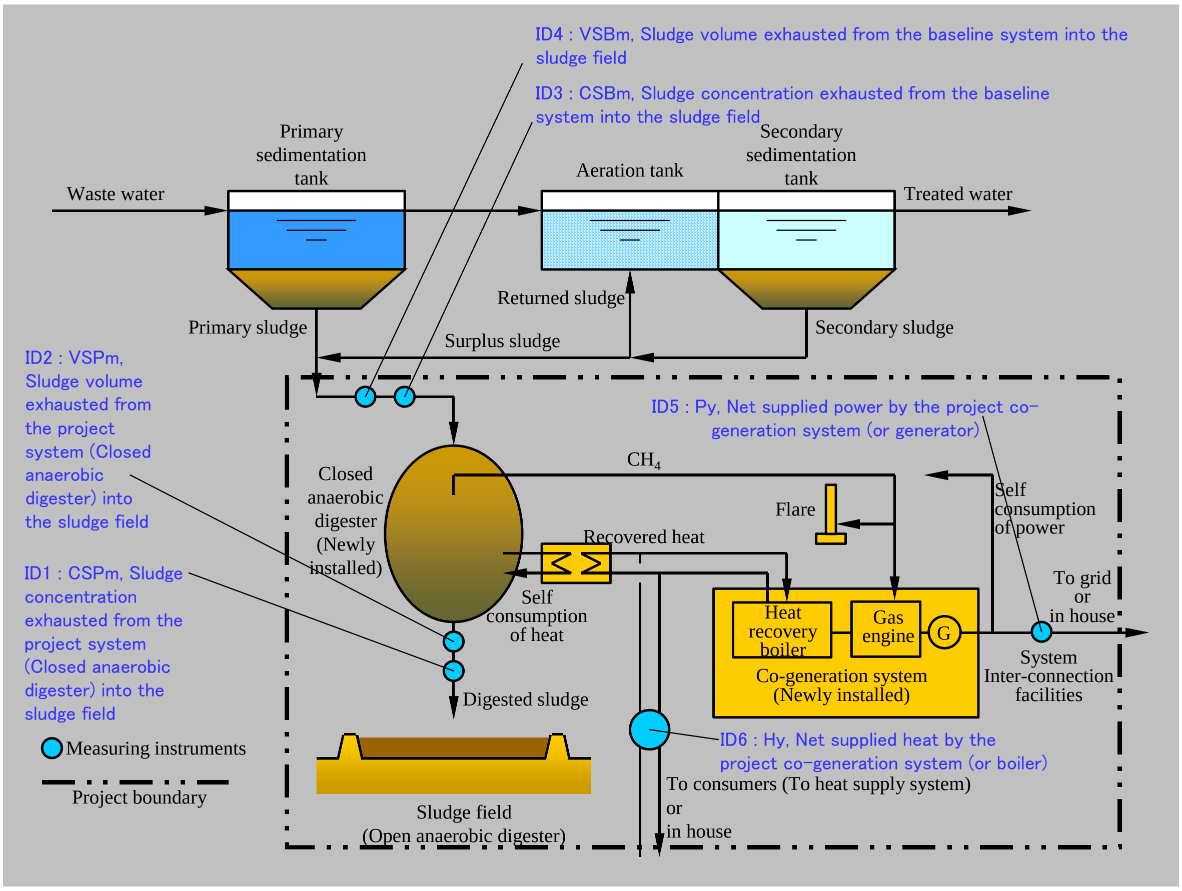

Figure-1: Project boundary

Explanation/justification:

>>Since the greenhouse gases involved in this project are limited to those deriving from the combustion of biogas generated from the decomposition of organic sludge, there is no need to consider PFC, HFC and SF_6. Accordingly, examination can be limited to just three greenhouse gases, i.e. CO_2, CH_4 and N_2O. Moreover, concerning emissions of CO_2, since the organic sludge from which it is derived comes from biomass, these emissions can also be disregarded. Concerning emissions of CH_4 and N_2O, too, these may also be disregarded because the quantities concerned are far smaller than CO_2 emissions. Accordingly, the only emissions source within the project boundary is CH_4 that is discharged from the sludge field as a result of decomposition of organic sludge.

D. Baseline Scenario

Methodology procedure:

>>In this methodology, the baseline scenario is identified by means of the following procedure:

(1) List all scenarios that are legal in the host country. Include the project scenario in these.

(2) Conduct barrier analysis on the listed scenarios; then conduct investment analysis on the scenarios with the fewest barriers, and make the scenario with the highest investment effect the baseline scenario.

In the barrier analysis here, the following barriers are examined:
(a-1) Technical barriers: The host country has no experience of handling the technical fields included in the scenario in hand, or any experience it does have is limited to extremely peculiar cases. Technical barriers refer to the absence of education, training, human resources, skills and materials required in order to realize the said technology (planning, design, execution, operation, maintenance, management, repairs).
(a-2) Conventional barriers: These barriers refer to the fact that the project scenario is not normally implemented in the host country because of popular social thinking, general customary, lifestyle customary, conventional and religious reasons.

In order to demonstrate that the above barriers exist, it is necessary to have the following transparent evidence:
(b-1) Opinions and testimony of experts in the said field (administrative officials in charge of the wastewater treatment plant, academics, engineers, surveyors and consultants specializing in sewage treatment technology, and managers of the treatment plant).
(b-2) Clear statistical data from literature.

The “peculiar cases” mentioned in (a-1) above indicate the following cases:
(c-1) First model projects in the industry.
(c-2) Projects that depend on some kind of subsidization.
(c-3) Projects that depend on some form of assistance from foreign countries.
(c-4) Projects that depend on contributions or charity with no commercial purpose, whether it is domestic or foreign.
(c-5) CDM projects
(c-6) JI projects
(c-7) GIS (green investment scheme) projects
(c-8) Projects that are linked to some kind of emissions trading.
(c-9) Demonstration projects that don’t take cost into account.

In investment analysis, it is necessary to calculate the following items in order to clarify cashflow and obtain the IRR after tax. Moreover, in order to secure a conservative outcome, it is permissible to use the IRR before tax.
(d-1) Design cost (initial cost)
(d-2) Construction cost (initial cost)
(d-3) Operation, maintenance and repair costs (running costs)
(d-4) Revenue from sale of electricity and sale of heat (0 when there is no revenue)
(d-5) Depreciation cost
(d-6) Taxes, commission fees and other institutionalized administrative expenses.

As a result of conducting investment analysis on the scenarios that pass the barrier analysis, the scenario with the highest IRR becomes the baseline scenario; however, scenarios that are deemed incapable of being the baseline scenario without conducting investment analysis because they do not generate enough revenue to cover costs may be excluded from investment analysis and may not be considered as the baseline scenario.

Even if a scenario has the highest IRR, it may be deemed not to be the baseline scenario in cases where it complies with any one of the following benchmarks. In other words, since the following cases indicate that there are no investors willing to take the necessary risk, it may be deemed that they are not the baseline scenario.
(e-1) When the calculated IRR is lower than the rate of interest on long-term government bonds.

(e-2) When the calculated IRR is lower than the minimum rate of return from similar projects proposed as an indicator by investment banks and investment funds in the host country.
(e-3) When the calculated IRR is lower than the minimum rate of return proposed as an indicator by prospective investors and participants in the project.

Explanation/justification:

>>**Why is this baseline methodology able to identify the baseline scenario?**
This baseline methodology identifies the scenario that entails the fewest barriers and highest economic feasibility. This scenario may be said to have the highest likelihood of being realized if there is no project. In other words, the scenario identified here is the baseline scenario. Moreover, in this methodology, as a result of the baseline scenario analysis, the methodology is described assuming that maintenance of status quo is the baseline scenario. Therefore, if baseline scenario analysis shows that maintenance of status quo is not the baseline scenario, this methodology cannot be used.

How can this baseline methodology be said to cover all possible scenarios?
This baseline methodology lists all possible scenarios without any exceptions. For example, possible scenarios are listed upon taking into account all possible sludge treatment methods as contained in literature, i.e. concentration, digestion, dewatering, composting, drying, incineration, melting and landfilling, etc. Checking to see if there are any exceptions is stringently carried out in validation (or determination in the case of a JI project) by the designated operational entity (DOE) (or independent entity (IE) in the case of JI).

What are the key assumptions and quantitative factors in this baseline methodology? Moreover, if they contain any uncertainty, what kind of uncertainty is that?
Investment analysis is carried out in this baseline methodology, and an objective or subjective rate of return is adopted as the benchmark in this. Such a rate of return is a key parameter. Any uncertainty here is that the subject and timing of judgment by this parameter are subject to variation. For example, it is possible that the subject and timing will be greatly affected by economic conditions.

How are policies and conditions of the host country and target sector incorporated into the methodology?
In this baseline methodology, only lawful cases are adopted when selecting the first candidate scenarios. Moreover, in the barrier analysis, conditions in the host country and target sector are incorporated in the technical and conventional aspects. Accordingly, policies and conditions in the host country and target sector are adequately incorporated into this baseline methodology.

SECTION E. Additionality

Methodology procedure:

>>If the following Equation-1 can be proven to be valid, demonstration of additionality is complete.

(Equation-1) Baseline emissions + Baseline leakage > Project emissions + Project Leakage

(Equation-2) Baseline emissions (ton-CO_2/y) = Sum (MSByi * EFsi) * GWPm

(Equation-3) Baseline leakage (ton-CO_2/y) = EFPy * Py + EFHy * Hy

(Equation-4) Project emissions (ton-CO_2/y) = Sum (MSPyi * EFsi) * GWPm

(Equation-5) Project Leakage (ton-CO_2/y) = 0

Where:
MSByi: Sludge i mass exhausted from the baseline system into the sludge field in the year y (ton-RDS/y, or ton-COD/y, or ton-TOC/y, or ton-BOD_5/y)
MSPyi: Sludge i mass exhausted from the project system into the sludge field in the year y (ton-RDS/y, or ton-COD/y, or ton-TOC/y, or ton-BOD_5/y)
EFsi: Emission factor of the sludge i (ton-CH_4/ton- RDS, or ton-CH_4/ton-COD, or ton-CH_4/ton-TOC, or ton-CH_4/ton- BOD_5)
EFPy: Emission factor of the baseline grid in the year y (ton-CO_2/MWh)
EFHy: Emission factor of the baseline heat supply system in the year y (ton-CO_2/MWh)
Py: Net supplied power by the project co-generation system (or generator) in the year y (MWh/y)
Hy: Net supplied heat by the project co-generation system (or boiler) in the year y (MWh/y)
GWPm: Global warming potential of CH_4 (no dimension) = 21

The unit of weight of sludge mass shall be one of the following units that can objectively express the quantity of organic material in sludge that generates CH_4, i.e. RDS (raw dry solid), COD (chemical oxygen demand), TOC (total organized carbon), or BOD_5 (biochemical oxygen demand). However, the said unit must correspond with the unit of sludge mass weight used when measuring EFs.

Here, if the following can be demonstrated, then the above Equation-1 becomes self-evident.

(Equation-6) Sum MSByi > Sum MSPyi

Accordingly, as a system characteristic, Equation-1 and additionality can be demonstrated if Equation-6 can be demonstrated, even qualitatively.

However, in Equation-2 and Equation-4, if a different EFs is set in the baseline case and the project case according to the type of sludge i, it is Equation-6-2, and not Equation-6, must be demonstrated in order to demonstrate additionality.

(Equation-6-2) Sum (MSByi * EFsi) > Sum (MSPyi * EFsi)

Explanation/justification:

>>**Why, following this procedure, can the project be said to be additional?**
Identification of the baseline scenario has already been completed up until Section D. Accordingly, if it can be demonstrated that GHG emissions in the project scenario are less than emissions in the baseline scenario, the project may be said to be additional. However, if the baseline scenario up to Section D is the same as the project scenario, i.e. if it is not business as usual, Equation-1 clearly does not come into effect and this methodology cannot be utilized.

What are the key assumptions and quantitative factors in this baseline methodology? Moreover, if they contain any uncertainty, what kind of uncertainty is that?

In Equation-2 and Equation-4, the same emission factor EFs is used concerning both sludge thrown into the sludge field in the baseline and sludge thrown into the sludge field in the project. The emission factor may differ if sludge in the two cases has differing properties, however, the key assumption here is that the same figure can be used in both cases.

In determining the emissions factor (EFs) of sludge, the emission factor of the sludge that is thrown into the current sludge field is measured prior to the project. Accordingly, the amount of CH_4 emitted from the present sludge field can be accurately calculated using this emission factor.

On the other hand, in the project, sludge that has been treated in the closed anaerobic digester is thrown into the sludge field. It is forecast that this sludge will already have reached an advanced stage of anaerobic decomposition and that the degree of anaerobic fermentation per unit of sludge in the sludge field will be greatly limited.

In other words, there is a strong possibility that the amount of CH4 that is actually emitted from sludge thrown into the sludge field in the project will be much lower than the amount of CH4 calculated using the above emission factor. Therefore, if the said emission factor is used, project emissions will be estimated on the high side, i.e. the estimate will be a conservative one.

If a different EFs is set in the baseline case and the project case according to the type of sludge, Equation-1, and not Equation-6, must be demonstrated in order to demonstrate additionality.

How are policies and conditions of the host country and target sector incorporated into the methodology?
Since the demonstration of additionality has already been implemented in the discussion up to Section D, this means that policies and conditions in the host country and target sector are adequately incorporated.

SECTION F. Baseline emissions

Methodology procedure:

>>Baseline emissions are calculated by means of Equation-2 and Equation-7 as follows:

$$\text{(Equation-2) Baseline emissions (ton-}CO_2\text{/y) = Sum (MSByi * EFsi) * GWPm}$$

$$\text{(Equation-7) MSByi = Sum (CSBim * VSBim)}$$

Where,
MSByi: Sludge i mass exhausted from the baseline system into the sludge field in the year y (ton-RDS/y, or ton-COD/y, or ton-TOC/y, or ton-BOD_5/y)
EFsi: Emission factor of the sludge i (ton-CH_4/ton- RDS, or ton-CH_4/ton-COD, or ton-CH_4/ton-TOC, or ton-CH_4/ton- BOD_5)
GWPm: Global warming potential of CH_4 (no dimension) = 21
CSBim: Sludge i concentration exhausted from the baseline system into the sludge field in the period m (ton-RDS/m^3, or ton-COD/m^3, or ton-TOC/m^3, or ton- BOD_5/m^3)
VSBim: Sludge i volume exhausted from the baseline system into the sludge field in the period m (m^3/month)

CSBm (instantaneous concentration) and VSBm (aggregate flow) are determined ex-post upon monitoring these items every month. However, in the ex-ante calculation of emissions, even if Equation-7 utilizing the monthly CSBm and VSBm is not conducted, it is possible to calculate using just the annual average sludge amount MSBy, or the annual average sludge concentration CSBm and sludge capacity VSBm.
EFs is a constant obtained by the PDD compiler in advance measurement.
GWPm is also a constant, set at 21 in this case.

Explanation/justification:

>>**Why is this method able to calculate baseline emissions?**

This calculation method is the same as that given in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 6 WASTE EQUATION 13 and is generally adopted in this technical field. However, in this calculation, because a site-specific emission factor is used to calculate the amount of CH4 emitted from the sludge field, this method is far more accurate than methods that use a default value as described in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and other literature.

Do any assumptions or parts of the procedure entail uncertainty?

CSBm and VSBm are determined ex-post by monitoring these items every month. This method enables factors causing seasonal fluctuation in sludge properties to be incorporated into the calculation, although factors that cause daily and hourly fluctuations cannot be incorporated. It may be said that this methodology contains uncertainty in this area. However, since tanks in wastewater treatment plants usually have vast capacity with enough room to deal with fluctuations in the quantity and quality of sewage flow, treatment processes are extremely stable. Accordingly, since the quantity and properties of sludge generated from wastewater treatment plants are not subject to major daily or hourly fluctuations, it should be sufficient to only conduct monitoring on a representative day every month.

SETION G. Project activity emissions

Methodology procedure:

>>Project activity emissions are calculated by means of Equation-4 and Equation-8 as follows.

(Equation-4) Project emissions (ton-CO_2/y) = Sum (MSPyi * EFsi) * GWPm

(Equation-8) MSPyi = Sum (CSPim * VSPim)

Where:

MSPyi: Sludge i mass exhausted from the project system into the sludge field in the year y (ton-RDS/y, or ton-COD/y, or ton-TOC/y, or ton-BOD_5/y)

EFsi: Emission factor of the sludge i (ton-CH_4/ton- RDS, or ton-CH_4/ton-COD, or ton-CH_4/ton-TOC, or ton-CH_4/ton- BOD_5)

GWPm: Global warming potential of CH_4 (no dimension) = 21

CSPim: Sludge i concentration exhausted from the project system (Closed anaerobic digester) into the sludge field in the period m (ton-RDS/m3, or ton-COD/m3, or ton-TOC/m3, or ton- BOD_5/m3)

VSPim: Sludge i volume exhausted from the project system (Closed anaerobic digester) into the sludge field in the period m (m3/month)

CSPm (instantaneous concentration) and VSPm (aggregate flow) are determined ex-post upon monitoring these items every month. However, in the ex-ante calculation of emissions, because there are no data, calculation with Equation-8 cannot be performed using CSPm and VSPm. This is resolved by utilizing forecast values as given in the equipment specification for the closed anaerobic digester. This figure may either be ① the amount of sludge MSPy at the outlet of the closed anaerobic digester, or ② the concentration of sludge CSPm at the outlet of the closed anaerobic digester and the capacity of sludge VSPm at the outlet of the closed anaerobic digester, or ③ the emission factor set on the low side by assuming the amount of sludge MSPy to be the amount of sludge at the inlet of the closed anaerobic digester of the reaction tank.

EFs is a constant obtained by the PDD compiler in advance measurement.

GWPm is also a constant, set at 21 in this case.

Explanation/justification:

>>**Why is this method able to calculate baseline emissions?**
This calculation method is the same as that given in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 6 WASTE EQUATION 13 and is generally adopted in this technical field. However, in this calculation, because a site-specific emission factor is used to calculate the amount of CH4 emitted from the sludge field, this method is far more accurate than methods that use a default value as described in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and other literature.

Do any assumptions or parts of the procedure entail uncertainty?
CSBm and VSBm are determined ex-post by monitoring these items every month. This method enables factors causing seasonal fluctuation in sludge properties to be incorporated into the calculation, although factors that cause daily and hourly fluctuations cannot be incorporated. It may be said that this methodology contains uncertainty in this area. However, since tanks in wastewater treatment plants usually have vast capacity with enough room to deal with fluctuations in the quantity and quality of sewage flow, treatment processes are extremely stable. Accordingly, since the quantity and properties of sludge generated from wastewater treatment plants are not subject to major daily or hourly fluctuations, it should be sufficient to only conduct monitoring on a representative day every month.

SECTION H. Leakage

Methodology procedure:

>>GHG emissions outside of the project boundary are as follows:
(1) Emissions from the grid generating electric power that is substituted by the cogeneration system (or generator); and
(2) Emissions from the heat supply system generating heat energy that is substituted by the cogeneration system (or boiler).

These emissions are regarded as leakage in the baseline. In the project, on the other hand, leakage does not exist. Summing up, baseline leakage and project leakage can be calculated by the following equations:

(Equation-3) Baseline leakage (ton-CO_2/y) = EFPy * Py + EFHy * Hy

(Equation-5) Project Leakage (ton-CO_2/y) = 0

Where,
EFPy: Emission factor of the baseline grid in the year y (ton-CO_2/MWh)
EFHy: Emission factor of the baseline heat supply system in the year y (ton-CO_2/MWh)
Py: Net supplied power by the project co-generation system (or generator) in the year y (MWh/y)
Hy: Net supplied heat by the project co-generation system (or boiler) in the year y (MWh/y)

Here, EFPy and EFHy can be determined using the following methodology.

EFPy
(1) When power generation capacity does not exceed 15MW: Use the "Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories AMS-I.D. Grid connected renewable electricity generation"(source: http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_C87N6C2G4PQEDPKV9CGQ6A5UNFJSJB)

(2) Use the "ACM0002 Consolidated baseline methodology for grid-connected electricity generation from renewable sources"(source: http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_ZIT66NYGZX2VK40KZ8KDNJ1NPFM61W)

(3) If there is an EFPy that is already disclosed and can be used, that may also be adopted.

Here, "an EFPy that is already disclosed and can be used" refers to the following:
(3-1) An EFPy that the host country's government has developed and published for CDM and/or JI.
(3-2) An EFPy that an international agency has developed and published for CDM and/or JI.
(3-3) An EFPy that an investing country's government has developed and published for CDM and/or JI.

EFHy
(4) If there is clear evidence that the baseline boiler efficiency does not exceed X%, use the following equation:

$$\text{(Equation-9) } EFHy = 3{,}600 MJ/MWh * 10^{-6} * CEF * FCO / X * 100 * 44/12$$

Where,
X: Efficiency of boiler of baseline scenario (%)
CEF: Carbon emission factor of the fuel used (ton-C/TJ)
FCO: Fraction of carbon oxidized of the fuel used (no dimension)

Concerning CEF and FCO, if the host country has its own unique values, use them; if not, use the value given in Table 1-1 and Table 1-6 of the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories" CHAPTER 1 ENERGY.

Explanation/justification:

>>**Why is this method able to calculate leakage?**
The following table lists sources of emissions from within the project boundary and states whether or not each emission is to be included in this methodology, along with the reasons.

Leakage sources included in or excluded outside the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Grid	CO_2	Included	The leakage calculation methods given in (1) through (3) adopt methodology that has already been approved or published by official agencies; accordingly, they may be viewed as general methods
		CH_4	Excluded	CH_4 emissions from fuel combustion are small enough to be ignored when compared to CO_2 emissions from the same source.
		N_2O	Excluded	N_2O emissions from fuel combustion are small enough to be ignored when compared to CO_2 emissions from the same source.
	Heat supply system	CO_2	Included	The leakage calculation method given in (4) adopts methodology given in the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories" CHAPTER 1 ENERGY; accordingly, it may be viewed as a general method.

		CH_4	Excluded	CH_4 emissions from fuel combustion are small enough to be ignored when compared to CO_2 emissions from the same source.
		N_2O	Excluded	N_2O emissions from fuel combustion are small enough to be ignored when compared to CO_2 emissions from the same source.
Project Activity	Initial construction works	CO_2	Excluded	GHG emissions exist at the time of plant investment (initial construction), and these may be viewed as project leakage. However, these emissions are negligible.

Do any assumptions or parts of the procedure entail uncertainty?
Uncertainty in the methods described in (1) through (3) may be viewed as the inherent uncertainty contained in each method. Uncertainty in (4) may be viewed as fluctuations in emissions according to changes in fuel composition and combustion conditions, however, in the heat supply facility, there shouldn't be any major fluctuations because efforts will be made to continue operation under optimum combustion conditions using the best possible fuel.

SECTION I. Emission reductions

Methodology procedure:

>>Emission reductions are calculated using the following equation:

(Equation-10) Baseline emissions + Baseline leakage - Project emissions + Project Leakage
= Baseline emissions + Baseline leakage - Project emissions

Explanation/justification:

>> (There are no items requiring any particular explanation)

SECTION J. Changes required for methodology implementation in 2nd and 3rd crediting periods (if relevant / optional)

Methodology procedure:

>> (None in particular)

Explanation/justification:

>> (There are no items requiring any particular explanation)

SECTION K. Selected baseline approach from paragraph 48 of the CDM modalities and procedures

Choose One (delete others):

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

Explanation/justification of choice:

>>In this methodology, barrier analysis and investment analysis are carried out in order to identify the baseline scenario. Accordingly, it is appropriate to adopt the above approach.

SECTION I. Other Information

Explanation/justification:

>>**Why can this methodology be described as transparent and conservative?**

This methodology can be called transparent for the following reasons:

(1) It uses a site-specific emission factor EFs.

(2) (2) EFPy and EFHy are determined using either an approved methodology or published figures or the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories."

Moreover, this methodology may be described as conservative for the following reasons:

(1) There is a strong possibility that the amount of CH_4 that is actually emitted from sludge thrown into the sludge field in the project will be much lower than the amount of CH_4 calculated using the emission factor EFs. Therefore, if the said emission factor is used, project emissions will be estimated on the high side, i.e. the estimate may be said to be a conservative one.

(2) Equation-6 is valid, i.e. the amount of sludge sent to the sludge field is definitely reduced in the project when compared to the baseline; however, the reduction in emissions arising from the reduction in transporting power is not claimed in this methodology.

What are the strengths of this methodology?

Strengths of the methodology are as follows:

(1) The main advantage of this methodology is that it uses the site-specific emission factor EFs. This emission factor is measured ex-ante and is extremely transparent because it includes all site conditions including the geographical area, climate, sewage composition, sewage treatment method, sludge field structure and soil conditions in the sludge field, etc.

(2) It is uncomplicated and simple.

What are the weaknesses of this methodology?

(None in particular)

Other information:

(None in particular)

-.-.-.-

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

CONTENTS

SECTION A. Identification of methodology

A.1. Title of the proposed methodology:

>> **The title of the proposed methodology**: Monitoring methodology for open anaerobic digestion of sewage sludge

The version number of the document: Version001

The date of the document: 10/03/2006

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

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

>>This baseline methodology can be applied to projects for water treatment plants that satisfy all the following conditions:

(1) The existing water treatment plant treats all generated sludge in an open anaerobic digester (sludge field) and discharges CH4 into the atmosphere. Before sludge is inserted into the open anaerobic digester, it can undergo some form of pretreatment. If some of the CH_4 discharged into the atmosphere is collected at the open anaerobic digester, this methodology cannot be applied.

(2) In the project, sludge is treated in a closed anaerobic digester, and all digestion gas/biogas including CH_4 that is generated from the closed anaerobic digester is collected.

(3) Sludge that undergoes ample treatment in the project closed anaerobic digester undergoes further treatment in an open anaerobic digester. (In cases where sludge that is amply treated in the project closed anaerobic digester is not further treated in an open anaerobic digester but by a method that doesn't generate CH_4, this methodology can be applied by assuming project emissions to be zero).

(4) The digestion gas/biogas including CH_4 that is generated from the closed anaerobic digester is used as fuel in a cogeneration system or for a generator or boiler. Alternatively, it is combusted in flaring equipment.

(5) Electric power obtained from the cogeneration system or generator, apart from the power consumed in the project system, is transmitted to the water treatment plant and/or power grid. As a result, power purchased from the grid by the water treatment plant is reduced and emissions saved at power plants on the grid can be claimed. (If they are not claimed, this methodology can be applied assuming the reduction to be zero).

(6) Waste heat obtained from the cogeneration system or boiler, apart from the heat consumed in the project system, is transmitted to the water treatment plant and/or heat consumers. Since utilization of this alternative energy leads to reduction in consumption of fossil fuels, the resulting reduction in emissions can be claimed. (If they are not claimed, this methodology can be applied assuming the reduction to be zero).

(7) The specific emission factor per unit amount of sludge in the open anaerobic digester is known beforehand. The ex-ante period of measurement of this emission factor must not exceed the actual treatment period of sludge in the open anaerobic digester. The unit of sludge when measuring ex-ante should conform to the unit of sludge during monitoring.

Furthermore, this Monitoring methodology must be used in tandem with the "Baseline methodology for open anaerobic digestion of sewage sludge."

Moreover, there is no other approved monitoring methodology that has the same conditions of application as this one.

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

>>**What are the strengths of this methodology?**
It is uncomplicated and simple.

What are the weaknesses of this methodology?
(None in particular)

SECTION B. Proposed new monitoring methodology

B.1. Brief description of the new methodology:

>>In this methodology, the three items of baseline emissions, project emissions, and leakage are monitored. An outline description of each monitoring item is given below.

(1) Monitoring of baseline emissions: In order to determine the amount of CH_4 emissions from the sludge field in the baseline scenario, the amount and concentration of sludge emitted from the water treatment plant to the closed anaerobic digester are monitored.
(2) Monitoring of project emissions: In order to determine the amount of CH_4 emissions from the sludge field in the project scenario, the amount and concentration of sludge thrown into the sludge field from the closed anaerobic digester are monitored.
(3) Monitoring of leakage: In order to determine CO_2 emissions from the grid and heat supply system in the baseline scenario, the amount of electric power and heat substituted by the cogeneration system (or generator and boiler) are monitored. Moreover, the emission factor of CO_2 from the grid and heat supply system is also monitored.

Figure 1 gives an illustrated view of the project boundary.

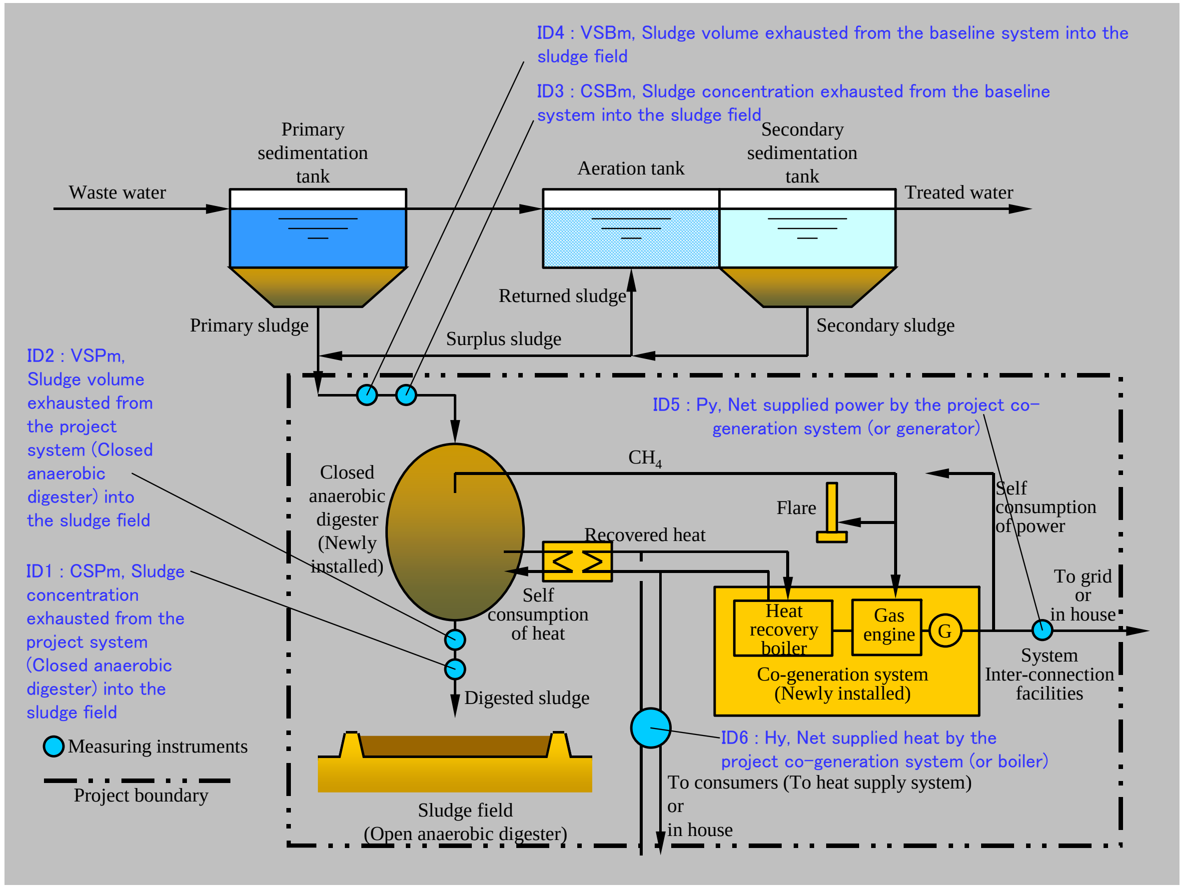

Figure-1: Project boundary

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

>>

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

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	*CSPim Sludge i concentration exhausted from the project system (Closed anaerobic digester) into the sludge field in the period m*	*RDS or COD or TOC or BOD_5 analysis method*	*ton-RDS/m3, or ton-COD/m3, or ton-TOC/m3, or ton-BOD_5/m3*	*m*	*Once a month (if unstable, once a week (if unstable once a day))*	*Monitored only once a month or once a week or once a day*	*Electric Monitored data shall be archived for 2 years following end of the crediting period.*	*If the weekly monitored data during one month are not different by 5%, this item can be monitored once a month. If the daily monitored data during one week are not different by 5%, this item can be monitored once a week.*
2	*VSPim Sludge i volume exhausted from the project system (Closed anaerobic digester) into the sludge field in the period m*	*Flow meter*	*m3/month or m3/week or m3/day*	*m*	*Once a month (if unstable, once a week (if unstable once a day))*	*100%*	*Electric Monitored data shall be archived for 2 years following end of the crediting period.*	*This item should be monitored at the same time as ID1*

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

>>Project activity emissions are calculated by means of Equation-4 and Equation-8 as follows:

(Equation-4) Project emissions (ton-CO_2/y) = Sum (MSPyi * EFsi) * GWPm

(Equation-8) MSPyi = Sum (CSPim * VSPim)

Where:
MSPyi: Sludge i mass exhausted from the project system into the sludge field in the year y (ton-RDS/y, or ton-COD/y, or ton-TOC/y, or ton-BOD_5/y)
EFsi: Emission factor of the sludge i (ton-CH_4/ton- RDS, or ton-CH_4/ton-COD, or ton-CH_4/ton-TOC, or ton-CH_4/ton- BOD_5)
GWPm: Global warming potential of CH_4 (no dimension) = 21
CSPim: Sludge i concentration exhausted from the project system (Closed anaerobic digester) into the sludge field in the period m (ton-RDS/m3, or ton-COD/m3, or ton-TOC/m3, or ton- BOD_5/m3)
VSPim: Sludge i volume exhausted from the project system (Closed anaerobic digester) into the sludge field in the period m (m3/month)

CSPm (instantaneous concentration) and VSPm (aggregate flow) are determined ex-post upon monitoring these items every month.
EFs is a constant obtained by the PDD compiler in advance measurement.
GWPm is also a constant, set at 21 in this case.

The unit of weight of sludge mass shall be one of the following units that can objectively express the quantity of organic material in sludge that generates CH_4, i.e. RDS (raw dry solid), COD (chemical oxygen demand), TOC (total organized carbon), or BOD_5 (biochemical oxygen demand). However, the said unit must correspond with the unit of sludge mass weight used when measuring Efs.

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

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
3	*CSBim Sludge i concentration exhausted from the baseline system into the sludge field in the period m*	*RDS or COD or TOC or BOD_5 analysis method*	*ton-RDS/m3, or ton-COD/m3, or ton-TOC/m3, or ton-BOD_5/m3*	*m*	*Once a month (if unstable, once a week (if unstable once a day))*	*Monitored only once a month or once a week or once a day*	*Electric Monitored data shall be archived for 2 years following end of the crediting period.*	*If the weekly monitored data during one month are not different by 5%, this item can be monitored once a month. If the daily monitored data during one week are not different by 5%, this item can be monitored once a week.*
4	*VSBim Sludge i volume exhausted from the baseline system into the sludge field in the period m*	*Flow meter*	*m3/month or m3/week or m3/day*	*m*	*Once a month (if unstable, once a week (if unstable once a day))*	*100%*	*Electric Monitored data shall be archived for 2 years following end of the crediting period.*	*This item should be monitored at the same time as ID3*

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

>>Baseline emissions are calculated by means of Equation-2 and Equation-7 a follows:

(Equation-2) Baseline emissions (ton-CO_2/y) = Sum (MSByi * EFsi) * GWPm

(Equation-7) MSByi = Sum (CSBim * VSBim)

Where,
MSByi: Sludge i mass exhausted from the baseline system into the sludge field in the year y (ton-RDS/y, or ton-COD/y, or ton-TOC/y, or ton-BOD_5/y)
EFsi: Emission factor of the sludge i (ton-CH_4/ton- RDS, or ton-CH_4/ton-COD, or ton-CH_4/ton-TOC, or ton-CH_4/ton- BOD_5)
GWPm: Global warming potential of CH_4 (no dimension) = 21
CSBim: Sludge i concentration exhausted from the baseline system into the sludge field in the period m (ton-RDS/m^3, or ton-COD/m^3, or ton-TOC/m^3, or ton- BOD_5/m^3)
VSBim: Sludge i volume exhausted from the baseline system into the sludge field in the period m (m^3/month)

CSBm (instantaneous concentration) and VSBm (aggregate flow) are determined ex-post upon monitoring these items every month.
EFs is a constant obtained by the PDD compiler in advance measurement.
GWPm is also a constant, set at 21 in this case.

The unit of weight of sludge mass shall be one of the following units that can objectively express the quantity of organic material in sludge that generates CH_4, i.e. RDS (raw dry solid), COD (chemical oxygen demand), TOC (total organized carbon), or BOD_5 (biochemical oxygen demand). However, the said unit must correspond with the unit of sludge mass weight used when measuring Efs.

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

>>In this methodology, since Option 1 is adopted, this section (Option 2) is not applicable.

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

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

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

>>

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

>>In this methodology, the baseline leakage is monitored. As for the project leakage, this is assumed to be zero.

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

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
5	*Py* *Net supplied power by the project co-generation system (or generator)*	*Watt hour meter*	*MWh*	*c*	*Once a year*	*100%*	*Electric* *Monitored data shall be archived for 2 years following end of the crediting period.*	*This item can be measured by using watt hour meter for sold power and watt hour meter for bought power. In order to know net supplied power, calculate as follows,* *net supplied power* *= sold power - bought power*
6	*Hy* *Net supplied heat by the project co-generation system (or boiler)*	*Calorie meter*	*MWh*	*c*	*Once a year*	*100%*	*Electric* *Monitored data shall be archived for 2 years following end of the crediting period.*	*This item can be measured by using following measurement instruments.* *(1) Thermometer installed in supplied heating medium* *(2) Thermometer installed in returned heating medium* *(3) Flow meter installed in supplied heating medium*
7	*EFPy* *Emission factor of the baseline grid*	*Data calculated in accordance with the baseline*	*ton-CO_2/MWh*	*c*	*Once a year*	*100%*	*Electric* *Monitored data shall be archived for 2 years following end of the crediting period.*	*This item can be acquired by adopting the following documents, (3-1) or (3-2) or (3-3) of the methodology below.*

		methodology						
8	*EFHy Emission factor of the baseline heat supply system*	*Data calculated in accordance with the baseline methodology*	*ton-CO_2/MWh*	*c*	*Once a year*	*100%*	*Electric Monitored data shall be archived for 2 years following end of the crediting period.*	
9	*X Efficiency of boiler of baseline scenario*	*Data received from the management of the water treatment plant or heating organization that supplies heat energy*	*%*	*n/a*	*Once a year*	*100%*	*Electric Monitored data shall be archived for 2 years following end of the crediting period.*	*This item shall be monitored in case project participants decide to select the methodology of (4) below.*

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

>>GHG emissions outside of the project boundary are as follows:

(1) Emissions from the grid generating electric power that is substituted by the cogeneration system (or generator); and
(2) Emissions from the heat supply system generating heat energy that is substituted by the cogeneration system (or boiler).

These emissions are regarded as leakage in the baseline. In the project, on the other hand, leakage does not exist. Summing up, baseline leakage and project leakage can be calculated by the following equations:

$$\text{(Equation-3) Baseline leakage (ton-}CO_2\text{/y)} = EFPy * Py + EFHy * Hy$$

$$\text{(Equation-5) Project Leakage (ton-}CO_2\text{/y)} = 0$$

Where,
EFPy: Emission factor of the baseline grid in the year y (ton-CO_2/MWh)
EFHy: Emission factor of the baseline heat supply system in the year y (ton-CO_2/MWh)
Py: Net supplied power by the project co-generation system (or generator) in the year y (MWh/y)

Hy: Net supplied heat by the project co-generation system (or boiler) in the year y (MWh/y)

Here, EFPy and EFHy can be determined using the following methodology.

EFPy

(1) When power generation capacity does not exceed 15MW: Use the “Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories AMS-I.D. Grid connected renewable electricity generation” (source: http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_C87N6C2G4PQEDPKV9CGQ6A5UNFJSJB)

(2) Use the “ACM0002 Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (source: http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_ZIT66NYGZX2VK40KZ8KDNJ1NPFM61W)

(3) If there is an EFPy that is already disclosed and can be used, that may also be adopted.

Here, “an EFPy that is already disclosed and can be used” refers to the following:
(3-1) An EFPy that the host country’s government has developed and published for CDM and/or JI.
(3-2) An EFPy that an international agency has developed and published for CDM and/or JI.
(3-3) An EFPy that an investing country’s government has developed and published for CDM and/or JI.

EFHy

(4) If there is clear evidence that the baseline boiler efficiency does not exceed X%, use the following equation:

$$\text{(Equation-9) } EFHy = 3{,}600\text{MJ/MWh} * 10^{-6} * CEF * FCO / X * 100 * 44/12$$

Where,
X: Efficiency of boiler of baseline scenario (%)
CEF: Carbon emission factor of the fuel used (ton-C/TJ)
FCO: Fraction of carbon oxidized of the fuel used (no dimension)

Concerning CEF and FCO, if the host country has its own unique values, use them; if not, use the value given in Table 1-1 and Table 1-6 of the “Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories” CHAPTER 1 Energy.

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

>>Emission reductions are calculated using the following equation:

(Equation-10) Baseline emissions + Baseline leakage - Project emissions + Project Leakage
= Baseline emissions + Baseline leakage - Project emissions

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

>>In this methodology, default values are used without conducting monitoring for the following items.

EFs: This is a constant obtained by the PDD compiler in advance measurement. Since a site-specific value is used, it has a low level of uncertainty.

GWPm: This is a constant value, set at 21. This constant is prescribed by the IPCC and does not require monitoring.

CEF: If the host country has its own unique value, use that; if not, use the value given in Table 1-6 of the “Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories” CHAPTER 1 ENERGY. Since the composition of fuel does not change very much, there is little possibility of the CEF fluctuating and it is not necessary to conduct monitoring.

FCO: If the host country has its own unique value, use that; if not, use the value given in Table 1-1 of the “Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories” CHAPTER 1 ENERGY. Since combustion conditions do not change very much, there is little possibility of the FCO fluctuating and it is not necessary to conduct monitoring.

B.7. Please indicate whether quality control (QC) and quality assurance (QA) procedures are being undertaken for the items monitored:		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1	*Medium*	*Measuring devices will be regularly tested to secure accuracy. It is planned to be monitored monthly, but monitored weekly or daily if the data is unstable.*
2	*Low*	*Measuring devices will be regularly tested to secure accuracy.*
3	*Medium*	*Measuring devices will be regularly tested to secure accuracy. It is planned to be monitored monthly, but monitored weekly or daily if the data is unstable.*
4	*Low*	*Measuring devices will be regularly tested to secure accuracy.*
5	*Low*	*Measuring devices will be regularly tested to secure accuracy.*
6	*Low*	*Measuring devices will be regularly tested to secure accuracy.*
7	*Low*	*Data calculated in accordance with the baseline methodology.*
8	*Low*	*Data calculated in accordance with the baseline methodology.*
9	*Low*	*Data received from the management of the water treatment plant or heating organization that supplies heat energy.*

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

>>This methodology has so far not been applied to any other cases.

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End