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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

CTL Landfill Gas Project
Version 5
02/09/2011

A.2. Description of the project activity:

The proposed project activity has the objective to capture and to flare/combustion the landfill gas[1] produced in the new landfill called, "*Central de Tratamento de Residuos Leste – CTL*" located in the city of São Paulo (in the state of São Paulo), Brazil.

The project activity will result in greenhouse gas (GHG) emission reduction from the CTL landfill through two ways:

- Burning CH_4 in flares and/or group generators;
- The amount of electricity generated in the project activity will be dispatched to the Brazilian national grid, avoiding the dispatch of an equal amount of energy produced by fossil-fuelled thermal plants to that grid. The initiative avoids CO_2 emissions and contributes to the regional and national sustainable development.

Prior to the implementation of the project activity the landfill gas is being released to atmosphere.

The project activity includes two phases: The first phase (2012) will be to capture and to flare the landfill gas (LFG). The second phase (2013 to 2036) will be the implementation of a power generation plant that will use LFG to generate electricity. The installed generation capacity will be expected to change during the lifetime of the project.

The first phase of the project will be to construct an efficient capture, collection and flaring system to burn CH_4 (a greenhouse gas), and this will reduce odours and adverse environmental impacts.

During the second phase, the project will install generators that will combust the LFG to produce electricity, using part of the electricity for self consumption and the other part will be exported to the grid. The flares will be kept in operation due to LFG excess, periods when electricity will not be produced or other operational considerations. The LFG power plant will be expected to install approximately 19.2 MW upon project completion. However, the final equipments that will be chosen (as well as the final installed capacity) may vary depending on the availability of the generation equipments on the market at the time of actual implementation of the second phase.

The LFG capture and collection systems and flaring station will consist on a LFG pipeline grid and a flaring station, equipped with flares, centrifugal blower(s), and all other supporting mechanical and electrical subsystems and appurtenances necessary to run the system. The power generation facility will be comprised of LFG engine generator sets of high performance standards. The engine-generator sets will be the primary equipment to combust the collected LFG once they are installed. A fraction of the

[1] The major landfill gas contents are methane (CH_4) and carbon dioxide (CO_2).

collected LFG will be diverted to flares, which will be used to combust any gas in excess of the fuel demand for the engines, as well as a contingency backup.

The landfill began its operation on 24 November 2010, receiving of household waste (Class II-A and II-B). The area of the landfill is 1,123,590m^2 being that only one third of this area will be to dispose of waste. There is the possibility of increasing the waste disposal area, however this possibility will be analyzed in the future.

EcoUrbis Ambiental S.A.[2] is the company responsible for the implementation and operation of the CTL landfill and also, it is responsible, since October/2004, for collection services and disposal of solid waste in region East and South of the city of São Paulo (covering around 6,000,000 of inhabitants) under a concession for twenty years, renewable for another twenty years.

Contribution of the Project Activity to Sustainable Development:

With the implementation of the project activity, besides the GHG emissions reduction (CH_4) there will also be contribution for the sustainable development through the improvement of the local environmental condition. During the operational phase, which will take place 24 hours/day, 7 days/week, there will be new jobs created locally for duties related to construction, operations and maintenance, landscaping, plumbing, monitoring and security personnel. These people will be fully trained by EcoUrbis on their duties and tasks. Local jobs will be created during the implementation and operation of the project activity.

Ecourbis has been carrying out a program called "Programa de Educação Ambiental" (in English, Ambient Education Program) which has been put into practice since it´s planning phase and will be extended for all the operational period. The program actions have already reached more than 6,837 children, teachers and local communities around the landfill, highlighting issues related to the municipal solid waste (MSW), from waste generation to final disposal.

Since its implantation the program has carried out several activities such as:

a. Formative activities along with teachers and the general community,
b. "Programa Ver de Perto" (in English, Close Look Program) meeting the landfill. Teachers and children take part in monitored visits as well as participate in educational speeches and discussions broaching around environmental issues focused on solid waste and involving the waste generation in the of São Paulo and the waste management from the first operation to the final closing of the landfill. In addition, it will be included an informative topic concerning the environmental impacts of Greenhouse Gases. This program will inform the community of the importance of Landfill Gas Projects and why such projects which collect LFG are being viewed as having two benefits. The first is reducing methane emissions from landfills and the second is using the LFG as a renewable energy source. Also, this program will provide an in-site of a Landfill Gas-to-Energy project in their community and the benefits of this project.

EcoUrbis also carry out an important integration activity between the employees, social entities and institutions located in São Paulo. The company has planned to have, among others:

a. Work Prevention and Security:
   Identification of situations that must be revised and re-evaluated offering permanent trainings and improvements;

[2] For more information access the site: http://www.ecourbis.com.br/

b. General Occupational health:
Employee work environment and occupational health follow up. The company offers health care plans for all its employees and their spouses and children;

c. Technological and "Know How" evolution:
Keep the employees dully qualified and aligned with the current job market conditions and requirements. The project activity will need engineers and other specialists with experience in this area to advise EcoUrbis while implementing the project. These professionals will also train local operators and engineers on operations and maintenance of the facilities. Technology will have to come from abroad and mainly from the United States and Canada. Hence, technology transfer will occur from countries with strict environmental legislative requirements and environmentally sound technologies.

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)
Brazil (host)	EcoUrbis Ambiental S/A (private entity)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

EcoUrbis Ambiental S/A is one of the largest companies of waste management in South America and it has as shareholders three well known Brazilian companies:

- Construtora Queiroz Galvão S.A.;
- Heleno & Fonseca Construtécnica S.A.;
- Construtora Marquise S.A.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil

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

São Paulo State

A.4.1.3. City/Town/Community etc.:

São Paulo City

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

CTL landfill is located at Av. Sapopemba, 22,254 – km 32, São Paulo (city), São Paulo (State), Brazil.

Geographical Coordinates: (Latitude: 23° 37' 52.17" S and Longitude: 46° 25' 30.29" W)[3]

Figure 1 - Geographical position of São Paulo city, inside of São Paulo State
(Source: http://www.ibge.gov.br/cidadesat/default.php)

Figure 2 - Aerial view of CTL Landfill before the start of its waste acceptance phase.

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

[3] The information is in the environmental impact report (EIA) of the CTL landfill and the document was given to DOE in validation visit.

Sectoral Scope: 13 (waste handling and disposal).

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

The implementation and operation of the CTL Landfill Gas Project consists concisely in:

LFG Capture and Collection Systems

The landfill gas capture and collection infrastructure of the landfill was designed with horizontal trenches and with the recovery of the vertical wells/drains. The horizontal trenches and vertical wells/drains will be connected to the collection system known as well as transmission pipeline that will accomplish the transport of gas to the flaring station responsible for its treatment and destruction.

Figure 3 - General view of the LFG Capture and Collection Systems and Flaring Station.

- Capture System (Horizontal Trenches)

The capture system consists on a grid of horizontal trenches made of High Density Polyethylene (HDPE), due to the flexibility and the corrosion resistance. Each trench has an average length of 100 meters and is installed with approximately 15 meters away from each other. The capture system will be installed throughout the lifetime of the CTL.

The figures below show an example of the installation of a horizontal trench.

Figure 4 - Typical installation of a horizontal trench – LFG capturing System.
(Source: Conestoga-Rovers & Associates – CRA – Manaus Landfill)

All horizontal trenches (capture system) are connected to a collection system known as well as transmission pipeline that transports the landfill gas to the flaring station.

Each individual trench can regulate the concentrations of O_2 in the LFG collected. In case the concentrations are above a certain value, it means that maybe some air is infiltrating in the landfill and the valve corresponding to the trench is then closed. The periodic operation of the horizontal trenches will promote a systematic control and monitoring of the characteristics of the LFG extracted.

- Vertical Wells/Drains

In order to drain the leachate of the landfill, vertical wells/drains will be progressively installed. In order to recover the LFG which will be released through the wells/drains, the project aim to cap the vertical wells/drains and connect them to the collection system. The average distance will be about 30 – 35 meters from each other. The top of the drains will be equipped with LFG wellheads. This equipment connects the drain to the pipeline.

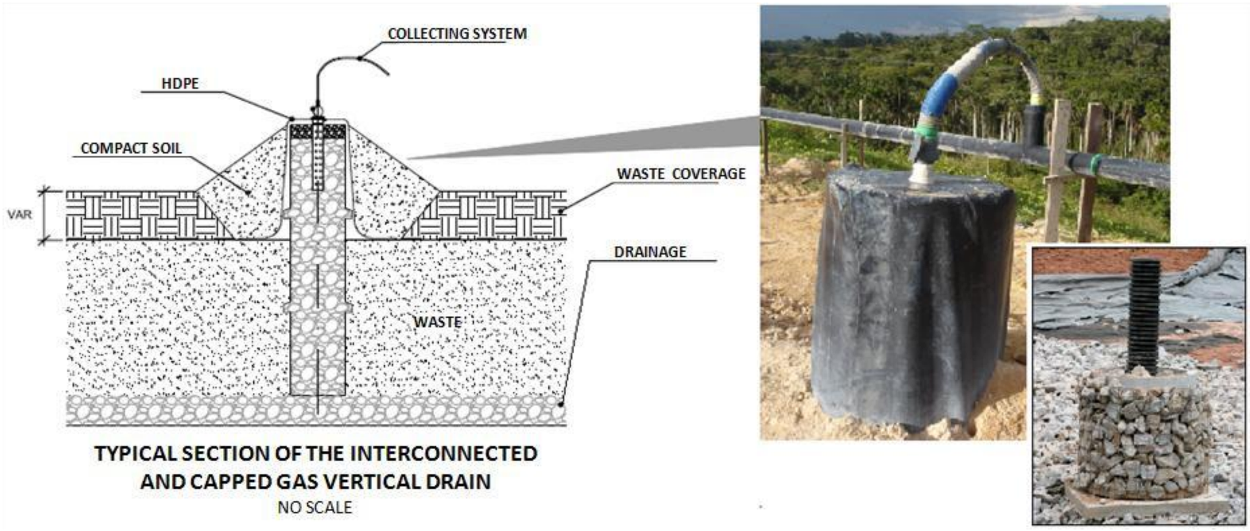

Figure 5 - Typical connection for recovery of the vertical wells/drains.
(Source: Conestoga-Rovers & Associates – CRA – Manaus Landfill)

- Collection System (Transmission Pipeline)

The collection system, known as well as transmission pipeline, transports the collected LFG to the flaring station.

The collection system is usually built using High Density Polyethylene (HDPE), due to the flexibility and the corrosion resistance. The sizing of the piping will be designed considering the maximum production of landfill gas. Intense welding activity is expected to connect each horizontal trench to the transmission pipeline.

Figure 6 - Example of transmission pipelines
(Source: Conestoga-Rovers & Associates – CRA – Manaus Landfill)

<u>Flaring Station</u>

The collection of LFG within the landfill will be made by applying a pressure differential in each horizontal trench and or vertical well/drain. The depressurization system shall be composed of a group of centrifugal multi-stage blowers, connected in parallel with the main transmission pipeline. The depressurization of the system will depend on the pressure of operation of flares. In addition, the Flaring Station usually has:

- Flares;
- Blowers;
- Safety valve on/off;
- Remover of condensate;
- Gas Analyzer;
- Meter for pressure;
- Meter for flow;
- Meter for temperature.

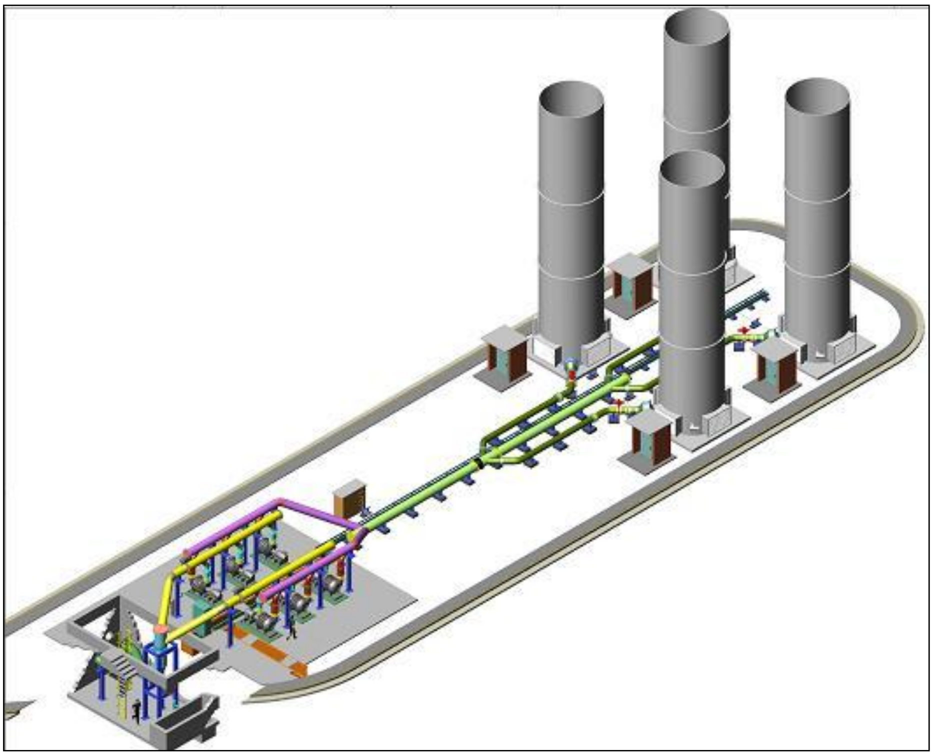

Figure 7 – Example of a Flaring station for a Landfill Gas Project.
(Source: Conestoga-Rovers & Associados Engenharia S/A)

- The Blower System

The blower system is responsible to give negative pressure to the landfill, suctioning the gas to the pipeline. The dimensioning of the blower will depend on the final use of the gas (flare, boiler, electricity).

In order to preserve the operation of the blowers, a dewatering system is installed to remove any condensate present in the LFG. This equipment is a single knock-out dewatering component.

Figure 8 - Example of blower system
(Source: Conestoga Rovers & Associates – CRA – Aurá Landfill - Belém / PA / Brazil)

- The Flare System

The destruction of the methane content in the LFG collected will be made via an enclosed flare, in order to assure higher methane destruction (above 98%)[4].

The flare efficiency will be monitored continuously.

The flaring station will have, even a system of destruction of methane through flares. This system will be composed initially by 1 enclosure flare and will have additional units installed, according to the LFG generation.

Basically, the flare is constructed using refractory material, a gas inlet, dampers to control the air inlet, an ignition spark, flame viewer and points to sample collection, as presented in the pictures below:

The flare is constructed in a vertical cylindrical combustion chamber, where the landfill gas is flared at a constant temperature (around 1,000º C), controlled by the admission of air, and with a retention time > 0.7 seconds.

[4] The destruction of the methane content in the LFG is above 98%, according to manufacturer specifications. The document was given to DOE in validation visit.

Figure 9 - Detail of Enclosed Flare
(Source: Conestoga Rovers & Associates – CRA – Aurá Landfill - Belém / PA / Brazil)

Power generation

The power generation system will be comprised of around 19.2 MW. The electricity generated by the Project will be supplied to the grid. The configuration of the equipments will be chosen in accordance with the availability of the generation equipments on the market at the time of actual implementation of the second phase.

This kind of technology is still not widely applied in Brazil. Very few landfills have already installed equipment for the collection and flare of LFG.

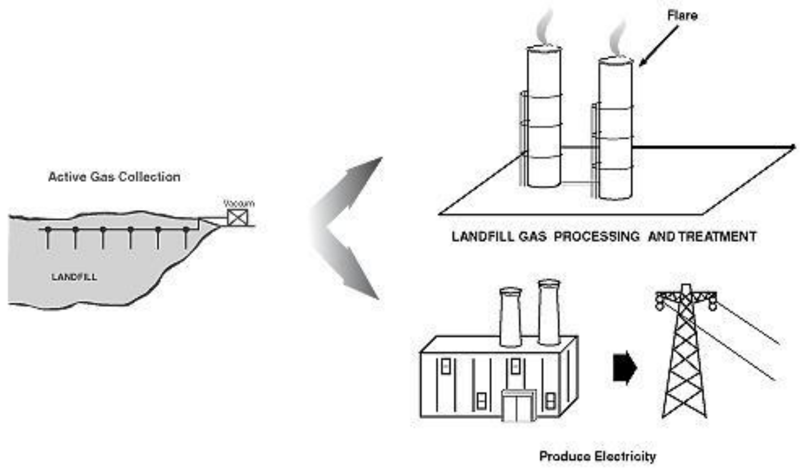

Figure 10 – Power generation diagram

The forecast installed capacity and electricity generated by the project activity are present below:

Year	Phase	Total installed capacity (MW)[1]	Net capacity (MWe)[2]	Electricity generated in the plant (MWh)
2012	1	0.0	0.0	0
2013	2	9.6	9.2	19,098[5]
2014		14.4	13.9	114,590
2015		17.6	16.9	140,055
2016		19.2	18.5	152,787
2017		19.2	18.5	152,787
2018		19.2	18.5	152,787
2019		19.2	18.5	76,393[6]

[1] Definition of Total installed capacity: is the maximum capacity at the plant.
[2] Definition of Net capacity: is the maximum capacity at the plant minus the amount of electricity that is consumed by the plant;
Note: As highlighted in Section A.2, the final equipments that will be chosen (as well as the final installed capacity) may vary depending on the availability of the generation equipments on the market at the time of actual implementation of the second phase.

The lifetime of the equipments is 25 years and it was based on manufacturer's specifications[7].

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

For the first crediting period (from 01/07/2012 to 30/06/2019) the estimation of emission reductions is:

[5] The forecast staring date of electricity generation is 01/10/2013.

[6] The forecast end of the first crediting period is 30/06/2019.

[7] The document was made available to DOE in validation visit.

Years	Annual estimation of emission reductions in tonnes of CO_2e
01/07/2012	234,305
2013	599,521
2014	706,278
2015	777,246
2016	829,219
2017	867,441
2018	897,529
30/06/2019	460,937
Total estimated reductions (tonnes of CO_2e)	**5,372,476**
Total Number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	767,497

A.4.5. Public funding of the project activity:

There is no Annex I public funding involved in the CTL Landfill Gas Project.

SECTION B. Application of a baseline and monitoring methodology

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

The following methodologies are applicable to this project activity:

- ACM0001 - Consolidated baseline and monitoring methodology for landfill gas project activities, version 11;
- Tool for the demonstration and assessment of additionality – version 5.2;
- Combined tool to identify the baseline scenario and demonstrate additionality – version 2.2.
- Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site – version 5.1;
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption – version 1;
- Tool to determine project emissions from flaring gases containing methane – version 1;
- Tool to calculate the emission factor for an electricity system – version 2.2;
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion – version 2;

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

The methodology ACM0001 is applicable for project activities that comprise one of the following scenarios:

- The captured gas is flared; and/or
- The captured gas is used to produce energy (e.g. electricity/thermal energy);
- The captured gas is used to supply consumers through natural gas distribution network.

The project activity corresponds to first and second of these three scenarios. In the first phase the LFG will be only flared and during the second phase will be installed power generators. So, the methodology ACM0001 was deemed appropriate.

- "Tool for demonstration and assessment of additionality" is applicable to the project activity, as it is included in the ACM0001 methodology.

- "Combined tool to identify the baseline scenario and demonstrate additionality" could be applied as all alternatives are available options of the project participants. However, for this project activity, the "Tool for demonstration and assessment of additionality" was used to evaluate the additionality, as required in the ACM0001 version 11.

- "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site" is applicable as the solid waste disposal site is clearly identified, there are no hazardous wastes and this is not a stockpile case.

- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" is also applicable to the project activity because electricity will be consumed from the grid.

- "Tool to determine project emissions from flaring gases containing methane" is applicable to this project activity because:

    - The residual gas stream to be flared contains no other combustible gases than methane, carbon monoxide and hydrogen;
    - The residual gas stream to be flared is obtained from decomposition of organic material (through landfill).

- "Tool to calculate the emission factor for an electricity system" is applicable as this project will supply electricity to the grid.

- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" is applicable to the project activity because electricity can be occasionally generated using a standby diesel generator located on site.

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

<table>
<tr><th></th><th>Source</th><th>Gas</th><th>Included?</th><th>Justification / Explanation</th></tr>
<tr><td rowspan="6">Baseline</td><td rowspan="3">Emissions from decomposition of waste at the landfill site.</td><td>CH_4</td><td>Yes</td><td>The major source of emissions in the baseline.</td></tr>
<tr><td>N_2O</td><td>No</td><td>N_2O emissions are small compared to CH_4 emissions from landfills. Exclusion of this gas is conservative.</td></tr>
<tr><td>CO_2</td><td>No</td><td>CO_2 emissions from the decomposition of organic waste are not accounted.</td></tr>
<tr><td rowspan="3">Emissions from electricity consumption</td><td>CO_2</td><td>Yes</td><td>Electricity may be consumed from the grid or generated onsite/offsite in the baseline scenario</td></tr>
<tr><td>CH_4</td><td>No</td><td>Excluded for simplification. This is conservative.</td></tr>
<tr><td>N_2O</td><td>No</td><td>Excluded for simplification. This is conservative.</td></tr>
</table>

Project Activity	On-site fossil fuel consumption due to the project activity other than for electricity generation	CO_2	Yes	May be an important emission source.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from on-site electricity use	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

Note: On-site fossil fuel consumption due to the project activity other than for electricity generation will be due to LPG consumption.

The flow diagram is presented below:

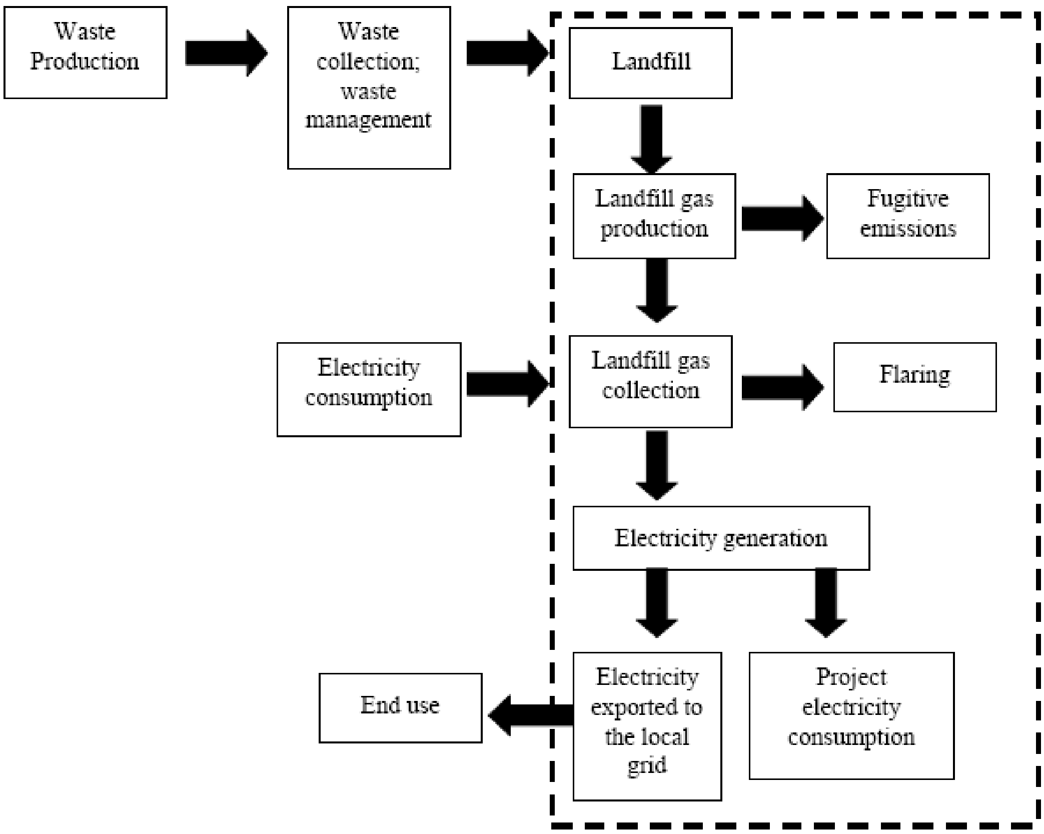

Figure 11 – Flow diagram project boundary

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

The baseline scenario for the project activity is identified using step 1 of the 'Tool for demonstration and assessment of additionality" (Version 05.2), as agreed in ACM0001 "Consolidated baseline and monitoring methodology for landfill gas project activities" (version 11).

Realistic and credible alternatives to the project activity that can be part of the baseline scenario are defined through the following sub-steps:

Step 1: Identification of alternative scenarios

The project participants will monitor all relevant policies and circumstances at the beginning of each crediting period and adjust the baseline accordingly.

The identified alternatives for the disposal/treatment of the waste in the absence of the project activity include:

LFG1	The project activity (capture of LFG and power generation) undertaken without being registered as a CDM project activity;
LFG2	Atmospheric release of the LFG.
LFG3	Capture of LFG and its flare, without being registered as a CDM project activity.

For power generation, the realistic and credible alternatives include:

Since the project uses LFG for generating electricity, according to ACM0001 Version 11 realistic and credible alternatives also may include the following:

P1	Power generated from landfill gas undertaken without being registered as CDM project activity;
P2	Existing or construction of a new on-site or off-site fossil fuel fired cogeneration plant;
P3	Existing or construction of a new on-site or off-site renewable based cogeneration plant;
P4	Existing or construction of a new on-site or off-site fossil fuel fired captive power plant;
P5	Existing or construction of a new on-site or off-site renewable based captive power plant;
P6	Existing and/or new grid-connected power plants.

According to “Tool for the demonstration and assessment of additionality” version 5.2, “For the purpose of identifying relevant alternative scenarios, the project participant should include the technologies or practices that provide outputs (e.g. cement) or services (e.g. electricity, heat) with comparable quality, properties and application areas as the proposed CDM project activity and that have been implemented previously or are currently being introduced in the relevant country/region”.

The project activity aims for electricity generation and the heat generation is not a service with comparable application for these areas. Thus, P2 and P3 are not considered a realistic alternative by the project participants.

Likewise, as the project activity does not involve construction of a captive power plant, or it will not provide electricity only for a specific necessity, as specified in P4 and P5. According to “Tool for the demonstration and assessment of additionality” – version 5.2, the alternatives must provide the same services or outputs, however the project activity will only provide constant power to the grid. Thus, the alternatives P4 and P5 cannot be taken into account.

Even though LFG3 is an alternative to the project activity, the alternative LFG3 was considered unrealistic because requires investment and it does not generate revenues.

The only remaining real alternatives to the project activity are LFG1, LFG2, P1, and P6.

Outcome of Step 1a: Four realistic and credible alternative scenarios to the project activity were identified.

Alternatives LFG1 and P1 comply with all applicable laws and regulations. Brazil's new National Solid Waste Policy (NSWP),[8] ratified by the President on 02/08/2010 after 19 years under discussion, does not request the LFG capture and/or flare and there is not forecast to approve any regulation or policy in the next years.

Alternatives LFG2 and P6, a continuation of the current situation (partial or total release of LFG to the atmosphere) represents the business as usual practice for the project site as well as for most of the landfills in Brazil, according to "*Sistema Nacional de Informações sobre Saneamento: diagnóstico do manejo de resíduos sólidos urbanos – 2007*".[9]

The project participants will monitor all relevant policies and circumstances at the beginning of each crediting period and adjust the baseline accordingly.

Step 2: Identify the fuel for the baseline choice of energy source taking into account the national and/or sectoral policies as applicable.

The power consumed by the project activity could be purchased from Brazilian interconnected electric system where the emission factor is 0.1635 tCO_2e/MWh (see section B.6.3). The project activity will supply energy to the grid, displacing energy from fossil fuel fired power plants connected to this grid.

Step 3: Assessment using Step2 and/or Step 3 of the latest approved version of the "Tool for demonstration and assessment of additionality"

Applying this step for the waste disposal:

The alternative LFG1 was not deemed a realistic and credible alternative as showed in item B.5. So, the only plausible alternative is the continuation of the baseline scenario, LFG2.

Applying this step for the power generation:

The alternative P1 was not deemed a realistic and credible alternative as showed in item B.5. The only plausible alternative is to continue electricity generation from existing and/or new grid-connected power plants, P6.

Thus, the most plausible baseline scenario for the LFG is identified as atmospheric release of LFG with electricity supplied from grid connected power plants, being applicable to version 11 of ACM0001.

The project participants identified the scenario "A: Electricity consumption from the grid" from the *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"* for the project electricity consumption during the first phase and if necessary the electricity consumption in the subsequent phase.

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[8] http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm

[9] SNIS – 2007, page II.281 (http://www.pmss.gov.br/snis/PaginaCarrega.php?EWRErterterTERTer=80)

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

The following table shows the timeline of the project activity showing that the CDM benefits were taken into account to implement it.

Table 1 - Implementation timeline of the Project

Key Events	Date
Prior Consideration of the CDM to UNFCCC and Brazilian DNA	06/12/2010
Contract between Designed Operational Entity (DOE) and the PP for the validation process.	20/12/2010
Submit the PDD for Global Stakeholder Consultation (GSC)	08/03/2011
Starting date of the project activity (the Project Participant will decide to implement the project activity after receiving the Brazilian Letter of Approval. The date chosen on 11/11/2011 is the forecast date of the Brazilian DNA meeting[10]. This date may be the date of the main equipment purchase.*	11/11/2011
Start-up – Phase I*	July/2012
Commercial operation – Phase II*	October/2013

*Estimated

According to "Guidelines on the demonstration and assessment of prior consideration of the CDM" – EB 49/Annex 22 paragraph #2:

> *"The Board decided that for project activities with a starting date on or after 02 August 2008, the project participant must inform a Host Party DNA and the UNFCCC secretariat in writing of the commencement of the project activity and of their intention to seek CDM status. Such notification must be made within six months of the project activity start date and shall contain the precise geographical location and a brief description of the proposed project activity, using the standardized form F-CDM-Prior Consideration. <u>Such notification is not necessary if a PDD has been published for global stakeholder consultation or a new methodology proposed to the Executive Board for the specific project before the project activity start date.</u>"*

As the PDD will be published for global stakeholder consultation before the project activity start date, the notifications for Brazilian DNA and the UNFCCC secretariats are not necessary.

Concerning the notifications which are not necessary, the project participants notified the Brazilian DNA and UNFCCC of their intention to seek CDM status.

[10] Source: http://www.mct.gov.br/index.php/content/view/327781.html, accessed on 03/06/2011.

The additionality of the project activity will be demonstrated and assessed using version 5.2 of the "Tool for the demonstration and assessment of additionality" agreed by the CDM Executive Board.

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

Sub-step 1a. Define alternatives to the project activity

The identified alternatives for the disposal of the waste in the absence of the project activity include:

- LFG1 – The project activity (capture of landfill gas and power generation) undertaken without being registered as a CDM project activity;
- LFG2 – Atmospheric release of the landfill gas;

For power generation, the realistic and credible alternatives include (see section B.4):

- P1 – Power generated from landfill gas undertaken without being registered as CDM project activity;
- P6 – Existing and/or new grid-connected power plants;

The only remaining real alternatives to the project activity are LFG1, LFG2, P1, and P6.

Outcome of Step 1a: Four realistic and credible alternative scenarios to the project activity were identified.

Sub-step 1b. Consistency with mandatory laws and regulations:

In Brazil, there is no regulation or policy that obligates the landfill operator to burn the LFG generated in the landfill. In documents available, there is no regulation or obligation about burning LFG in landfill. Following below the source of this statement:

Table 2 - Relevant policies and documents about solid waste sector

Documents	Elaborated by	Reference
Integrated Solid Waste Management	Ministry of Environment and Ministry of Cities	Gestão integrada de resíduos sólido (2007) http://www.ibam.org.br/media/arquivos/estudos/01-girs_mdl_1.pdf, accessed on 16/12/2010.
SNIS - 2007	Ministry of Cities	SNIS (2007), page II.281 http://www.pmss.gov.br/snis/PaginaCarrega.php?EWRErterterTERTer=80, accessed on 16/12/2010.
Brazil's new National Solid Waste Policy (NSWP)	Parliament	http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm, accessed on 16/12/2010.

The project participants will monitor all relevant policies and circumstances at the beginning of each crediting period and adjust the baseline accordingly.

Step2. Investment analysis

Sub-step2a. Determine appropriate analysis method

As the proposed project activity will generate financial benefits other than CDM related income, the Option III is chosen. This option is appropriated because the baseline does not require investment, as per "Guidelines on the assessment of investment analysis" - version 05", paragraph 19.

Sub-step2b. – Option III. Apply benchmark analysis

For the purpose of assessing the financial/economic attractiveness, the indicator used was the Net Present Value (NPV).

The benchmark used for this analysis was the value pointed out in Appendix A (Group 1 - Brazil) of the "Guidelines on the assessment of investment analysis" - version 05. The value was 11.75%.

Sub-step 2c. Calculation and comparison of financial indicators

The following assumptions were taken for the purpose of the calculation of the financial indicator:

Table 3 - Main assumptions - CTL Landfill Gas Project

	CTL Landfill Gas Project			
	Assumptions			
	Parameter	**Value**	**Unit**	Reference
Assumptions	Benchmark	11.75%	%	Guidelines on the assessment of investment analysis - version 04, Group 1 (Brazil).
	Asset's Life time	25	Years	"Tool to determine the remaining lifetime of equipment" - version 1 (Electric Generators, air cooled) and CRA's document (Engineering company) - file: (10290-001 RevD.pdf)
	Installed capacity for each engine	1.60	MW	Manufacturer's specification. File (Engine-Datasheet_G3520C_1600ekW@1200rpm_DM5860-01-M.pdf)
	Net capacity for each engine	1.54	MW	Manufacturer's specification. File (10AR12676C - UTE CTL ECOURBIS-G3520C - Rev00.pdf)
	Number of generators groups	12	unit	Manufacturer's specification. File (10AR12676C - UTE CTL ECOURBIS-G3520C - Rev00.pdf)
	Total installed capacity	19.2	MW	-
	Price per MW installed	R$ 3,684,060.99	R$/MWe	Manufacturer's specification. File (10AR12676C - UTE CTL ECOURBIS-G3520C - Rev00.pdf)
	Load factor	94.38%	%	Manufacturer's specification. File: (Proposta _O&M - CTL ECOURBIS - Rev00.pdf)
	Exchange Rate	1.70	R$/USD	"Banco Central do Brasil" (in English, Brazilian Central Bank) on 16/12/2010 (http://www4.bcb.gov.br/pec/conversao/conversao.asp)
	Electricity price	148.39	R$/MWh	The highest value from the only two auctions held in Brazil (Source: Electric Power Commercialization Chamber - CCEE)
	Contingency	5%	%	Landfill Full Cost Accounting Guide. File: (Contingency Factor.pdf)
	Tax - IRPJ (income tax)	25%	%	Incomex tax (http://www.receita.fazenda.gov.br/legislacao/ins/Ant2001/Ant1997/1995/insrf05195.htm), accessed on 14/01/2011.
	Tax - CSLL (social contribution)	9%	%	Social contribution (http://www.planalto.gov.br/ccivil_03/LEIS/L7689.htm), accessed on 14/01/2011.
	Tax (PIS)	1.65%	%	Contribution to the Social Integration Program and Civil Service Asset Formation Program – PIS/PASEP (http://www.receita.fazenda.gov.br/principal/Ingles/SistemaTributarioBR/Taxes.htm), accessed on 14/01/2011.
	Tax (Cofins)	7.60%	%	COFINS - Contribution to Social Security Financing (http://www.receita.fazenda.gov.br/principal/Ingles/SistemaTributarioBR/Taxes.htm), accessed on 14/01/2011.
	Depreciation	10.00%	years	Secretary of the Federal Revenue of Brazil. Available on http://www.receita.fazenda.gov.br/legislacao/ins/ant2001/1998/in16298ane1.htm, accessed on 14/01/2011. Item: 8501
	Commercial Lending rate	10.97%	%	http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Produtos/FINEM/energias_alternativas.html, accessed on 19/07/2011.
	Debt term	16	years	http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Produtos/FINEM/energias_alternativas.html, accessed on 30/06/2011

Note: All numbers are in Brazilian Real (R$)

Alternative LFG1

For the first alternative: LFG1 – The project activity (capture of landfill gas and power generation) undertaken without being registered as a CDM project activity, the estimated project cash flow is presented below:

Year		0	1	2	3	4	5	6	7	8	9	10
Biogas flaring and Electricity generation		**YEARLY INVESTIMENT ANALYSIS**										
		2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
INCOME x COSTS ANALYSIS												
Dispatched electricity (MWh/year)			(878)	19,098	114,590	140,055	152,787	152,787	152,787	152,787	152,787	152,787
Electricity Price (R$/MWh)			148	148	148	148	148	148	148	148	148	148
Electricity reveneus (kR$)			(130)	2,834	17,004	20,783	22,672	22,672	22,672	22,672	22,672	22,672
Gross Reveneus (kR$)			(130)	2,834	17,004	20,783	22,672	22,672	22,672	22,672	22,672	22,672
Tax (PIS/Cofins)	9.25%		0	(262)	(1,573)	(1,922)	(2,097)	(2,097)	(2,097)	(2,097)	(2,097)	(2,097)
Net reveneus			(130)	2,572	15,431	18,860	20,575	20,575	20,575	20,575	20,575	20,575
O&M Total Costs			(600)	(3,269)	(8,824)	(10,652)	(11,566)	(11,566)	(11,566)	(11,566)	(11,566)	(11,566)
Operational Results - EBITDA			(730)	(697)	6,607	8,208	9,009	9,009	9,009	9,009	9,009	9,009
Depreciation			(1,283)	(5,542)	(7,872)	(9,860)	(11,011)	(11,574)	(12,136)	(12,698)	(13,260)	(13,822)
EBIT			(2,013)	(6,239)	(1,265)	(1,651)	(2,002)	(2,564)	(3,127)	(3,689)	(4,251)	(4,813)
Interests			(660)	(2,806)	(3,814)	(4,566)	(4,820)	(4,732)	(4,624)	(4,497)	(4,351)	(4,186)
EBT			(2,673)	(9,044)	(5,080)	(6,218)	(6,823)	(7,296)	(7,751)	(8,186)	(8,602)	(8,999)
IRPJ/ CSLL taxes (Real Profit Regime)	34%		0	0	0	0	0	0	0	0	0	0
Depreciation			1,283	5,542	7,872	9,860	11,011	11,574	12,136	12,698	13,260	13,822
Net operational profit			(1,390)	(3,503)	2,793	3,642	4,189	4,277	4,385	4,512	4,658	4,824
CapEx												
CapEx - LFG Station		(6,293)	(1,600)	0	(2,465)	0	0	0	0	0	0	0
CapEx - LFG Collection System		(6,536)	(5,621)	(5,621)	(5,621)	(5,621)	(5,621)	(5,621)	(5,621)	(5,621)	(5,621)	0
CapEx - Electricity Generation		0	(35,367)	(17,683)	(11,789)	(5,894)	0	0	0	0	0	0
Drawdown of debt		6,415	21,294	11,652	9,938	5,758	2,811	2,811	2,811	2,811	2,811	
Debt Repayment			(401)	(1,732)	(2,460)	(3,081)	(3,441)	(3,617)	(3,792)	(3,968)	(4,144)	(4,319)
Net Cash Flow Equity		(6,415)	(23,085)	(16,887)	(9,605)	(5,197)	(2,063)	(2,150)	(2,218)	(2,267)	(2,296)	504

Note: All numbers are in Brazilian Real (k R$)

Benchmark	11.75%

NPV (25 years)	(43,056.68)

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
2022	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
152,787	152,787	152,787	127,322	114,590	101,858	76,393	63,661	50,929	50,929	38,197	25,464	25,464	25,464	12,732
148	148	148	148	148	148	148	148	148	148	148	148	148	148	148
22,672	22,672	22,672	18,893	17,004	15,115	11,336	9,447	7,557	7,557	5,668	3,779	3,779	3,779	1,889
22,672	22,672	22,672	18,893	17,004	15,115	11,336	9,447	7,557	7,557	5,668	3,779	3,779	3,779	1,889
(2,097)	(2,097)	(2,097)	(1,748)	(1,573)	(1,398)	(1,049)	(874)	(699)	(699)	(524)	(350)	(350)	(350)	(175)
20,575	20,575	20,575	17,146	15,431	13,717	10,287	8,573	6,858	6,858	5,144	3,429	3,429	3,429	1,715
(600)	(600)	(600)	(600)	(600)	(600)	(600)	(600)	(600)	(600)	(600)	(600)	(600)	(600)	(600)
19,975	19,975	19,975	16,546	14,831	13,117	9,687	7,973	6,258	6,258	4,544	2,829	2,829	2,829	1,115
(12,539)	(8,280)	(5,950)	(3,962)	(2,811)	(2,249)	(1,686)	(1,124)	(562)	0	0	0	0	0	0
7,436	11,695	14,025	12,583	12,020	10,868	8,001	6,849	5,696	6,258	4,544	2,829	2,829	2,829	1,115
(3,712)	(3,238)	(2,764)	(2,290)	(1,816)	(1,343)	(913)	(629)	(425)	(289)	(193)	(116)	(58)	(19)	0
3,724	8,457	11,261	10,293	10,204	9,525	7,088	6,220	5,271	5,969	4,351	2,714	2,771	2,810	1,115
(1,266)	(2,875)	(3,829)	(3,500)	(3,469)	(3,239)	(2,410)	(2,115)	(1,792)	(2,030)	(1,479)	(923)	(942)	(955)	(379)
12,539	8,280	5,950	3,962	2,811	2,249	1,686	1,124	562	0	0	0	0	0	0
14,997	13,862	13,382	10,756	9,545	8,535	6,365	5,229	4,041	3,940	2,872	1,791	1,829	1,855	736
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(4,319)	(4,319)	(4,319)	(4,319)	(4,319)	(4,319)	(3,918)	(2,588)	(1,859)	(1,238)	(878)	(703)	(527)	(351)	(176)
10,678	9,542	9,063	6,436	5,226	4,216	2,446	2,642	2,182	2,701	1,993	1,088	1,302	1,503	560

For the alternative LFG 1 (electricity generation plant and the landfill gas extraction system), the NPV is k R$ - 43,056.68. Consequently, this scenario is not deemed attractive by the project participants.

The second alternative LFG2 (atmospheric release of the landfill gas) is the continuation of the current practice, which is in compliance with all applicable regulations and policies, and was deemed the most plausible alternative to the project activity.

Sub-step 2d. Sensitivity analysis

The sensitivity analysis was performed varying the electricity tariff (revenues), the capital expenses (CapEx) and operational and maintenance costs (O&M) for the alternatives. All parameters ranging from -10% to +10%, as the result presented below:

Table 4 - Sensitivity analysis

	Variation	NPV (k R$) Alternative LFG1
CapEx	-10%	(33,208.23)
	10%	(52,905.13)
Revenues	-10%	(53,079.60)
	10%	(33,033.76)
O&M	-10%	(38,265.05)
	10%	(47,848.31)
Base Case	0.0%	(43,056.68)

As presented above, the project Net Present Values are always below zero in all sensitivity analyses.

The figures below show the sensitivity analysis for LFG1.

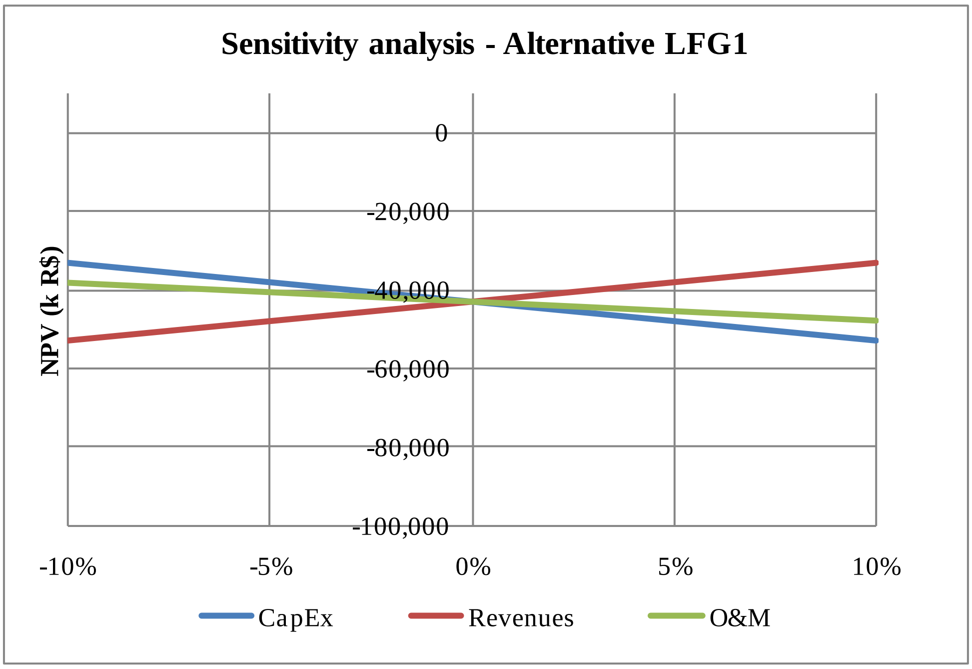

Figure 12 - Sensitivity analysis - LFG 1 (in Brazilian Reais - k R$)

Breakeven point

To ensure the additionality of this project activity, the project proponents varied the three identified parameters (CapEx, Revenues and O&M) until each of them reached the benchmark (i.e. NPV=0). The results are presented below for each alternative (LFG1 and LFG2) and the spreadsheet will be provided to the audit team:

- **LFG 1 (project activity scenario): Capture of landfill gas and power generation**

To ensure the additionality of this project activity, the project proponents varied the three identified parameters (CapEx, Revenues and O&M) until each of them reached the benchmark (i.e. NPV=0). The results are presented below and the spreadsheet was provided to the audit team:

Capital Expenditures (CapEx) – To reach the benchmark, the Capital Expenditures should be reduced in 43.7%. This result is extremely unlikely to happen in the future, as this reduction is too large for any kind of project which has a reliable investment estimate (such as CTL Landfill Gas Project) and as usually the CapEx increases during the project implementation.

Revenues – This value should be increased in 45.3% to reach the benchmark. This means that the electricity tariff should reach R$ 215.60 or the maximum annual electricity generated reaches 221,990 MWh[11], deemed unrealistic[12] as this value is far superior to the average values from the latest electricity sale auctions in Brazil.

The table below shows the electricity price for the only two alternatives sources auctions held in Brazil. The maximum electricity price was in auction in 2010 (148.39 R$/MWh). In addition, in Brazil the energy auctions are reverse auctions, therefore power is acquired at the lowest prices.

Table 5 - Results of the alternatives sources auctions held in Brazil

Date	Name of the Auction	Numbers of the plants	Starting operation	Highest electricity price (R$/MWh)
26/08/2010	2nd New Energy Auction*	89	2013	148.39

[11] Note: It is important to notice that for the revenues to reach 45.3% the LFG production should increase 64.71%, since the collection efficiency of the biogas plant is 70%.

[12] According to the EPA publication: Turning a Liability into an Asset A Landfill Gas-To-Energy Project Development Handbook (1996), page 26, the biogas generation estimative should vary by a range of plus or minus 50 % due to uncertainties in estimating waste compositions and climatic conditions parameters. Since the LFG production should increase 64.71% (more than 50%) in order to raise the revenues up to 45.3%, this situation is very unlikely to happen. Furthermore, such estimative uncertainties should currently be reduced considering the date of the study publication.

EPA publication source: http://nepis.epa.gov/Exe/ZyNET.exe/600008CZ.TXT?ZyActionD=ZyDocument&Client=EPA&Index=1995+Thru+1999&Docs=&Query=430B96004%20or%20epa%20or%20tuning%20or%20liability%20or%20asset&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=pubnumber%5E%22430B96004%22&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=pubnumber&IntQFieldOp=1&ExtQFieldOp=1&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C95thru99%5CTxt%5C00000019%5C600008CZ.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=10&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=p%7Cf&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL#, Accessed on 02/09/2011.

18/06/2007	1st New Energy Auction**	18	2010	139.12

Source: Electric Power Commercialization Chamber – CCEE (http://www.ccee.org.br), accessed on 02/06/2011.
*http://www.ccee.org.br/StaticFile/Arquivo/biblioteca_virtual/Leiloes/2_F_A/Resulta_Completo_2_LFA_site.xls
**http://www.ccee.org.br/StaticFile/Arquivo/biblioteca_virtual/Leiloes/1_leilao_fontes_alternativas/Resultados/resultados.xls

O&M – Also, to reach the benchmark, the O&M shall be reduced in 101.3%. This means that PPs should receive and not pay to operate the project. Consequently, this scenario is unreal.

Thus, the PPs deemed this situation to be unlikely to happen in the future.

- **LFG 2: Atmospheric release of the landfill gas**

As in this alternative there are no revenues or expenditures, the NPV is zero. Thus, it is not possible to carry out the breakeven point.

Outcome of Step 2

A short list raking the alternatives of the project activity is presented below according to the best NPV (financial indicator), taking into account the results of the sensitivity analysis.

Alternatives	Results
LFG2	Best scenario
LFG1	Intermediate Scenario

As a result the sensitivity analysis was conclusive and the most financially attractive alternative scenario is considered to be the alternative LFG2.

Therefore, it seems reasonable to conclude that the project activity (alternative LFG 1) is unlikely to be the most financially attractive scenario.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:

- The second Brazilian Greenhouse Gases Emissions Inventory Report (published in July/2010).[13]

  It states that between 1990-2002 the total amount of recovered methane in Brazilian landfills were considered zero. Furthermore, from 2003 onwards, all flared/recovered methane considered in the Inventory came from CDM landfill projects in Brazil.

- São Paulo State Greenhouse Gases Emissions Inventory Report in Waste Sector (published in April/2011)[14]

  It states that between 1990-2002 the total amount of recovered methane in São Paulo State landfills were considered zero. Furthermore, from 2003 onwards, all recovered methane considered in the State Inventory came from the CH_4 reductions of the CDM landfill projects in the State of São Paulo.

- Reducing the uncertainty of methane recovered (R) in greenhouse gas inventories from waste sector and of adjustment factor (AF) in landfill gas projects under the Clean Development Mechanism (published in September/2010)[15].

  It states that "all of Brazilian landfills with collection and destruction system (active system) are implemented projects under the CDM".

Thus, there are no similar activities[16] like the proposed project activity in Brazil operating or underway without CDM benefits, because all of the landfills that are developing capture and electricity generation using LFG, are being developed as CDM project activities.

Sub-step 4b. Discuss any similar options that are occurring:

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[13] Source: Ministry of Science and Technology. The second Brazilian Greenhouse Gases Emissions Inventory Report. Page 62. (http://www.mct.gov.br/upd_blob/0213/213909.pdf), accessed on 07/04/2011.

[14] Source: São Paulo State Environmental Company – CETESB. São Paulo State Greenhouse Gases Emissions Inventory Report in Waste Sector. Page 253. (http://www.cetesb.sp.gov.br/userfiles/file/mudancasclimaticas/geesp/file/docs/consulta/relatorios/residuos.pdf), accessed on 07/04/2011.

[15] Source: MAGALHÃES, G.HC.; ALVES, J.W.S.; SANTO FILHO. F.; COSTA, R.M.; KELSON. M. Reducing the uncertainty of methane recovered (R) in greenhouse gas inventories from waste sector and of adjustment factor (AF) in landfill gas projects under the clean development mechanism (2010). Page 174. (http://ghg.org.ua/fileadmin/user_upload/book/Proceedengs_UncWork.pdf), accessed on 07/04/2011.

[16] The "Tool for the demonstration and assessment of additionality" – version 5.2, states: "Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Other CDM project activities (registered project activities and project activities which have been published on the UNFCCC website for global stakeholder consultation as part of the validation process) are not to be included in this analysis"

Not applicable. There are no similar options to the proposed project activity not being developed as a CDM project activity.

Conclusion:

Since all the criteria of the *"Tool for the demonstration and assessment of additionality" 5.2* are satisfied, the proposed project activity is additional.

B.6.1. Explanation of methodological choices:

The baseline emissions were calculated according to the following formula:

$$BE_y = (MD_{project,y} - MD_{BL,y}) \times GWP_{CH4} + EL_{LFG,y} \times CEF_{elec,BL,y} + ET_{LFG,y} \times CEF_{ther,BL,y}$$

Where:

BE_y	=	Baseline emissions in year *y* (tCO_2e);
$MD_{project,y}$	=	The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH_4) in project scenario;
$MD_{BL,y}$	=	The amount of methane that would have been destroyed/combusted during the year in the absence of the project due to regulatory and/or contractual requirement, in tonnes of methane (tCH_4);
GWP_{CH4}	=	Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4;
EL_{LFG}	=	Net quantity of electricity produced using LFG which in the absence of the project activity would have been produced by power plants connected to the grid or by an on-site/off-site fossil fuel based captive power generation, during year *y*, in megawatt hours (MWh);
$CEF_{elec,BL,y}$	=	CO_2 emissions intensity of the baseline source of electricity displaced, in tCO_2e/MWh;
$ET_{LFG,y}$	=	The quantity of thermal energy produced utilizing the landfill gas, which in the absence of the project activity would have been produced from onsite/offsite fossil fuel fired boiler, during the year y in TJ;
$CEF_{ther,BL,y}$	=	CO_2 emissions intensity of the fuel used by boiler to generate thermal energy which is displaced by LFG based thermal energy generation, in tCO_2/TJ.

As the project only aims to flare and generate electricity, $ET_{LFG,y} = 0$, and the equation is changed as following:

$$BE_y = (MD_{project,y} - MD_{BL,y}) \times GWP_{CH4} + EL_{LFG,y} \times CEF_{elec,BL,y}$$

As in there is no regulatory or contractual requirements specifying MD_{BL}, do not exist historic data for LFG capture and destruction, an "Adjustment Factor" (AF) is used taking into account the project context, by using the following formula:

$$MD_{BL} = MD_{project,y} \times AF$$

MAGALHAES *et al* (2010)[17] carried out a study based on a sample with 154 Brazilian municipal solid waste landfills and on IPCC and UNFCCC methodologies to estimate AF to these landfills. The result shows that the AF is 0.0054 (or 0.54%).

Adopting a conservative approach, the *AF* used in the project activity is 1%.

According to the methodology ACM0001 version 11, the methane destroyed by the project activity ($MD_{project,y}$) during a year is determined by monitoring the quantity of methane actually flared and gas used to generate electricity a. The project activity aims to capture and flare LFG and in a second phase to generate electricity with LFG.

The sum of the quantities fed to the flare(s) and to the power plant(s)

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y};$$

Where:

$MD_{flared,y}$ = Quantity of methane destroyed by flaring (tCH_4);

$MD_{electricity,y}$ = Quantity of methane destroyed by generation of electricity (tCH_4);

$MD_{flared,y}$ is calculated as following:

$$MD_{flared,y} = (LFG_{flared,y} \times w_{CH4} \times D_{CH4}) - \frac{PE_{flare,y}}{GWP_{CH4}}$$

Where:

$LFG_{flare,y}$ = Quantity of landfill gas fed to the flare(s) during the year measured in (m^3);

w_{CH4} = Average methane fraction of the landfill gas as measured during the given time period t in time intervals of not greater than one hour (typically every 2-3 minutes)and expressed as a fraction of CH_4 volume per LFG volume (in m^3CH_4/m^3LFG);

D_{CH4} Methane density, expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4), and measured at STP (0 degree Celsius and 1.013 bar), which is 0.0007168 $tCH4/m^3CH_4$ (as per consolidated methodology ACM0001 ver.11);

$PE_{flare,y}$ = Project emissions from flaring of the residual gas stream in year y (tCO_2e);

And $MD_{electricity,y}$ is calculated as follows:

$$MD_{electricity,y} = LFG_{electricity,y} \times w_{CH4} \times D_{CH4}$$

Where:

$LFG_{electricity,y}$ = Quantity of landfill gas fed into electricity generator (m^3).

The ex-ante emissions were calculated as described in item B.6.3.

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[17] MAGALHAES, G.HC.; ALVES, J.W.S.; SANTO FILHO. F.; COSTA, R.M.; KELSON. M. (2010). Reducing the uncertainty of methane recovered (R) in greenhouse gas inventories from waste sector and of adjustment factor (AF) in landfill gas projects under the clean development mechanism. Page 175. (http://ghg.org.ua/fileadmin/user_upload/book/Proceedengs_UncWork.pdf)

Project emissions:

$$PE_y = PE_{EC} + PE_{FC,j,y}$$

Where:

$PE_{EC,y}$ = Emissions from consumption of electricity in the project case (tCO_2).

$PE_{FC,j,y}$ = Emission from consumption of heat in the project case (tCO_2).

Calculation of $PE_{EC,y}$ – project emission from consumption of electricity

According to *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"*, version 1, the project emission from consumption of electricity will be from two sources:

- $PE_{EC1,y}$ - Grid (Brazilian interconnected electric system);
- $PE_{EC2,y}$ - Diesel generator(s) (off-grid captive power plant)

Thus,

$$PE_{EC,y} = PE_{EC1,y} + PE_{EC2,y}$$

$PE_{EC1,y}$ - Project emission from the grid

As electricity will be consumed from the grid, the option A1 of the scenario A was chosen, as follows:

> *Option A1: Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest approved version of the "Tool to calculate the emission factor for an electricity system" ($EF_{EL,j/k/l,y} = EF_{grid,CM,y}$).*

Thus, the project emission is calculated as following:

$$PE_{EC1,y} = EC_{PJ1,y} \times EF_{grid,CM,y} \times (1 + TDL_y)$$

Where:

$EC_{PJ1,y}$ = quantity of electricity consumed from the grid by the project activity during the year y (MWh);

$EF_{grid,CM,y}$ = the emission factor for the grid in year y (tCO_2/MWh);

TDL_y = average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

$PE_{EC2,y}$ - Project emission from diesel generator(s)

As electricity will be consumed from diesel generators (off-grid captive power plant), a conservative approach was adopted and the option B2 of the scenario B was chosen because: "The electricity consumption source is a project or leakage electricity consumption source". Therefore, the value used will be 1.3 tCO2/MWh for project emission from diesel generator(s).

$$PE_{EC2,y} = EC_{PJ2,y} \times EF_{diesel\_generator,y}$$

Where:

$EC_{PJ2,y}$ = quantity of electricity consumed from diesel generator by the project activity during the year y (MWh);
$EF_{diesel\_generator,y}$ = the emission factor for the diesel generator in year y (tCO_2/MWh);

Calculation of $PE_{FC,y}$ – project emission from consumption of heat

The consumption of heat will be provided by the burning of liquefied petroleum gas (LPG) from pilot flames of the flares.

According to "*Tool to calculate project of leakage CO2 emissions from fossil fuel combustion*" - version 2, the equation is:

$$PE_{FC,j,y} = \sum_{i} FC_{i,j,y} \times COEF_{i,y}$$

Where:

- $PE_{FC,j,y}$ is the CO_2 emissions from LPG combustion in flares during the year y (tCO_2/yr);
- $FC_{i,j,y}$ is the quantity of LFG combusted in pilot flames of flares during year y (mass /yr); and
- $COEF_{i,y}$ is the CO_2 emission coefficient of LPG in year y (tCO_2/mass).

In Brazil, there is data about chemical composition in diesel invoices. Therefore, option B was chosen for calculation of $COEF_{i,y}$.

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

Where:

- $NCV_{i,y}$ is the weighted average net caloric value of fuel type i in year y (GJ/mass); and
- $EF_{CO2,I,y}$ is the weighted average emission factor of fuel type i in year y (tCO_2/GJ).

Leakage:

In accordance with the ACM0001 version 11, no leakage effects need to be accounted.

Emission Reduction

Emission reductions are calculated as follows:

$$ER_y = BE_y – PE_y,$$

Where:
ER_y = Emission reductions in year y (tCO_2e/yr);

BE_y = Baseline emissions in year y (tCO_2e/yr);
PE_y = Project emissions in year y (tCO_2e/yr);

Enclosed flare(s) will be installed in the project activity to increase the destruction efficiency. Those flares reach 98% (minimum) of methane destruction efficiency.

To determine the project emissions from flaring gases were used the “Tool to determine project emissions from flaring gases containing methane”. According to this tool, the project emissions should be calculated in 7 steps.

STEP 1. Determination of the mass flow rate of the residual gas that is flared

The density of the residual gas is determined based on the volumetric fraction of all components in the gas:

$$FM_{RG} = \rho_{RG,n,h} \times FV_{RG,h}$$

$FM_{RG,h}$ = Mass flow rate of the residual gas in hour h (kg/h);
$\rho_{RG,n,h}$ = Density of the residual gas at normal conditions in hour h (kg/m^3);
$FV_{RG,h}$ = Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h;

And

$$\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \times T_n}$$

P_n = Atmospheric pressure at normal conditions (101,325Pa);
R_u = Universal ideal gas constant (8.314 $Pa.m^3/kmol.K$);
$MM_{RG,h}$ = Molecular mass of the residual gas in hour *h* (kg/kmol);
T_n = Temperature at normal conditions (273.15K);

And,

$$MM_{RG,h} = \sum_i (fv_{i,h} \cdot MM_i)$$

$fv_{i,h}$ = Volumetric fraction of component *i* in the residual gas in the hour *h*;
MM_i = Molecular mass of residual gas component *i* (kg/kmol/);
i = Gas components;

As permitted by the tool, the project participants will only measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2).

STEP 2. Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

$$fm_{j,h} = \frac{\sum_i fv_{i,h} \cdot AM_j \cdot NA_{j,i}}{MM_{RG,h}}$$

$fm_{j,h}$ = Mass fraction of element *j* in the residual gas in hour *h*;
AM_j = Atomic mass of element *j* (kg/kmol);
$NA_{j,i}$ = Number of atoms of element *j* in component *i*;
$MM_{RG,h}$ = Molecular mass of the residual gas in hour *h (kg/kmol)*;
j = The elements carbon, hydrogen, oxygen and nitrogen;
i = The components CH_4 and N_2 (according to the simplification used);

STEP 3. Determination of the volumetric flow rate of the exhaust gas on a dry basis

$$TV_{n,FG,h} = V_{n,FG,h} \times FM_{RG,h}$$

Where:

$TV_{n,FG,h}$ = Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour h (m^3/h);
$V_{n,FG,h}$ = Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in hour *h* (m^3/kg residual gas);
$FM_{RG,h}$ = Mass flow rate of the residual gas in the hour *h* (kg residual gas/h);

$$V_{n,FG,h} = V_{n,CO2,h} + V_{n,O2,h} + V_{n,N2,h}$$

Where:

$V_{n,N2,h}$ = Quantity of N_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h* (m^3/ kg residual gas);
$V_{n,O2,h}$ = Quantity of O_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h* (m^3/ kg residual gas);
$V_{n,CO2,h}$ = Quantity of CO_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h* (m^3/ kg residual gas);

$$V_{n,O2,h} = n_{O2,h} \times MV_n$$

$n_{O2,h}$ = Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h* (kmol/$kg_{residual\_gas}$);
MV_n = Volume of one mole of any ideal gas at normal temperature and pressure (22.4 L/mol) (in m^3/kmol);

$$V_{n,CO2,h} = \frac{fm_{C,h}}{AM_C} \times MV_n$$

$fm_{C,h}$ = Mass fraction of carbon in the residual gas in the hour h;
AM_C = Atomic mass of carbon (kg/kmol);
MV_n = Volume of one mole of any ideal gas at normal temperature and pressure (22.4 L/mol) (in m^3/kmol);

And

$$V_{n,N2,h} = MV_n \cdot \left\{ \frac{fm_{N,h}}{200AM_n} + \left(\frac{1-MF_{o_2}}{MF_{O_2}} \right) \cdot \left(F_h + n_{O_2,h} \right) \right\}$$

Where:

$fm_{N,h}$ = Mass fraction of nitrogen in the residual gas in the hour h
AM_n = Atomic mass of nitrogen (kg/kmol);
MF_{O2} = O_2 volumetric fraction of air (0.21);
F_h = Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas flared in hour h (kmol/kg residual gas);
$n_{O2,h}$ = Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour h (kmol/kg residual gas);

$$n_{O_2,h} = \frac{t_{O_2,h}}{(1-(\frac{t_{O_2,h}}{MF_{O_2}}))} \times \left[\frac{fm_{C,h}}{AM_C} + \frac{fm_{N,h}}{2AM_N} + \left(\frac{1-MF_{O2}}{MF_{O2}} \right) \times F_h \right]$$

$t_{O2,h}$ = Volumetric fraction of O_2 in the exhaust gas in the hour *h*;
MF_{O2} = O_2 volumetric fraction of air (0.21);
F_h = Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h* (kmol/kg residual gas);
AM_j = Atomic mass of element *j* (kg/kmol);
j = The elements carbon, hydrogen, oxygen and nitrogen;

$$F_h = \frac{fm_{C,h}}{AM_C} + \frac{fm_{H,h}}{4AM_H} - \frac{fm_{O,h}}{2AM_O}$$

Where:

$fm_{j,h}$ = Mass fraction of element *j* in the residual gas in hour *h;*

STEP 4. Determination of methane mass flow rate in the exhaust gas on a dry basis

The mass flow of methane in the exhaust gas is based on the volumetric flow of the exhaust gas and the measured concentration of methane in the exhaust gas, as follows:

$$TM_{FG,h} = \frac{TV_{n,FG,h} \cdot fv_{CH4,FG,h}}{1000000}$$

Where:

$TV_{n,FG,h}$ = Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour *h* (m^3/h exhaust gas);
$fv_{CH4,FG,h}$ = Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in hour *h* (mg/m^3).

STEP 5. Determination of methane mass flow rate in the residual gas on a dry basis

The quantity of methane in the residual gas flowing into the flare is the product of the volumetric flow rate of the residual gas ($FV_{RG,h}$), the volumetric fraction of methane in the residual gas ($fv_{CH4,RG,h}$) and the density of methane ($\rho_{CH4,n,h}$) in the same reference conditions (normal conditions and dry or wet basis).

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n}$$

$FV_{RG,h}$ = Volume flow rate of the residual gas in dry basis at normal conditions in hour h (m^3/h);
$fv_{CH4,RG,h}$ = Volumetric fraction of methane in the residual gas on dry basis in hour h (NB: this corresponds to fvi,RG,h where i refers to methane).
$\rho_{CH4,n}$ = Density of methane at normal conditions (0.716 kg/m^3);

STEP 6. Determination of the hourly flare efficiency

The determination of the hourly flare efficiency depends on the operation of flare (through temperature), the type of flare used (enclosed) and the approach selected (continuous).

For the project activity, the case of enclosed flares and continuous monitoring of the flare efficiency, the flare efficiency in the hour h is:

- 0% if the temperature of the exhaust gas of the flare (T_{flare}) is below 500°C during more than 20 minutes during the hour *h*;
- Determined as follows in cases where the temperature of the exhaust gas of the flare (T_{flare}) is above 500°C for more than 40 minutes during the hour *h*;

$$\eta_{flare,h} = 1 - \frac{TM_{FG,h}}{TM_{RG,h}}$$

Where:

$TM_{FG,h}$ = Methane mass flow rate in exhaust gas averaged in a period of time *t* (kg/h);
$TM_{RG,h}$ = Mass flow rate of methane in the residual gas in the hour *h* (kg/h);

STEP 7. Calculation of annual project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions from each hour *h*, based on the methane flow rate in the residual gas ($TM_{RG,h}$) and the flare efficiency during each hour *h* ($\eta_{flare,h}$), as follows:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH4}}{1000}$$

$TM_{RG,h}$ = Mass flow rate of methane in the residual gas in the hour *h* (kg/h);
$\eta_{flare,h}$ = Flare efficiency in hour *h*;

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

Data / Parameter:	Regulatory requirements relating to landfill gas
Data unit:	Text
Description:	Regulatory requirements relating to landfill gas
Source of data used:	SNIS (2007) - Secretaria Nacional de Informações sobre Saneamento Sistema Nacional de Informações sobre Saneamento: diagnóstico do manejo de resíduos sólidos urbanos, page II.281[18]. Integrated Solid Waste Management: http://www.ibam.org.br/media/arquivos/estudos/01-girs_mdl_1.pdf, accessed on 14/01/2011.
Value applied:	-
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	The information though recorded annually, is used for changes to the adjustment factor (AF) or directly $MD_{BL,y}$ at renewal of the credit period. Relevant regulations for LFG project activities shall be updated at renewal of each credit period. Changes to regulation should be converted to the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{BL,y}$). Project participants should explain how regulations are translated into that amount of gas

Data / Parameter:	φ
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	Oonk et el. (1994) have validated several landfill gas models based on 17 realized landfill gas projects. The mean relative error of multi-phase models was assessed to be 18%. Given the uncertainties associated with the model and in order to estimate emission reductions in a conservative manner, a discount of 10% is applied to the model results.
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value used
Any comment:	Used for projection of methane avoidance

[18] SNIS http://www.pmss.gov.br/snis/PaginaCarrega.php?EWRErterterTERTer=80

Data / Parameter:	OX
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value used for managed solid waste disposal sites
Any comment:	Used for projection of methane avoidance

Data / Parameter:	F
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC.
Any comment:	Used for projection of methane avoidance

Data / Parameter:	DOC_f
Data unit:	-
Description:	Fraction of degradable organic carbon that can decompose
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Used for projection of methane avoidance

Data / Parameter:	MCF
Data unit:	-
Description:	Methane correction factor
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	1.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPPC default value for anaerobic managed solid waste disposal site is applied. The landfill site has a controlled placement
Any comment:	Used for projection of methane avoidance

Data / Parameter:	DOC_j
Data unit:	-
Description:	Fraction of degradable organic carbon (by weight) in the waste type j
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	see table below
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value for anaerobic managed solid waste disposal site is applied.
Any comment:	Used for projection of methane avoidance

Waste type j	DOCj (% wet waste)
Wood and wood products	43%
Pulp, paper and cardboard (other than sludge)	40%
Food, food waste, beverages and tobacco (other than sludge)	15%
Textiles	24%
Garden, yard and park waste	20%
Glass, plastic, metal, other inert waste	0%

<table>
<tr><td>Data / Parameter:</td><td>k_j</td></tr>
<tr><td>Data unit:</td><td>-</td></tr>
<tr><td>Description:</td><td>Decay rate for waste type j</td></tr>
<tr><td>Source of data used:</td><td>2006 IPCC Guidelines for National Greenhouse Gas Inventories</td></tr>
<tr><td>Value applied:</td><td>
<table>
<tr><th colspan="2" rowspan="2">Waste type j</th><th>Tropical (MAT > 20 °C)</th></tr>
<tr><th>Wet (MAP > 1,000mm)</th></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.07</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.035</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.17</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.4</td></tr>
</table>
</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>IPCC default value for anaerobic managed solid waste disposal site is applied.</td></tr>
<tr><td>Any comment:</td><td>Used for projection of methane avoidance. The climate data was provided to Rainfall index database from São Paulo city – Station: E3-243 (http://www.sigrh.sp.gov.br/cgi-bin/bdhm.exe/plu?qwe=qwe). And the temperature data was provided to CIIAGRO (http://www.ciiagro.sp.gov.br/ciiagroonline/Quadros/QTmedPeriodo.asp)</td></tr>
</table>

Data / Parameter:	Waste composition
Data unit:	%
Description:	Waste composition
Source of data used:	Landfill waste characterization report
Value applied:	**Composition of the waste** A) Wood and wood products: 1.31% B) Pulp, paper and cardboard (other than sludge): 9.85% C) Food, food waste, beverages and tobacco (other than sludge): 62.51% D) Textiles: 2.39% E) Garden, yard and park waste: 0.00% F) Glass, plastic, metal, other inert waste: 23.95% **TOTAL: 100.0%**
Justification of the choice of data or description of measurement methods and procedures actually applied :	The values are based on historical data from waste composition reports.
Any comment:	Used for projection of methane avoidance

Composition of the waste	
A) Wood and wood products	1.31%
B) Pulp, paper and cardboard (other than sludge)	9.85%
C) Food, food waste, beverages and tobacco (other than sludge)	62.51%
D) Textiles	2.39%
E) Garden, yard and park waste	0.00%
F) Glass, plastic, metal, other inert waste	23.95%
TOTAL	**100.0%**

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Global warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data used:	Decisions under UNFCCC and the Kyoto Protocol
Value applied:	21
Description of measurement methods and procedures to be applied:	21 for the first commitment period. Shall be updated according to any future COP/MOP decisions.
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” version 5
Any comment:	

Data / Parameter:	D_{CH4}
Data unit:	tCH_4/m^3CH_4
Description:	Methane density
Source of data used:	ACM0001 – version 11
Value applied:	0.0007168
Description of measurement methods and procedures to be applied:	At standard temperature and pressure (0 degrees Celsius and 1,013 bar) the density of methane is 0.0007168 tCH_4/m^3CH_4
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per guidance in ACM0001 version 11
Any comment:	

Data / Parameter:	$BE_{CH4,SWDS,y}$
Data unit:	tCO_2e
Description:	Methane generation from the landfill in the absence of the project activity at year y
Source of data used:	Emission reduction (ER) spreadsheet
Value applied:	(see table below)
Description of measurement methods and procedures to be applied:	As per the "Tool to determine methane emissions avoided from disposal of waste at a waste disposal site" version 4.
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	Used for ex-ante estimation of the amount of methane that would have been destroyed/combusted during the year

Year	$BE_{CH4,SWDS,y}$ (tCO_2)
2012	338,411
2013	861,218
2014	993,261
2015	1,089,662
2016	1,161,655
2017	1,216,809
2018	1,260,226
2019	647,679

Data / Parameter:	f
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner.
Source of data to be used:	Project participants
Value applied:	0%
Description of measurement methods and procedures to be applied:	-
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" version 4
Any comment:	More details please see ACM0001 – version 11, page 10.

Data / Parameter:	$\mathbf{EF_{diesel\_generator}}$
Data unit:	tCO_2/MWh
Description:	the emission factor for the diesel generator
Source of data used:	Tool to calculate baseline, project and/or leakage emissions from electricity consumption – version 1
Value applied:	1.3
Description of measurement methods and procedures to be applied:	As per "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" – version 1.
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" – version 1.
Any comment:	-

B.6.3. Ex-ante calculation of emission reductions:

The emission reductions derived from the displacement of fossil fuels used for electricity generation from other sources are estimated for the Brazilian Interconnected System and strictly guided by ACM0001 ver. 11 which includes the "Tool to Calculate the Emission Factor for an Electricity System" version 2.2, as follows.

Step 1. Identify the relevant electric power system

For the purpose of determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without signification transmission constraints.

The Brazilian DNA published an official delineation of the project electricity system in Brazil, considering a national interconnected system.[19]

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)

The Brazilian DNA is responsible for calculating the emission factors and it is not included in calculation the off-grid power plants.

Step 3. Select a method to determined the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

a) Simple OM, or
b) Simple adjusted OM, or
c) Dispatch data analysis OM, or
d) Average OM.

The Brazilian DNA is responsible for calculating the OM emission factor in Brazil. It uses the method c) Dispatch data analysis OM.

For the dispatch data analysis OM, it is necessary to use the year in which the project activity displaces grid electricity and to update the emission factor annually during monitoring.

Step 4. Calculate the operating margin emission factor according to the selected method

The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the power units that are actually dispatched at the margin during each hour h where the project is displacing electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of $EF_{grid,OM-DD,y}$.

The emission factor is calculated as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_{m} EG_{PJ,h} \times EF_{EL,DD,h}}{EG_{PJ,y}}$$

Where:

$EF_{grid,OM-DD,y}$	=	Dispatch data analysis operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{PJ,h}$	=	Electricity displaced by the project activity in hour *h* m of year y (MWh)
$EF_{EL,DD,h}$	=	CO_2 emission factor for power units in the top of the dispatch order in hour *h* in year y (tCO_2/MWh)
$EG_{PJ,y}$	=	Total electricity displaced by the project activity in year y (MWh)
h	=	hours in year y in which the project activity is displacing grid electricity

[19] DNA Resolution n.8 was published on 26/05/2008 on http://www.mct.gov.br/index.php/content/view/14797.html, accessed on 12/08/2010.

y = Year in **w**hich the project activity is displacing grid electricity

The $EF_{EL,DD,h}$, $EF_{EL,DD,d}$ and $EF_{EL,DD,m}$ are displayed on the Brazilian DNA website[20], for the year 2009. However only the $EF_{EL,DD,m}$ will be used in order to calculate the emission reductions.

In order to estimate the emission reductions for the first crediting period the $EF_{EL,DD,2009}$ was calculated as a mean average of the $EF_{EL,DD,m}$. Then,

$$EF_{grid,OM-DD,2009} = 0.2476\ tCO_2/MWh.$$

Step 5. Calculate the build margin (BM) emission factor

The Brazilian DNA is responsible for calculating the BM emission factor in Brazil.

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: For the first crediting period, calculate the build margin emission factor *ex-ante* based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor should be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin factor shall be calculated ex-ante, as described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

The *Option 2* was chosen for the proposed project.

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

$$EF_{grid,BM,2009} = 0.0794\ tCO_2/MWh$$

Step 6. Calculate the combined margin emissions factor

The option a) weighted average CM was used to calculate the combined margin (CM).

$$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y}$$

[20] Source: http://www.mct.gov.br/index.php/content/view/74689.html, accessed on 04/01/2011.

The default weights are as follows: w_{OM} = 0.5 and w_{BM} = 0.5, fixed for the first crediting period. That gives:

EF_{2009} = 0.2476 * 0.5 + 0.0794 * 0.5 = 0.1635 tCO_2/MWh

The build margin CO_2 emission factor and operating margin CO2 emission factor will be ex-post. Therefore, the combined margin CO2 emission factor will be ex-post.

Emission reduction

The total methane generation at the site has been estimated based on the waste tonnage of the landfill using the first order decay model presented in the *"Tool to determine methane emissions from disposal of waste at a solid waste disposal site"* and considering the following equation as mentioned previously.

The methane generation from the landfill in the absence of the project activity (ex-ante emissions) may be calculated as per the following equation in the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" as stated in Section B.6.1:

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot \left(1-e^{-k_j}\right)$$

Where:

- $BE_{CH4,SWDS,y}$ is the methane generation from the landfill in the absence of the project activity, measured in tCO_2e.
- φ is the model correction factor to account for model uncertainties (0.9);
- GWP_{CH4} is the global warming potential of methane (21 tCO_2e/tCH_4);
- OX is the oxidation factor (0.1);
- F is the fraction of methane in the SWDS gas (0.5);
- DOC_f is the fraction of degradable organic carbon that can decompose (0.5);
- MCF is the methane correction factor (1.0);
- $W_{j,x}$ is the amount of organic waste type j prevented from disposal in the SWDS , measured in tonnes;
- DOC_j is the fraction of degradable organic carbon (by weight) in the waste type j; and
- k_j is the decay rate constant for waste type j;

The assumptions used to calculate methane emissions are presented as follows:

Methane content in LFG = 50%;
LFG collection efficiency = 70%; and
Density of methane = 0.0007168 tonnes/m^3 (as per consolidated methodology ACM0001 ver. 11).

The landfill gas collection and utilization system will capture only a portion of the generated landfill gas. Thus, an estimate of 70% LFG collection was applied to the estimate of LFG produced, under assumption that generated LFG is composed of 50% methane.

The ex ante estimation of the $MD_{project,y}$ is presented below:

$$MD_{project,y} = \frac{BE_{CH4,SWDS,y}}{GWP_{CH4}}$$

Where:

$MD_{project,y}$ = Amount of methane destroyed by the project activity during the year y of the project activity (tCH_4).
$BE_{CH4,SWDS,y}$ = Methane generation from the landfill in the absence of the project activity at year y (tCO2e), calculated as per the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site". The tool estimates methane generation adjusted for, using adjustment factor (f) any landfill gas in the baseline that would have been captured and destroyed to comply with relevant regulations or contractual requirements, or to address safety and odor concerns. As this is already accounted for in equation 2, "f" in the tool shall be assigned a value 0.
GWP_{CH4} = Global warming Potential (GWP) of methane.

The table below illustrates the ex ante quantities of methane collected by the project activity during the crediting period.

Table 6 - Estimated amount of methane captured by the project activity

Year	$MD_{project}$ (tCH_4)
2012	11,280
2013	28,707
2014	33,109
2015	36,322
2016	38,722
2017	40,560
2018	42,008
2019	21,589

1. Leakage:

No leakage effects need to be accounted under methodology ACM0001 ver. 11.

2. Project emission:

Calculation of $PE_{EC,y}$ – project emission from consumption of electricity

The project emission from consumption of electricity is:

$$PE_{EC,y} = PE_{EC1,y} - PE_{EC2,y}$$

Where:

$PE_{EC1,y}$ - Project emission from the grid

In the project activity, the electrical consumption from the grid is estimated around 3,240 MWh/year.

In the option A1 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" ver. 1, states that a value of the combined margin emission factor ($EF_{grid,CM,y}$) may be used as the emission factor ($EF_{ELj/k/l,y}$) Therefore a value of 0.1635 tCO_2/MWh will be used.

Finally the technical transmission and distribution losses ($TDL_{j,y}$) value has been assumed to be 6%, according to BEN - 2006.[21] Table below summarizes the project emissions resulting from electrical consumption in the plant.

Table 7 - Electricity consumption from the grid resulting due to project activity

Year	**Electricity consumption from the grid** (MWh/year)	**$PE_{el,grid}$ (tCO_2/year)**
2012	878	153
2013	1,756	305
2014	3,240	562
2015	3,240	562
2016	3,240	562
2017	3,240	562
2018	3,240	562
2019	1,620	281

It is noted that in 2013, the first year of electrical generation utilizing LFG as a fuel, the power plant will be able to supply both the requirements of the power plant and of the blowers required to collect the LFG. As a result, the data contained in Table above will be an overestimation of the actual emissions resulting from electrical consumption and should be seen as conservative estimate for the period prior to implementation of the power plant.

$PE_{EC2,y}$ - Project emission from diesel generator(s)

The diesel generator consumption will be around 171 MWh/year and emission factor from the diesel generator(s) is 1.3 tCO2/MWh. The following table represents the project emissions from the use of the standby generator over the crediting period. Table below presents the project emissions associated with fossil fuel combustion at the project site.

[21] National Energy Balance 2006 (base year 2005), page 21.

Table 8 - Project emissions from diesel generator

Year	$PE_{el,diesel}$ (MWh/year)	$PE_{el,diesel}$ (tCO_2/year)
2012	46	60
2013	92	120
2014	171	223
2015	171	223
2016	171	223
2017	171	223
2018	171	223
2019	86	112

Calculation of $PE_{FC,y}$ – project emission from consumption of heat

For ex-ante calculation, this factor was considered zero because there is no estimation from LPG consumption in pilot flames of flares.

$PE_{FC,y} = 0$

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

3.1. Emission Reductions Associated with Methane Destruction:

Year	$MD_{project}$ (tCH_4)
2012	11,280
2013	28,707
2014	33,109
2015	36,322
2016	38,722
2017	40,560
2018	42,008
2019	21,589

$ER_y = EG_y \, x \, EF_{grid,CM,y} – PE_y – L_y$

Where:

- ER_y are the emission reductions associated with the project activity (tonnes of CO_2e);
- PE_y are the project activity emissions (tonnes of CO_2e); and
- L_y are the emissions due to leakage (tonnes of CO_2e).

Since emissions due to leakage are not considered for landfill gas projects (ACM0001 ver. 11), the emission reductions for the electricity displacement are then simplified as:

$ER_y = EG_y \text{ x } EF_{grid,CM,y} – PE_y$

The baseline emissions was estimated and summarized as per table below.

Year	$MD_{Project}$ (tCH_4)	MD_{BL} (tCH_4)	BEy (tCO_2)	PEy (tCO_2)	Leakage (tCO_2)	ERy (tCO_2)
2012	11,280	113	234,518	213	0	234,305
2013	28,707	287	599,946	425	0	599,521
2014	33,109	331	707,063	785	0	706,278
2015	36,322	363	778,031	785	0	777,246
2016	38,722	387	830,004	785	0	829,219
2017	40,560	406	868,226	785	0	867,441
2018	42,008	420	898,314	785	0	897,529
2019	21,589	216	461,330	393	0	460,937

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

Year	Estimation of project activity emission (tCO_2e)	Estimation of the baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of emission reductions (tCO_2e)
2012	213	234,518	0	234,305
2013	425	599,946	0	599,521
2014	785	707,063	0	706,278
2015	785	778,031	0	777,246
2016	785	830,004	0	829,219
2017	785	868,226	0	867,441
2018	785	898,314	0	897,529
2019	393	461,330		460,937
Total (tonnes of CO_2e)	**4,653**	**5,377,432**	**0**	**5,372,476**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2 /MWh
Description:	CO_2 emission factor of the Brazilian grid electricity during the year y
Source of data to be used:	Brazilian DNA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.1635

Description of measurement methods and procedures to be applied:	The emission factor is calculated ex-post, as the weighted average of the dispatch data analysis OM (Operating Margin) and the BM (Build margin), as described in B.6.3.
QA/QC procedures to be applied:	Apply procedures in the “Tool to calculate the emission factor for an electricity system” Version 2.2.
Any comment:	All data and parameters to determine the grid electricity emission factor, as required by the “Tool to calculate the emission factor for an electricity system”, Version 2.2, were included in the monitoring plan. For more details, see Annex 3.

Data / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2 /MWh
Description:	Build margin emission factor of the Brazilian grid
Source of data to be used:	Brazilian DNA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0794
Description of measurement methods and procedures to be applied:	The emission factor is calculated ex-post, as described in B.6.3.
QA/QC procedures to be applied:	Apply procedures in the “Tool to calculate the emission factor for an electricity system” Version 2.2.
Any comment:	All data and parameters to determine the grid electricity emission factor, as required by the “Tool to calculate the emission factor for an electricity system”, Version 2.2, were included in the monitoring plan. For more details, see Annex 3.

Data / Parameter:	$EF_{grid,OM,y}$
Data unit:	tCO_2 /MWh
Description:	Operating margin emission factor of the Brazilian grid
Source of data to be used:	Brazilian DNA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.2476
Description of measurement methods and procedures to be applied:	The operating margin emission factor is calculated ex-post, as described in B.6.3.
QA/QC procedures to	Apply procedures in the “Tool to calculate the emission factor for an electricity

be applied:	system" Version 2.2.
Any comment:	All data and parameters to determine the grid electricity emission factor, as required by the "Tool to calculate the emission factor for an electricity system", Version 2.2, were included in the monitoring plan. For more details, see Annex 3.

Data / Parameter:	$LFG_{total,y}$
Data unit:	Nm^3
Description:	Total amount of landfill gas captured at normal temperature and pressure
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	13,380 (estimated to 2018)
Description of measurement methods and procedures to be applied:	The data will be collected continuously using a flow meter. The data will be aggregated on a monthly and yearly basis using continuous monitoring average values in time intervals of not greater than one hour (every 2-3 minutes). The data will be archived throughout the crediting period and two years thereafter.
QA/QC procedures to be applied:	Calibration of equipment as per manufacturer specifications to ensure validity of data measured. Periodical calibration.
Any comment:	-

Data / Parameter:	$LFG_{flare,y}$
Data unit:	Nm^3
Description:	Amount of landfill gas flared at Normal Temperature and Pressure
Source of data to be used:	Project Participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100% for the first phase and 0% for the subsequent phase. However this value may vary according to the gensets availability.
Description of measurement methods and procedures to be applied:	During Phase 1 and 2, the data will be collected continuously (average values in time intervals of not greater than one hour (every 2-3 minutes)) using on-line mass-compensated flow meter located in the piping. The supply to each point of methane destruction, through flaring and use for energy generation, will be measured separately. The data will be aggregated monthly and yearly. The data will be archived throughout the crediting period and two years thereafter.
QA/QC procedures to be applied:	Calibration of equipment as per manufacturer specifications to ensure validity of data measured. Periodical calibration.
Any comment:	-

Data / Parameter:	$LFG_{electricity,y}$
Data unit:	Nm^3
Description:	Amount of LFG combusted in power plant at Normal Temperature and Pressure
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0% of the LFG_{total} for the first year and 100% for the subsequent years. However this value will vary according to the gensets availability and operational schedule.
Description of measurement methods and procedures to be applied:	The data will be collected continuously (average values in time intervals of not greater than one hour (every 2-3 minutes)) using a flow meter. The data will be aggregated monthly and yearly for the power plant. The data will be archived throughout the crediting period and two years thereafter.
QA/QC procedures to be applied:	Calibration of equipment as per manufacturer specifications to ensure validity of data measured. Periodical calibration.
Any comment:	-

Data / Parameter:	$\mathbf{w_{CH4}}$
Data unit:	m^3CH_4/m^3LFG
Description:	Methane fraction in the landfill gas
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50%
Description of measurement methods and procedures to be applied:	Continuous measurements from gas quality analyzer. Data will be aggregated monthly and yearly, using an average value in a time interval not greater than an hour. The equipment will be certified.
QA/QC procedures to be applied:	The gas analyzer should be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	Monitoring under responsibility of the Project's operators (the team, the organizational structure and the management structure will be defined after the project's implementation). The data will be archived throughout the crediting period and two years thereafter.

Data / Parameter:	$PE_{flare,y}$
Data unit:	tCO_{2e}
Description:	Project emissions from flaring of the residual gas stream in year y
Source of data to be used:	Project participants through to "Tool to determine project emissions from flaring gases containing methane"
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2%
Description of measurement methods and procedures to be applied:	Annual data will be recorded as per the most current version of the *"Tool to determine project emissions from flaring gases containing Methane"* at the time of validation. The data will be archived throughout the crediting period and two years thereafter.
QA/QC procedures to be applied:	The parameters used for determining the project emissions from flaring of the residual gas stream in year y will use the QA/QC procedures as per the "*Tool to determine project emissions from flaring gases containing methane"*.
Any comment:	The value of 98% was based on the manufacturer specification. The flare efficiency will be monitored continuously.

Data / Parameter:	EL_{LFG} .
Data unit:	MWh
Description:	Net amount of electricity generated using LFG
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	see table below
Description of measurement methods and procedures to be applied:	The data will be collected continuously using an electricity meter. The net amount of electricity will be directly measured. The data will be archived throughout the crediting period and two years thereafter.
QA/QC procedures to be applied:	Calibration of equipment as per manufacturer specifications to ensure validity of data measured. Periodical calibration.
Any comment:	-

Year	**Electricity generated in the plant (MWh)**
2012	0
2013	19,098
2014	114,590
2015	140,055
2016	152,787
2017	152,787
2018	152,787
2019	76,393

Data / Parameter:	Operational of the energy plant
Data unit:	Hours
Description:	Operation of the energy plant
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	8,268 hours/year
Description of measurement methods and procedures to be applied:	Information will be monitored and reviewed on an annual basis. The information will be archived during the crediting period and for two years thereafter.
QA/QC procedures to be applied:	Reliable sources will be used. The information acquired will be peer reviewed.
Any comment:	The value was calculated using information by engineering company. The data will be archived throughout the crediting period and two years thereafter.

Data / Parameter:	$NCV_{fuel,y}$
Data unit:	GJ per mass (GJ/ton)
Description:	Weighted average net calorific value of fossil fuel i in year y
Source of data to be used:	Regional or national default values
Value of data applied for the purpose of calculating expected emission reductions in section B.5	46.4 for LPG
Description of measurement methods and procedures to be applied:	Measurements should be undertaken in line with national or international fuel standards. Monitoring frequency: Review appropriateness of the values annually
QA/QC procedures to be applied:	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Any comment:	The value was based on Brazilian Energy Balance -BEN (2009). The data will be archived throughout the crediting period and two years thereafter.

Data / Parameter:	$EC_{PJ1,y}$
Data unit:	MWh/y
Description:	Quantity of electricity consumed from the grid by the project activity during the year y;
Source of data to be used:	Project participants.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	(see table below)
Description of measurement methods and procedures to be applied:	Continuously measured by electricity meters for the grid electricity consumption as per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” version 1 and methodology ACM0001 version 11.
QA/QC procedures to be applied:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” version 1
Any comment:	The data will be archived throughout the crediting period and two years thereafter.

Year	**$EC_{PJ1,y}$ (MWh/year)**
2012	878
2013	1,756
2014	3,240
2015	3,240
2016	3,240
2017	3,240
2018	3,240
2019	1,620

Data / Parameter:	$EC_{PJ2,y}$
Data unit:	MWh/y
Description:	Quantity of electricity consumed from diesel generator by the project activity during the year y
Source of data to be used:	Project participants.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	<table><tr><th>Year</th><th>$PE_{el,diesel}$ (tCO_2/year)</th></tr><tr><td>2012</td><td>46</td></tr><tr><td>2013</td><td>92</td></tr><tr><td>2014</td><td>171</td></tr><tr><td>2015</td><td>171</td></tr><tr><td>2016</td><td>171</td></tr><tr><td>2017</td><td>171</td></tr><tr><td>2018</td><td>171</td></tr><tr><td>2019</td><td>86</td></tr></table>
Description of measurement methods and procedures to be applied:	Continuously measured by electricity meters for the diesel generators as per “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” version 1 and ACM0001 methodology.
QA/QC procedures to be applied:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” version 1
Any comment:	The data will be archived throughout the crediting period and two years thereafter.

Data / Parameter:	$FC_{i,j,y}$
Data unit:	kg
Description:	Quantity of LPG combusted in pilot flames of flares during year y.
Source of data to be used:	Invoices of LPG suppliers.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	The mass of LPG purchased by the project developer will be stated in the invoices issued by the LPG supplier. Hard copies of the invoices will be kept in files during the crediting period and two years after.
QA/QC procedures to be applied:	Scope of the LPG supplier.
Any comment:	Where such data is not available, IPCC data will be used in a conservative manner. The data will be archived throughout the crediting period and two years thereafter.

<table>
<tr><td>Data / Parameter:</td><td>$EF_{CO2,LPG,y}$</td></tr>
<tr><td>Data unit:</td><td>$EF_{CO2,i,y}$</td></tr>
<tr><td>Description:</td><td>Weighted average CO_2 emission factor of LFG in year y</td></tr>
<tr><td>Source of data to be used:</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>a) Values provided by the fuel supplier in invoices.</td><td>This is the preferred source.</td></tr>
<tr><td>b) Measurements by the project participants.</td><td>If a) is not available.</td></tr>
<tr><td>c) Regional or national default values.</td><td>If a) is not available These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.</td><td>If a) is not available.</td></tr>
</table></td></tr>
<tr><td>Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td>n/a</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>For a) and b) Measurements should be undertaken in line with national or international fuel standards.</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td>For a) and b): The CO_2 emission factor will be obtained for each fuel delivery, from which weighted average annual values should be calculated.
For c): Review appropriateness of the values annually.
For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>Any comment:</td><td>-</td></tr>
</table>

Data / Parameter:	T
Data unit:	°C
Description:	Temperature of the landfill gas
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	n/a
Description of measurement methods and procedures to be applied:	Measured to determine the density of methane DCH4. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters. Monitoring of frequency will be continuous.
QA/QC procedures to be applied:	Measuring instruments should be subject to a regular maintenance and testing regime in accordance to appropriate national/international standards
Any comment:	-

Data / Parameter:	P
Data unit:	Pa
Description:	Pressure of the landfill gas
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	n/a
Description of measurement methods and procedures to be applied:	Measured to determine the density of methane D_{CH4}. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters. Monitoring of frequency will be continuous.
QA/QC procedures to be applied:	Measuring instruments should be subject to a regular maintenance and testing regime in accordance to appropriate national/international standards.
Any comment:	-

Regarding Flare efficiency, according to “Tool to determine project emissions from flaring gases containing methane”

Data / Parameter:	$t_{O2,h}$
Data unit:	-
Description:	Volumetric fraction of O_2 in the exhaust gas of the flare in the hour h
Source of data to be used:	Measurements by project participants using a continuous gas analyzer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Extractive sampling analyzers with water and particulates removal devices or *in situ* analyzers for wet basis determination. The point of measurement (sampling point) shall be in the upper section of the flares (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperature level.
QA/QC procedures to be applied:	Analyzers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas. Periodical calibration.
Any comment:	-

Data / Parameter:	$fv_{CH4,FG,h}$
Data unit:	mg/m^3
Description:	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour h
Source of data to be used:	Measurements by project participants using a continuous gas analyzer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	n/a
Description of measurement methods and procedures to be applied:	Extractive sampling analyzers with water and particulates removal devices or *in situ* analyzers for wet basis determination. The point of measurement (sampling point) shall be in the upper section of the flares (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperature level. Data will be recorded continuously and values will be averaged hourly or at a shorter time interval
QA/QC procedures to be applied:	Analyzers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas. Periodical calibration.
Any comment:	Measurement instruments will be read ppmv values.

Data / Parameter:	T_{flare}
Data unit:	º C
Description:	Temperature on the exhaust gas of the flare
Source of data to be used:	Measurements by project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 500 ^{o}C indicates that a significant amount of gases are still being burnt and that the flare is operating. Data will be recorded continuously and values will be averaged hourly or at a shorter time interval
QA/QC procedures to be applied:	Thermocouples will be replaced or calibrated every year
Any comment:	-

Data / Parameter:	$FV_{RG,h}$
Data unit:	m^3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h
Source of data to be used:	Measurements by project participants using a flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	n/a
Description of measurement methods and procedures to be applied:	The residual gas flow rate is measured on wet basis. To convert it on dry basis, the current CDM procedures will be used. Ensure that the same basis (wet or dry) is considered for this measurement and the measurement of volumetric fraction of all components in the residual gas. Data will be monitored continuously and values will be averaged hourly or a shorter time interval.
QA/QC procedures to be applied:	Flow meters must be periodically calibrated according to the manufacturer's recommendation. Periodical calibration.
Any comment:	-

Data / Parameter:	$fv_{i,,h}$
Data unit:	
Description:	Volumetric fraction component i of the residual gas in dry basis at normal conditions in the hour h, where i = CH_4 and N_2
Source of data to be used:	Measurements by project participants using a continuous gas analyzer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50% of methane
Description of measurement methods and procedures to be applied:	Ensure that the same basis (wet or dry) is considered for this measurement and the measurement of volumetric fraction of all components in the residual gas when the residual gas temperature exceeds 60 ^{0}C. Data will be monitored continuously and values will be averaged hourly or a shorter time interval.
QA/QC procedures to be applied:	Analyzers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas. Periodical calibration.
Any comment:	-

Data / Parameter:	**TDL_y**
Data unit:	-
Description:	Average technical transmission and distribution losses in the grid in year *y* for the voltage level at which electricity is obtained from the grid at the project site.
Source of data to be used:	Regional or national default values
Value of data applied for the purpose of calculating expected emission reductions in section B.5	6%
Description of measurement methods and procedures to be applied:	The technical distribution losses do not contain grid losses other than technical transmission and distribution.
QA/QC procedures to be applied:	-
Any comment:	The data was based on National Energy Balance 2006, page 21.

Data / Parameter:	$MG_{PR,y}$
Data unit:	tCH_4
Description:	Amount of methane generated during year *y* of the project activity
Source of data to be used:	Calculated by the project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-

Description of measurement methods and procedures to be applied:	Estimated using the actual amount of waste disposed in the landfill as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
QA/QC procedures to be applied:	As per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Any comment:	-

B.7.2. Description of the monitoring plan:

The monitoring plan will be done according to the methodology ACM0001 version 11 and the applicable tools. Details are available in section B.7.1 above. The monitoring equipments locations are presented in the picture below:

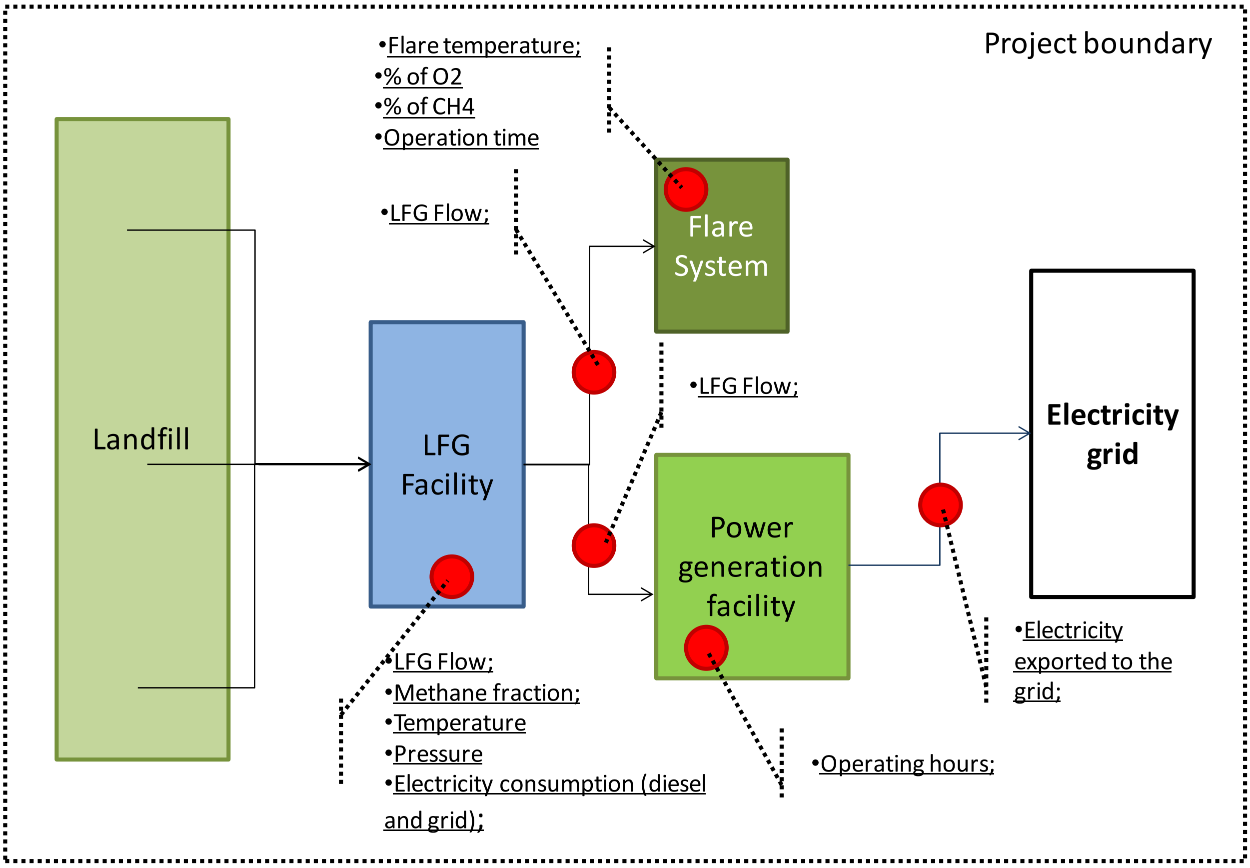

Figure 13 - Monitoring equipments locations

All continuously measured parameters (LFG flow, CH_4 concentration, flare temperature, flare operating hours, engine operating hours, and engine electrical output) will be recorded electronically via a datalogger, located within the Site boundary which will have the capability to aggregate and print the collected data at the frequencies as specified above. It will be the responsibility of the Site Operator to provide all requested data logs which will be stored over the duration of the reporting period at the Site office. The data logs will be summarized into emission reduction calculations prior to each verification. This task will be completed by EcoUrbis and reported directly to the DOE. These logs will be available at the request of the DOE in order to prove the operational integrity of the Project.

1. Introduction and Objectives

The two primary purposes of the monitoring plan are:

- To collect the necessary system data required for the determination of emissions reductions; and
- To demonstrate successful compliance with established operating and performance criteria to verify the emission reductions and generate the respective CERs.

The operational data that is collected will be used to support the periodic verification report that will be required for CER auditing. The monitoring plan discussed herein is designed to meet or exceed the UNFCCC requirements (approved monitoring methodology ACM0001 ver. 11).

The routine system monitoring program required for the determination of the emission reductions is discussed in section 2 below, while the additional system data that is collected to ensure the safe, correct, and efficient operation of the LFG management system is discussed in section 3.

2. Training of monitoring personnel

Before commencement of the O&M phase, EcoUrbis will conduct a training and quality control program to ensure that good management practices are carried out and implemented by all project operating personnel in terms of record-keeping, equipment calibration, overall maintenance, and procedures for corrective action. An operations manual will be developed for the operating personnel. The procedures for filing data and calculations to be performed by the LFG utilization operator will be included in a daily log to be placed in the main control room.

3. Monitoring Work Program

The LFG monitoring program is a relatively simple, straight forward program designed to collect system operating data required to safely operate the system and for the verification of CERs. This data will be collected in real time, and will provide a continuous record that is easy to monitor, review, and validate.

The following sections will outline and discuss the following key elements of the monitoring program:

- Flow measurement;
- Gas quality measurements;
- Uncombusted methane;
- Electrical Consumption;
- Project electricity output;
- Regulatory requirements;
- Data records; and
- Data assessment and reporting.

3.1. Flow Measurement

According to ACM0001 ver. 11, one flow meter will be installed during Phase 1 (flaring) on the piping, straight before the flares.

During phase 2 (electricity generation) implementation, in order to follow ACM0001 version 11, two other flow meters will also be installed: one flow meter will be installed in the main piping straight after the blowers to measure the total LFG flow extracted from the landfill; and another flow meter will be installed in the piping before the power plant to measure the LFG flow utilized for electricity generation.

The flow of LFG collected by the system and subsequently utilized or flared are measured via individual flow measuring devices suitable for measuring the velocity and volumetric flow of a gas. One common example is an annubar. The flow measurements are taken within the piping itself, and the flow sensors are connected to transmitters that are capable of collecting and sending continuous data to a recording device such as a datalogger.

The flow sensors are calibrated according to a specified temperature and composition of the gas, thus the flow actually measured must be corrected to according to actual temperature, pressure, and composition, thus density, of the gas measured. The equipment selected will allow dynamic compensation for these parameters, normalized to a standard temperature, pressure, and gas composition. For reporting purposes, the flows are generally required to be normalized to 0°C and 1.01325 bar at standard gas composition of 50% methane and carbon dioxide each by volume.

The accuracy of a flow meter is dependent on the design of the equipment, and the specific type of sensor used, however equipment is available that will provide a minimum accuracy of +/- 2% by volume. The equipment selected for the site utilizes a continuous monitoring system as defined in ACM0001 ver. 11, which measures and aggregates flow data approximately once every two minutes.

3.2. Gas Quality

The two parameters that are most pertinent to the validation of CERs, as well as the safe and efficient operation of the system are the concentration of methane and oxygen in the gas stream delivered for utilization or diverted to flaring. These two parameters are measured via a common sample line that is ran to the main collection system piping, and measured in real time by two separate sensors, one for methane and the other for oxygen, installed as per ACM0001 ver.11.

Regular calibration of the equipment is especially important, as the accuracy of the methane and oxygen sensors is greatest within the expected range of the gas stream to be measured. Equipment is readily available that will provide an accuracy of at least +/- 1% by volume. The equipment selected for the site aggregates gas compositions approximately once every 2 minutes as per the definition of a continuous monitoring system in ACM0001 ver. 11.

3.3. Uncombusted Methane

The efficiency of the enclosed flares will be measured per the methodological “Tool to determine project emissions from flaring gases containing methane”.

3.4. Electrical Consumption

The consumed electricity from the grid by the project activity will be continuously measured by electricity meters for the grid and diesel generators. The respective data will be electronically recorded.
Monthly electrical bills charged to the project will be monitored and considered as the actual energy consumption for the project.

3.5. Project Electricity Output

The generated electricity supplied to the grid by the project activity will be continuously measured by an electricity meter and respective data will be electronically recorded.

3.6. LPG purchased

The mass of LPG purchased by the project developer will be stated in the invoices issued by the LPG supplier. For ex-ante calculation, the value of LPG purchased was considered zero since there is no estimation from LPG consumption in pilot flames of flares and this emission source is very small.

3.7. Regulatory Requirements

Regulatory requirements relating to LFG projects will be evaluated annually by investigating municipal, state and national regulations pertaining to LFG. This will be done through consultation with the appropriate regulatory bodies, ongoing discussion with regulators, and monitoring of publications delineating upcoming legislative changes governing landfills and LFG.

4. Data records and storage

Data collected from each of the parameter sensors is transmitted directly to an electronic database from which the CER volume calculations may be carried out, as described in section 2.1 above. A hard copy backup or reports of the data may be printed as required or recorded in Portable Document Format (PDF). Backup of the electronic data is conducted on a 2-3 minute intervals, as described above.

4.1. Data Assessment and Reporting

Assessment of the flow and composition data described above coupled with the operating hours of the engines/flare and engines/flare destruction efficiencies are used to determine the quantity of CERs to be generated. For electricity generation offsets, the appropriate emission factors will be applied.

The destruction efficiency of the flare is a function of the internal combustion temperature and resident holding time, which are generally measured by the flare system controller and recorded for auditing purposes. Extensive technical documentation is available that documents the destructive efficiency of the enclosed drum flares that will be used, subject to the flow rate and combustion temperature verification. Destruction efficiency will also be assessed periodically through measurement of uncombusted methane emissions.

As discussed in Section 2.1, flow data is normalized to standard temperature, pressure, and composition for reporting purposes. The data will be compiled and assessed to produce the required quantification and validation. The periodic monitoring report will contain the data required for the verification of the CERs, and additionally may contain operational data from the collection system and flaring system described below to illustrate that the system is well maintained and operating at peak efficiency. Records of regular maintenance performed will also be a component of the annual report.

5. Related monitoring and project performance review

EcoUrbis will conduct an additional operational monitoring of the LFG collection system to check the project performance and ensure that the system is being operated both correctly and efficiently. Periodic adjustments to the horizontal trenches and to the extraction wells/drains will be required to optimize the capture and collection systems effectiveness. LFG collection field adjustments will be made based upon a review of the trench and well performance history considered within the context of the overall LFG collection field operation in order to maximize the collection of methane balanced against minimization of any oxygen in the system that could introduce unsafe operating conditions. Monitoring at each trench and extraction well will consist of the following parameters: valve position, individual well/trench flow, individual well/trench vacuum, and composition of the gas collected, i.e., methane, carbon dioxide, and oxygen, using a portable measuring device.

6. Emergency procedures

As a precautionary measure, the Landtec® system is plugged to a battery-based uninterruptible power supply (UPS) to avoid data loss due to power failures. As a backup is produced and stored off-site from the main recording system, no more than 2 to 3 minutes of data at a time would ever be lost due to a system malfunction.

All data will be collected through a Landtec® Field Analytical Unit (FAU) and will be transmitted to a Landtec® Field Server Unit (FSU), which records the data on-site and automatically sends it via a "always-on" Internet connection to an off-site server for storage and off-site back-up. All collected data is available for viewing, report generation, and retrieval through a Web interface, the EnviroComp™ Reporting System (ECRS), which can be accessed from anywhere an Internet connection is available. The plant Manager will check daily the records. In addition, there will be developed an Emergency Plan including others types of emergencies such as fire and work accidents.

7. Calibration

All the measurement instruments will be subject to regular calibration as per manufacturer's specifications. The regular check and calibration will be made to the operators. The plant Manager will be responsible for checking the equipment's proper working order, as well as checking and storing up the calibration certificates and records. Calibration certificates will be kept for all the equipments during the crediting period and two years after.

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

The date of completion the application of the methodology to the project activity study is 11/11/2010.

The person/entity determining the baseline is as follows:
Econergy Brasil Ltda, São Paulo, Brazil
Telephone: +55 (11) 3555-5700
Contact person: Mr. Francisco do Espirito Santo Filho
E-mail: francisco.santo@econergy.com.br

Econergy Brasil Ltda is not a Project Participant.

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:

Project starting date: 11/11/2011.

The Project Participant will decide to implement the project activity after receiving the Brazilian Letter of Approval. The forecast date of the Brazilian DNA meeting is 11/11/2011[22]. In addition, this date may also be the date of the main equipments purchase.

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

25 years and 0 months

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

C.2.1. Renewable crediting period:

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

The crediting period will start on 01/07/2012 or on the date of the registration of the CDM project activity (whichever is later).

C.2.1.2. Length of the first crediting period:

7 years (renewable for two times) and 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Left blank on purpose.

C.2.2.2. Length:

Left blank on purpose.

SECTION D. Environmental impacts

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

According to the Brazilian laws, the possible environmental impacts are analyzed by the State Secretary of Environment (*Secretaria de Estado do Meio Ambiente*) through its executive branch CETESB (*Companhia Ambiental do Estado de São Paulo*).

A complete Environmental Impact Assess (EIA) was submitted to CETESB (*Companhia Ambiental do Estado de São Paulo*) and this document was concluded that the site selected presents the necessary conditions to the landfill's installation without any significant changes on their actual environmental

[22] Source: http://www.mct.gov.br/index.php/content/view/327781.html, accessed on 03/06/2011.

quality. With the approval of the EIA, CTL landfill received, from CETESB, the Operational License no. 30006398, process number 30/00847/08, issued on 23/11/2010 and valid until 23/11/2015[23].

There will be no transboundary impacts resulting from this project activity. All the relevant impacts occur within Brazilian borders and have been mitigated to comply with the environmental requirements for project's implementation.

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

All environmental assesses were analyzed by CETESB and CTL landfill has all pertinent Licenses for the operation. Thus, no significant environmental impact was identified.

SECTION E. Stakeholders' comments

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

According to the Resolutions Number 1[24], 4[25] and 7[26] of the Brazilian Designed National Authority (CIMGC – Comissão Interministerial de Mudança Global do Clima / *Interministerial Commission on Global Climate Change*), project participants shall send letters to local stakeholders 15 days before the start of the validation period, in order to receive comments. It includes:

- Name and type of the activity project;
- PDD (translated to Portuguese), made available through a website;
- Description of the project's contribution to the sustainable development, also made available through a website.

Letters were sent on 15/02/2011 to the following stakeholders involved and affected by the project activity:

- *Prefeitura municipal de São Paulo*/ Municipal Administration of *São Paulo*;
- *Câmara dos vereadores de São Paulo* / Legislation Chamber of *São Paulo*;
- *Secretaria Municipal do Verde e do Meio Ambiente* / Municipal Secretary for Green and Environmental São Paulo City;
- *Companhia Ambiental do Estado de São Paulo (CETESB)*/Enviroment Agency of São Paulo State;
- Secretaria do Meio Ambiente do Estado de São Paulo/São Paulo State Environmental Secretary.
- *Fórum Brasileiro das Organizações Não Governamentais e Movimentos Sociais para o Meio Ambiente e o Desenvolvimento - FBOMS* / Brazilian Forum of Non-Governmental Organizations and Social Movements for Environment and Development;
- *Ministério Público do Estado de São Paulo* / São Paulo Pr*osecutor's Office;*
- *Ministério Público Federal* / Federal Prosecutor's Office.

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[23] The EIA and Operation License was made available to DOE in validation visit.
[24] http://www.mct.gov.br/upd_blob/0002/2736.pdf (Art. 3º, II)
[25] http://www.mct.gov.br/upd_blob/0011/11780.pdf (Artº 5°, unique paragraph)
[26] http://www.mct.gov.br/upd_blob/0023/23744.pdf, accessed on July 21st, 2008.

- Local associations;
    - Cooperativa de Trabalho com Materiais Reaproveitáveis Chico Mendes;
    - CEMAIS - Centro de Estudo de Meio Ambiente & Integração Social;
    - Ofea;
    - Sociedade Amigos do Bairro Vila Leme e Jardim dos Marianos;
    - Sociedade Ambientalista Leste - "SAL".

E.2. Summary of the comments received:

Comments were received from four stakeholders and the table below presents a brief summary of each comment.

Stakeholder	Comments
São Paulo Prosecutor's Office	The assessment of the project activity is outside of attribution from São Paulo Prosecutor's Office[27].
Cooperativa de Trabalho com Materiais Reaproveitáveis Chico Mendes	The project activity shows that currently technologies can decrease in large scale impacts from landfills. The advantages of the project activity are: the safety of implanting a gas treatment at the beginning reducing the methane release to atmosphere. Thus, the entity supports this project activity.
Municipal Secretary for Green and Environment São Paulo city;	The stakeholder highlighted that besides destruction methane, the project activity will generate electricity reducing problems related to global warming and contributing to the sustainable development to the city.
OFEA	The project activity reduces the methane emission, generated through solid waste decomposition, decreasing the greenhouse effect.

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

All the comments received were with positive responses, except the São Paulo Prosecutor's Office which did not make any comments to the project activity (Please see the footnote below). The comments will be taken in consideration by the Project Participant.

[27] Despite the São Paulo Prosecutor's Office has not pronounced the project activity, the consultation for this entity was carried out in accordance with Brazilian DNA requirements (*Manual para Submissão de Atividades de Projeto no Âmbito do MDL* – version 2, dated of 01/07/2008).

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project Participant 1:

Organization:	EcoUrbis Ambiental S/A
Street/P.O.Box:	Rua João Francisco Delmas, 117 - Campo Limpo
Building:	-
City:	Sao Paulo
State/Region:	Sao Paulo
Postcode/ZIP:	05781-320
Country:	Brazil
Telephone:	+55 (11) 5512-3204
FAX:	+55 (11) 5512-3232
E-Mail:	ndomingues@ecourbis.com.br
URL:	http://www.ecourbis.com.br/
Represented by:	Nelson Domingues Pinto Júnior
Title:	President
Salutation:	Mr.
Last name:	Domingues
Middle name:	
First name:	Nelson
Department:	-
Mobile:	-
Direct FAX:	-
Direct tel:	-
Personal e-mail:	ndomingues@ecourbis.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no Annex I public funding involved in the project activity.

Annex 3

BASELINE INFORMATION

The baseline scenario for the project activity is the uncontrolled release of landfill gas to the atmosphere and also the generation of electricity from other sources.

The table below shows the key elements used for estimate the emissions of the baseline scenario.

1. Key Parameters

Year landfilling operations started operator/historical logs	24/11/2010
Projected year for landfill closure - estimated based on current filling rate	2021
GWP for methane (UNFCCC and Kyoto Protocol decisions)	21
Methane concentration in LFG (% by volume) typical assumption for baseline scenario	50
LFG collection efficiency (%)	70
Flare efficiencies (%) operational data from flare manufacturer	98
Electricity consumption from the grid due to the project activity (MWh/year)	3,240
Electricity consumption from the diesel generator due to the project activity (MWh/year)	171
Unit price of electricity sold to the grid (R$/MWh)	148.39
Combined margin emission factor for electricity displacement (tCO_2/MWh) calculated based on the Tool to calculate the emission factor for an electricity system, Version 2.2.	0.1635
Installed capacity of Power Plant (MW)	19.2
Load factor	94.38
Operational lifetime of the project activity (years)	25
Adjustment Factor (AF)	1%

2. Waste disposal

The forecast amount of waste disposal in CTL landfill is presented below:

Year	Waste disposal (tonnes/yr)
2010	203,076
2011	2,002,699
2012	2,002,699
2013	2,002,699
2014	2,002,699
2015	2,002,699
2016	2,002,699
2017	2,002,699
2018	2,002,699
2019	2,002,699
2020	2,002,699
2021	834,458

Annex 3

BASELINE INFORMATION

Emission factors

The table below shows the Brazilian emission factors according to determination of the Brazilian DNA. More information is available at the Brazilian DNA website.

Combined Margin Emission Factor 2009 (tCO_2/MWh)		
1st crediting Period		**0.1635**
Build Margin - 2009		0.0794
Operating Margin 2009	January	0.2813
	February	0.2531
	March	0.2639
	April	0.2451
	May	0.4051
	June	0.3664
	July	0.2407
	August	0.1988
	September	0.1622
	October	0.1792
	November	0.1810
	December	0.1940
	2009	0.2476

Source: Brazilian DNA[28]

[28] Source: http://www.mct.gov.br/index.php/content/view/303076.html#ancora, accessed on 14/01/2010.

Annex 4

MONITORING INFORMATION

The monitoring will be made as described in items B.7.1. and B.7.2.