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

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Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

ENGEP & BEGREEN CDM Project at UTGR – Jambeiro Landfill
Version 03
Date: 27/03/2012

A.2. Description of the project activity:

The Solid Waste Treatment and Management Plant of Jambeiro (UTGR – Jambeiro) is a privately owned landfill planned to start operations in 2012. UTGR - Jambeiro is intended to receive Municipal and Industrial non-hazardous Solid Waste (SW) from cities located at the Paraíba Valley and North Cost of São Paulo State, such as: São José dos Campos, Ilhabela, Ubatuba, Caraguatatuba, São Sebastião, Jambeiro, Paraibuna e Jacareí.

The landfill will be implemented in the municipality of Jambeiro, at the Old Road of Jambeiro, at about 4 kilometers of Tamoios Road, within an area of 138.99 ha. The UTGR – Jambeiro is expected to start receiving SW in July 2012, to operate 7 days a week, 24 hours a day, 365 days a year and the total capacity of the site (9.656 million m^3) is expected to be completed in 2032.

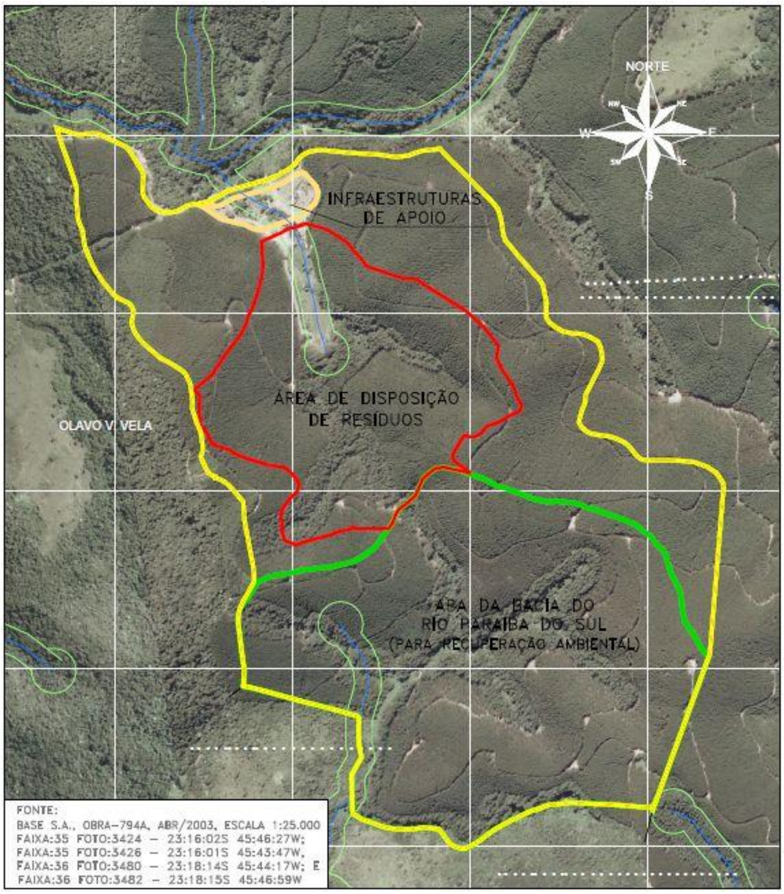

Figure 1- Plant of the land where UTGR – Jambeiro will be implanted

As usual in modern well managed landfill operations in Brazil, UTGR - Jambeiro will be an excavate and fill type of landfill with an impermeable liner constructed of HDPE (High-density Polyethylene) underneath a leachate drainage system to protect the ground water table. The waste to be land filled will be properly disposed in specific areas, mechanically compacted and daily covered by the ground material excavated for future cells. This type of operation is in compliance with the local and national environmental requirements[1], avoids leachate infiltration into the ground and the proliferation of insects and small animals around the waste. On the other hand, as the SW will be managed in an anaerobic way, the organic content of the waste land filled, through its decomposition, will produce large amount of landfill gas (LFG) to be emitted to the atmosphere. The LFG is rich in methane (CH_4), a greenhouse gas (GHG) with a global warming potential (GWP) 21 times the carbon dioxide's (CO_2) GWP. Therefore, the baseline scenario of UTGR - Jambeiro operation, as explained in Section B.4, involves the emission of CH_4, which contributes to raise the greenhouse effect and as consequence, to the climate global changes.

The purpose of the project activity is to reduce GHG emissions by installing in UTGR - Jambeiro an active landfill gas extraction system with methane destruction equipment. The project involves the enhancement of the planned LFG collection pipeline network and the installation of blowers in order to maximize LFG recovery rates. The gas collection pipeline will direct the LFG to be destroyed through flaring.

Therefore, the proposed CDM project activity will reduce GHG emissions by capturing and combusting the methane that otherwise would be released by the landfill to the atmosphere.

Besides climate change mitigation, the proposed CDM project activity will also produce secondary benefits, which will significantly contribute to the sustainable development for the environment and the local community, such as:

1- While destroying LFG, it will also minimize the risk of potential fire and explosion at the site and avoid the bad odors related to some LFG components. Moreover, landfill gas contains trace amounts of volatile organic compounds, which are air pollutants. Therefore, local labor and local community are granted with local safety and air quality improvement.

2- Creation of local short and long-term employment during the project implementation and throughout the project lifetime, given the need for specific labor for its operation, maintenance and monitoring;

[1] Plano Nacional de Resíduos Sólidos. Available at http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm (accessed April, 2011).

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)	ENGEP – Engenharia e Pavimentação Ltda.	No
Brazil (host)	BEGREEN Consultoria em Projetos de Bioenergia e Sustentabilidade Ltda.	No

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.:

State of São Paulo (SP), southeast region of Brazil.

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

Jambeiro.

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

UTGR – Jambeiro is located at the Old Road of Jambeiro, at about 4 kilometers of Tamoios Road, municipality of Jambeiro. Jambeiro is a small town located in the micro region of Alto Paraíba, in the foothills of the Serra do Mar, being 125 km away from the capital of the state, the City of São Paulo. The GPS coordinates of the project site are 23°16'26"S and 45°45'08"W, which in decimal format is 23.273889 South and 45.752222 West.

The UTGR – Jambeiro encompasses an area of 138.99 ha from which 337,929 m^2 are destined to receive the non-hazardous Municipal and Industrial Solid Wastes, the subject of this CDM project.

The detailed geographic location can be observed in the figures below (Figures 2 to Figure 4):

Figure 2 – Map of Brazil (Host Country) **Figure 3 – Map of the State of São Paulo**

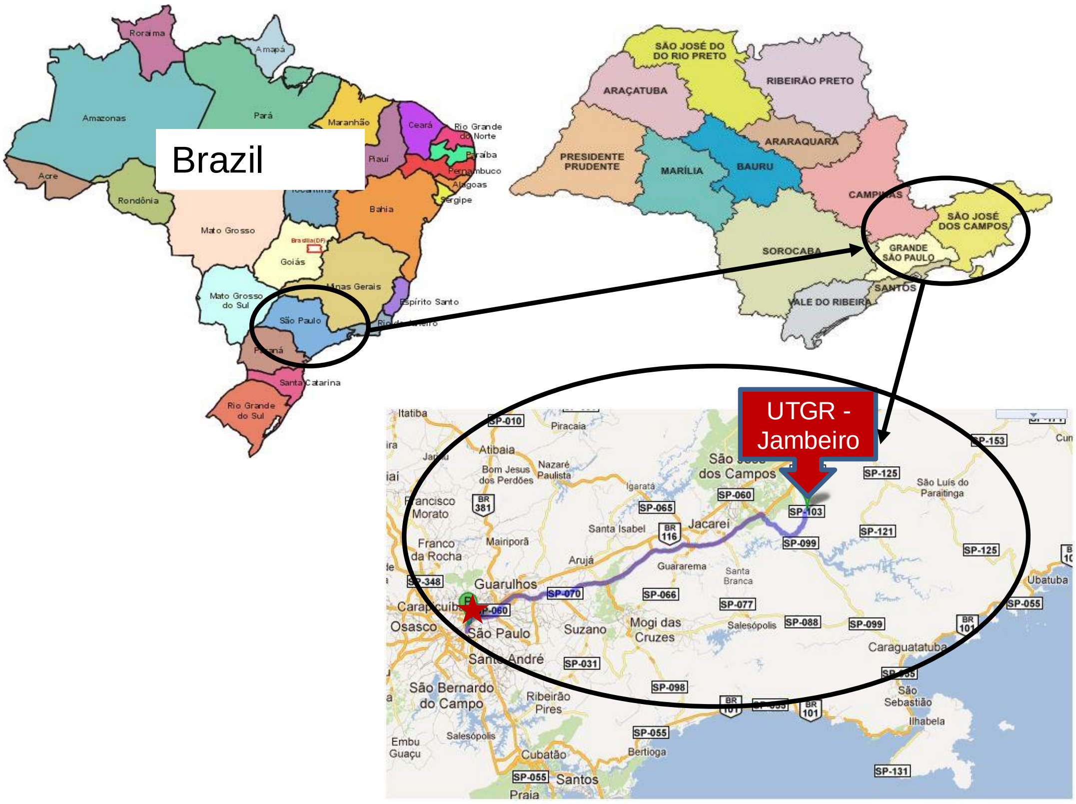

Figure 4 – Detailed map, including the Capital (São Paulo), in the southwest, and UTGR – Jambeiro, about 125 km to the northeast of the State.

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

The proposed CDM project falls in Sectoral Scope 13(Waste handling and disposal).

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

The scenario existing prior to the start of the implementation of the project activity

The issue of solid waste management in Brazil has emerged as one of the biggest problems of modern society, however this is an issue that goes unnoticed by most people, either through lack of interest, lack of information or simply their waste is regularly collected at the door of their homes by garbage truck.

The problem with the waste management at the northern coast of São Paulo became more evident when in December 2008, the environmental agency (CETESB) closed the landfill of the city of Ubatuba, the last one working on the northern coast.

The solution found by the four cities of the north coast: São Sebastião, Caraguatatuba, Ilha Bela and Ubatuba was to transfer their waste to licensed landfills outside the coast located at distances of over 150 km. Since the lifetime of their current disposal systems are in the final phase, with no perspective of short-term environmentally adequate solutions, UTGR - Jambeiro aims to fill a major gap in the treatment and disposal of waste from the cities of the North Coast and the Paraíba Valley, and will be implemented with the same characteristics of the these licensed landfills referred above, as described below.

UTGR - Jambeiro will be an excavate and fill type of landfill with an impermeable liner constructed of HDPE (High-density Polyethylene) of 2 mm to protect the ground water table, being expected to start receiving SW in July 2012. The total capacity of the site is 9,656,025 tonnes, which is expected to be completed by 2032. The sequence of waste placement is phased to complete a specified area then once completed begin a new layer of 5 meters in height. The site will place daily cover over the waste being land filled (20 – 30 cm thick) by using the material being excavated for future cells.

The landfill will operate 7 days a week, 24 hours a day, 365 days a year, receiving up to 2,000 tonnes per day of non-hazardous Municipal and Industrial Solid Waste classified as per the norm ABNT NBR- 1004[2]. The Landfill will count with an access gate with a security check point manned 24 hours a day. Incoming waste will be weighed on an automatic scale and computer software will register the weight at the scale house. The office complex for the site will be located near the scale house.

In order to protect the groundwater, the bottom of the whole landfill will have a 5 meter layer of compacted ground and double sealing consisting of a bentonite layer of 5 mm (equivalent a 1 meter of compacted clay) followed by a liner of 2 mm of HDPE installed over the bentonite layer. Therefore, the impermeable layer at the bottom of the landfill will be at least 5 meters distant of the water table, which is much larger than the 1,5 meter distance required by Brazilian regulation[3].

In all cells, a leachate collection system will be installed over the liner. The system consists of horizontal drains interconnected with vertical drains of approximately 3 meters diameter, constituted of gravel contained by a wire netting (10 x 10 cm) with a 0.3 m drilled concrete pipe in the center (DCP). The DCP will be installed on a 50 meter grid with rock trenches interconnecting them. The leachate is gravity feed through the horizontal interconnecting trench system to a central collection point that feeds the storage cisterns for further off-site treatment. As a new layer of waste is put in place the DCP's are extended up vertically to the top of the layer, serving two purposes: the first being a vertical collection system for the leachate and the second being a passive vent to release LFG pressure from the site (Figure 5).

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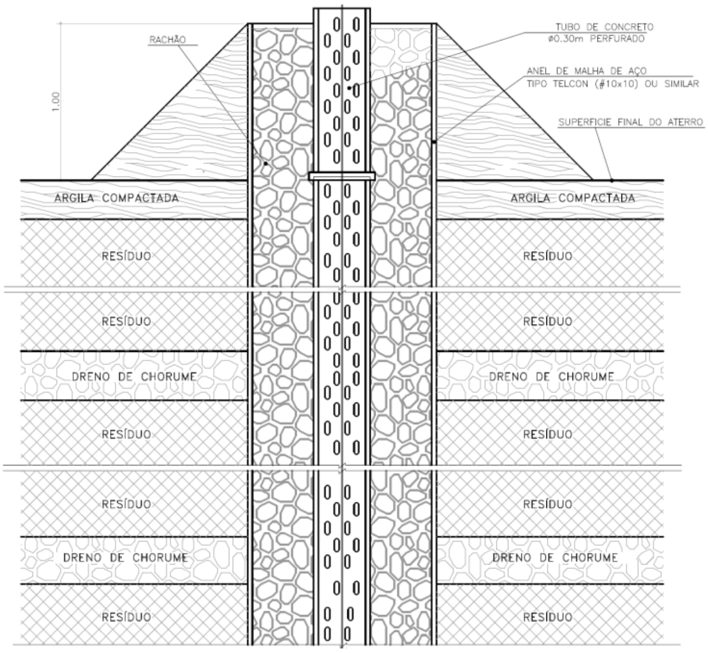
[2] According to Brazilian Association of Technical Norms (ABNT), the approved norm - ABNT NBR 10004:2004 - Solid waste – Classification – defines solid wastes into two categories, depending on the characteristics of its content, raw material and production process: Class I (hazardous) and Class II (non-hazardous). The area of UTGR-Jambeiro landfill included in this CDM project boundary will receive only non-hazardous wastes, which consist of Class II and some hospital inert Class I wastes.

[3] ABNT NBR 13896 - Solid wastes landfill – Criteria and procedures for planning, installation and operation

Figure 5 - Drilled Concrete Pipe (DCP)



Nevertheless, the amount of DCPs along with its methane destruction efficiency is very limited and not sufficient to mitigate most of the LFG emitted to the atmosphere. In the passive venting system the LFG is burned directly in the top of the well in open flares, with probably less than 50% of combustion efficiency. The biogas that reaches these wells is located around the structure, and is drained naturally. Consequently, the baseline LFG destruction efficiency is very low (for more details please refer to Section B.6.1).

This scenario is typically what is practiced in well managed sanitary landfill operations in Brazil and characterizes (as further explained in Section B.4) the baseline scenario of this CDM project.

Therefore, the implementation of the UTGR-Jambeiro landfill in the absence of the project activity will allow to the cities of São Paulo State located at the northern cost and at the Paraíba valley to dispose their waste in the same conditions of the currently provided by other landfills, but at a much shorter distance, which will save costs by reducing the MSW transportation load. However, the emissions of GHG (specially CH_4), still will be at much higher level than if the proposed project activity can be implemented.

Proposed CDM Project Activity

The project activity consists in enhancing the passive venting system of UTGR - Jambeiro, through a forced exhaustion one with methane destruction equipment. An engineering company from Italy will be responsible for the technology transfer. The construction of the project activity will use environmentally safe and sound technology. The installed equipment, with proper maintenance procedures, will have an average lifetime longer than 10 years, which will allow the project activity continuation over the whole crediting period.

The project activity involves the installation of a landfill gas collection system, the flaring station and a monitoring system, as follows:

LFG Collection System

The landfill design does not include an active landfill gas collection system. Therefore, an active LFG collection system (including new horizontal wells) will need to be installed. To maximize LFG recovery rates, the collection system should be installed comprehensively over closed landfill areas and in active areas of the landfill at intermediate grade. The landfill will grow vertically and horizontally as waste continues to be deposited. Therefore, the initial collection system design will include the ability to be expanded to the final closure design of the landfill. Of course, the design of the collection system is likely to change overtime during the project period to accommodate actual LFG recovery rates and site conditions.

The vertical wells will be installed using the optimized vent wells and will be equipped with a wellhead with an on/off valve and gas monitoring ports.

HDPE piping will be installed to connect the extraction wells with the flaring station.

Flaring Station

The flaring station consists of enclosed-type flares (so that GHG emissions reduction and exhaust components can be tested and quantified) designed to have the following features: skid mounted robust construction; flares will be installed separately directly on the concrete; high safety standard; concealed high temperature combustion with residence time and automatic temperature control. The first equipment shall be purchased in mid 2013 and during the 10 years of crediting period there will be a total of three flares, which will be installed in phases according to the LFG recovery rate, estimated as follows: 1st flare of 2,000 Nm^3/h shall start operations in 2014 (corresponding to Phases I and II of the landfill); 2nd flare of 2,000 Nm^3/h shall start operations in 2017 (corresponding to Phase III of the landfill) and the 3rd flare of 3,000 Nm^3/h shall start operations in 2022 (corresponding to Phase IV of the landfill).

The flaring system will include:

- Enclosed flares with:
  - gas flow rate between: min. 400 Nm^3/h – 2,000 Nm^3/h (3rd flare of 3,000 Nm^3/h);
  - Lifetime: 10 years
  - electrical ignition device;
  - minimal combustion efficiency: 99%;
  - Thermocouple for the continuous monitoring of the temperature of the exhaust gas stream;
  - Heat insulation by ceramic fiber modules thickness 150 mm;
  - Multiflame gas burner;
  - Pilot burner fed by biogas.

- Multi-stage centrifugal gas blowers with:
  - Maximum gas flow capacity: 2 of 2,000 Nm_3/h and the 3rd of 3,000 Nm^3/h;
  - Lifetime: 10 years;
  - Base-plate common to the machine and the motor;
  - A series of foundation fixings, the machine/motor;
  - Transmission using pulleys and belts;
  - Shock-absorbing blocks between the base-plate and the bearing surface
  - Electric motor with a nominal power rating of 30 kW (37 kW for the 3rd blower);

Monitoring System

Swirl flow meters shall be placed on the gas pipes leading to each of the flares to measure the amount of LFG flared in Nm^3/h (wet basis). The conversion to dry basis will be made according procedures provided by the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", Version 02.0.0.

A continuous gas analyzer will be installed on the main gas pipe to measure the methane content of the LFG on a dry basis. In the flares it will be installed a thermocouple to measure the temperature of the exhaust gas in the flare and a probe connected to a flare emissions analyzer to monitor the flare efficiency.

The system will be automated by having a Programmable Logic Controller to process the operation, monitoring and data storage activities.

The electricity consumed by the blower and monitoring equipment will be supplied by a diesel generator of 150 kWe.

The project activity will therefore reduce greenhouse gas (GHG) emissions by destroying the methane (CH_4) content of the LFG, which in the absence of the project would have been emitted into the atmosphere.

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

Table 1 – UTGR - Jambeiro estimated emission reductions

Years	Annual estimation of emission reductions in tonnes of CO_2e
2014	53,990
2015	67,143
2016	77,194
2017	85,070
2018	91,399
2019	110,587
2020	125,106
2021	139,161
2022	150,145
2023	161,744
Total estimated reductions (tonnes of CO_2e)	1,061,540
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	106,154

A.4.5. Public funding of the project activity:

No public funding from Parties included in Annex I is involved in this CDM 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:

This project activity uses the approved consolidated methodology ACM0001"Flaring or use of landfill gas", Version 12.0.0 (valid from 25 Nov 11 onwards).

According to ACM0001, Version 12.0.0, the project activity also uses the following tools:

1) "Combined tool to identify the baseline scenario and demonstrate additionality", Version 03.0.1 and as the guidelines referred in this tool, the "Guidelines for objective demonstration and assessment of barriers", version 01 and the "Guidelines on the assessment of investment analysis", version 05;

2) "Emissions from solid waste disposal sites", Version 06.0.1;

3) "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", Version 02.0.0

4) "Tool to determine project emissions from flaring gases containing methane", Version 01;

5) "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", Version 01;

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

The proposed project activity meets the applicability conditions proposed in ACM0001"Flaring or use of landfill gas", Version 12.0.0 and the referred tools as justified as follows:

Applicability of the methodology is justified as follows:

Applicability Condition	Justification
(a) Install a new LFG capture system in a new or existing SWDS; or (b) Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that: (i) The captured LFG was only vented or flared and not used prior to the implementation of the project activity; and (ii) In the case of an existing active LFG capture system for which the amount of LFG cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project system: historical data on the amount of LFG capture and flared is available.	The project activity involves the installation of a new LFG system in a new SWDS, therefore complying with paragraph (a). The LFG system to be installed in UTGR-Jambeiro is a forced exhaustion one, i.e. an improved version of the passive venting system planned in the design submitted for licensing of the landfill.

(c) Flare the LFG and/or use the captured LFG in any (combination) of the following ways: (i) Generating electricity; (ii) Generating heat in a boiler, air heater or kiln (brick firing only);[1] and/or (iii) Supplying the LFG to consumers through a natural gas distribution network.	The project activity at UTGR-Jambeiro will only flare the LFG, as per paragraph (c).
(d) Do not reduce the amount of organic waste that would be recycled in the absence of the project activity.	The implementation of UTGR-Jambeiro project activity will not reduce the amount of organic waste that would be recycled in its absence.
The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is: (a) Partial or total release of the LFG from the SWDS; and (b) In the case that the LFG is used in the project activity for generating electricity and/or generating heat in a boiler, air heat or kiln; (i) For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or (ii) For heat generation: that heat would be generated using fossil fuels in on-site equipment.	As demonstrated in Section B.4, the most plausible baseline scenario is the partial release of the LFG from the SWDS, which is according to item (a). The project activity will not use the LFG to generate electricity or heat, therefore item (b) is not applicable.
This methodology is not applicable: (a) In combination with other approved methodologies. For instance, ACM0001 cannot be used to claim emission reductions for the displacement of fossil fuels in a kiln, where the purpose of the CDM project activity is to implement energy efficiency measures at the kiln; (b) If the management of the SWDS in the project activity is deliberately changed in order to increase methane generation compared to the situation prior to the implementation of the project activity (e.g. other to meet a technical or regulatory requirement). For example, this may apply to the addition of liquids to a SWDS, pre-treating waste to seed it with bacteria for the purpose of increasing the anaerobic degradation environment of the SWDS or changing the shape of the SWDS to increase the Methane Correction Factor.	This project activity uses only ACM0001. In addition, the management of the SWDS will not be changed in the project activity. The management of the SWDS will be performed according to the executive plan approved by the official authorities only in order to meet the technical/regulatory requirements, which is the opposite. Therefore items (a) and (b) do not apply to UTGR-Jambeiro project activity.

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

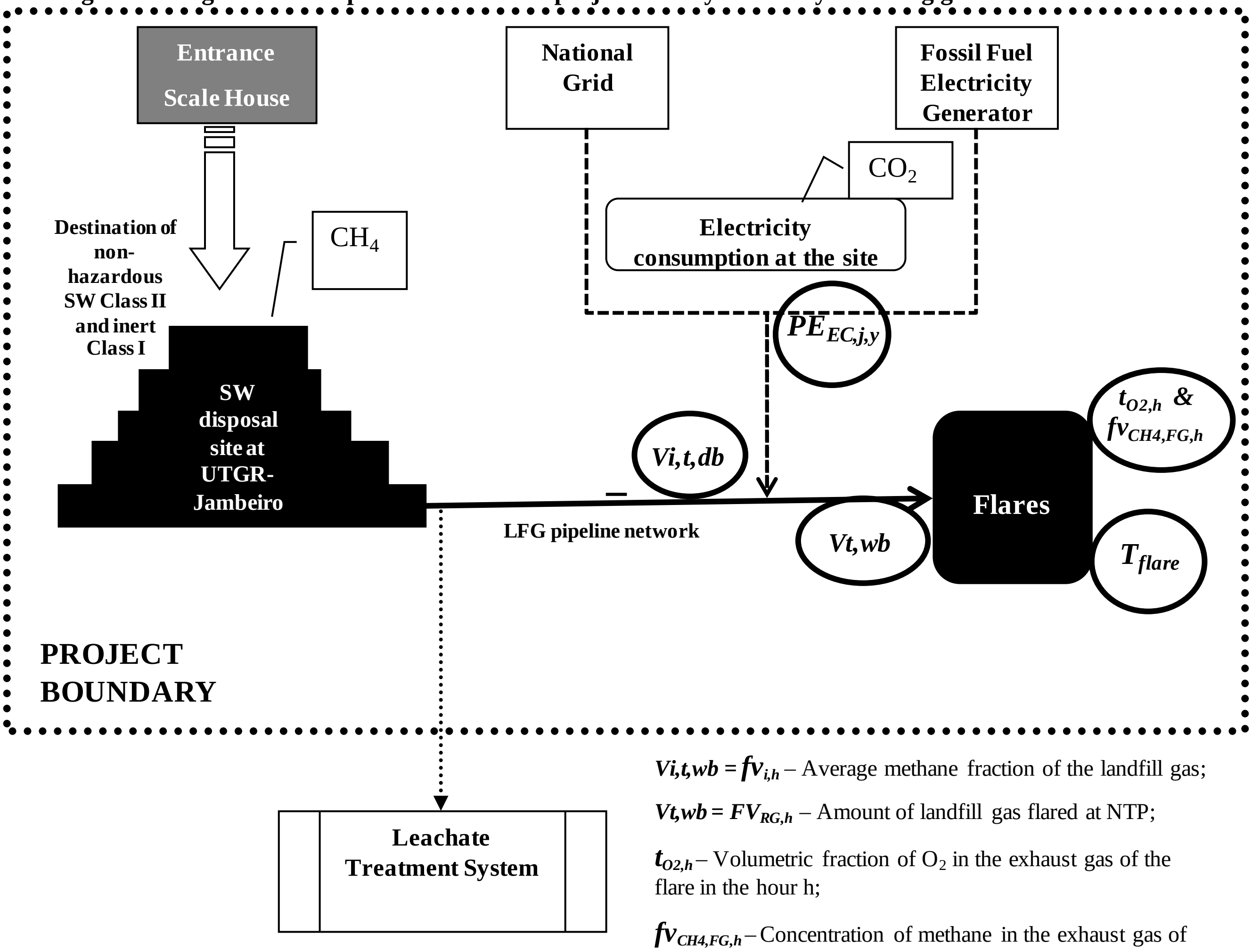
As per ACM0001, Version 12.0.0, the project boundary of the project activity shall include the site where the LFG is captured and, as applicable:

- Sites where the LFG is flared or used (e.g. flare, power plant, boiler, air heater, kiln or natural gas distribution network);
- Captive power plant(s) or power generation sources connected to the grid, which are supplying electricity to the project activity;
- Captive power plant(s) or power generation sources connected to the grid, which are supplying electricity in the baseline that is displaced by electricity generated by captured LFG in the project activity; and
- Heat generation equipment or sources which are supplying heat in the baseline that is displaced by heat generated by captured LFG in the project activity.

Therefore, the project boundary encompasses the site where the SW is disposed at the UTGR - Jambeiro, the fossil fuelled electricity generator that will source the project activity equipment, the National Grid (National Interconnected System - SIN) in case the project activity is also sourced by the grid and the facilities installed to capture and destroy the methane: landfill gas collection system, monitoring system and flaring station.

The diagram below illustrates the project boundary and the respective sources of GHG emissions.

Figure 6- Diagrammatic representation of the project activity boundary including gases and sources



Vi,t,wb = $fv_{i,h}$ – Average methane fraction of the landfill gas;

Vt,wb = $FV_{RG,h}$ – Amount of landfill gas flared at NTP;

$t_{O2,h}$ – Volumetric fraction of O_2 in the exhaust gas of the flare in the hour h;

$fv_{CH4,FG,h}$ – Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour h;

Tflare – Temperature in the exhaust gas of the flare;

$PE_{EC,j,y}$ – Project emissions from electricity consumption by the project activity during the year y;

The sources and gases included in the project boundary may be found in Table 2.

Table 2 - Summary of gases and sources included in the project boundary

	Source	Gas	Included?	Justification/Explanation
Baseline	Emissions from decomposition of waste at the SWDS site	CH_4	Yes	The major source of emissions in the baseline.
		N_2O	No	N_2O emissions are small compared to CH_4 emissions from SWDS. This is conservative.
		CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted, since the CO_2 is also released under the project activity.
	Emissions from electricity generation	CO_2	No	Electricity generation from LFG use is not included in the project activity.
		CH_4	No	
		N_2O	No	
	Emissions from heat generation	CO_2	No	Heat generation is not included in the project activity.
		CH_4	No	
		N_2O	No	
	Emissions from the use of natural gas	CO_2	No	Supply of LFG through a natural gas distribution network is not included in the project activity.
		CH_4	No	
		N_2O	No	
Project Activity	Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO_2	No	There will be no fossil fuel consumption due to the project activity other than for electricity generation.
		CH_4	No	
		N_2O	No	
	Emissions from electricity consumption due to the project activity	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

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

Methodology ACM0001, Version 12.0.0 determines the following procedures:

Procedure for estimating the end of the remaining lifetime of existing equipment

Not applicable. This procedure applies if LFG is used in equipment that was in operation prior to the implementation of the project activity, which is not the case of UTGR-Jambeiro project activity, since this will be a new LFG system.

Procedure for the selection of the most plausible baseline scenario and demonstrate additionality

According to ACM0001, version 12.0.0, the identification of the baseline scenario and demonstration of additionality shall be made by using the "Combined tool to identify the baseline scenario and demonstrate additionality" and following the requirements below:

Step 1: Identification of alternative scenarios

In accordance to ACM0001, Version 12.0.0, Step 1 of the "Combined tool to identify the baseline scenario and demonstrate additionality", Version 03.0.1 is used to identify all realistic and credible alternatives by following the sub-steps ***1a*** and ***1b*** presented below:

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

In applying Step 1 of the tool, ACM0001 establishes baseline alternatives for the destruction of LFG, shall take into consideration, inter alia, the following alternatives:

- LFG1: The project activity implemented without being registered as a CDM project activity (i.e. capture and flaring or use of LFG);
- LFG2: Atmospheric release of the LFG or partial capture of LFG and destruction to comply with regulations or contractual requirements, or to address safety and odour concerns;
- LFG3: LFG is partially not generated because part of the organic fraction of the solid waste is recycled and not disposed in the SWDS;
- LFG4: LFG is partially not generated because part of the organic fraction of the solid waste is treated aerobically and not disposed in the SWDS;
- LFG5: LFG is partially not generated because part of the organic fraction of the solid waste is incinerated and not disposed in the SWDS.

The project activity at UTGR-Jambeiro does not involve the separation of organic waste neither for recycling nor for other type of treatment (aerobic or incineration).

Besides, in Brazil, over 97% of the solid waste is treated in solid waste disposal sites (SWDS). Hence, recycling, composting or incineration of waste are not well developed treatment options. The National Survey on Basic Sanitation from 2008[4], conducted by the Brazilian Institute of Geography and Statistics for the Ministry of Cities, shows that less than 2% of the daily amount of waste received and treated in the country is disposed through these types of units, as presented in Table 3:

[4] IBGE - Pesquisa Nacional de Saneamento Basico (2008), table 93. Available at: http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/pnsb2008/PNSB_2008.pdf (accessed Feb 2011).

Table 3 – Final destination of solid residues in Brazil:

Type of Treatment Unit	Amount of Waste (tons/day)	%
Open Dump	45,710	17.6%
Dumpsite in flooded area	46	0.02%
Controlled Landfill	40,695	15.7%
Sanitary Landfill	167,636	64.6%
Composting unit	1,635	0.6%
Sorting Unit	3,122	1.2%
Incineration Unit	67	0.03%
Other	636	0.2%
Total	259,547	100.0%

This practice has not changed much at the current days. The Sanitation Atlas of 2011[5], provided by the same institution referred above, reports the following about this issue: "…One last aspect to be considered concerns to organic waste. Like the recyclables, its reuse is still very incipient in Brazil. Its reuse in sorting centers of waste and/or composting of organic waste can generate reusable by products, such as organic fertilizers, among others. What happens, however, is that the organic waste is not separated from other waste types and gets contaminated by various toxic materials, losing their reusability, therefore being extremely important an appropriate separation of household waste prior to its collection and disposal."

This fact clearly demonstrates that the credible alternatives to waste disposal at the UTGR-Jambeiro landfill would other solid waste disposal sites such as controlled and sanitary landfills.

Also, the quantities of waste received by composting, sorting or incineration facilities are not comparable to the quantity of waste disposed off in a solid waste disposal sites (SWDS). It is therefore difficult to consider that a SWDS would divert organic materials from being recycled.

Therefore, alternatives LFG3, LFG4 and LFG5 are not realistic scenarios for this project activity.

Also according to the referred methodology, in addition to the alternative baseline scenarios identified for the destruction of LFG, alternative scenarios for the use of LFG shall also be identified, i.e. if LFG is used for generation of electric or heat energy for export to a grid and/or to a nearby industry or used on-site or if LFG is supplied to a natural gas distribution network.

Given the project activity will not use LFG neither for electricity nor heat generation and also will not be supplied to a gas distribution network, other alternatives (par (a); (b) and (c)) are not analyzed, since they are not deemed realistic and credible alternative(s).

[5] IBGE - Atlas de Saneamento Básico (2011), p.66-67. Available at: http://www.ibge.gov.br/home/estatistica/populacao/atlas_saneamento/default_zip.shtm (accessed Feb 2011).

Outcome of Step 1a:

In conclusion, the only remaining real alternatives to the project activity are related to the LFG management:

LFG1: The project activity (i.e. capture of landfill gas and its flaring) undertaken without being registered as a CDM project activity;

LFG2: Atmospheric release of the landfill gas or partial capture of landfill gas and destruction to comply with regulations or contractual requirements, or to address safety and odour concerns.

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

All the alternatives listed above, which are to continue with the business as usual situation (LFG2) or to implement the proposed CDM project activity without CDM incentives (LFG1) are consistent with Brazilian laws and regulations.

Currently in Brazil, there is no law or regulations mandating capture and flaring the landfill gas. Based on the Brazilian National Policy of Solid Waste (PNRS)[6], which has been approved recently (2010), there is no indication that LFG capture and/or flaring will be required in the near future. Also, other regulatory requirements related to technical standards of landfill operation and gas drainage system, such as the Brazilian Norms (ABNT NBR 13896[3] and ABNT NBR 8419:1992 – section 5.1.6.5[7]) and the local regulation (Plan of Solid Residues of the State of São Paulo[8]), which are also applicable to UTGR-Jambeiro do not require LFG capture and flaring.

In addition, UTGR - Jambeiro has a valid Preliminary Environmental License (LP Nº 41444), issued by the Environmental Agency of the State of São Paulo – CETESB (Companhia Ambiental do Estado de São Paulo). The LP implies that UTGR – Jambeiro's planned operation, which refers to scenario LFG2, is in compliance with federal, state and municipal environmental legislation. Besides, the implementation of scenario LFG1 would benefit the environment, given it would enhance the overall landfill management and would reduce adverse global and local environmental effects of uncontrolled releases of LFG (for more information, please refer to Session D.1).

Identification of the baseline fuel for electricity generation by captive fossil fuel fired power plants and/or heat generation

Since there is no energy generation using the biogas in the project activity, this step is not applicable.

Outcome of Step 1b:

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[6] Lei Nº 12.305, de 2 de Agosto de 2010 - Política Nacional de Resíduos Sólidos. Available at http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm (accessed April, 2011)

[7] ABNT (Brazilian Association of Technical Norms) - NBR 8419:1992 - Operating technical standards for landfills – section 5.1.6.5 (Gas Drainage Systems).

[8] SMA – Secretaria do Meio Ambiente do estado de São Paulo. Lei Estadual n° 12.300/ 2006. Available at www.ambiente.sp.gov.br/wp/cpla/files/2011/05/PERS.pdf (accessed October, 2011)

Both scenarios listed above: LFG1 and LFG2, are identified as realistic and credible alternative scenario(s) to the project activity that are in compliance with mandatory legislation and regulations taking into account the enforcement in the region or country and EB decisions on national and/or sectoral policies and regulations.

Outcome of the procedure for the selection of the most plausible baseline scenario

As further showed in Section B.5, the scenario LFG1 is not deemed realistic and credible alternative, given it faces investment barrier, since it is clearly economically unattractive.

Therefore, the only plausible conservative scenario is the partial capture of landfill gas and destruction to address safety and odor concerns – LFG2.

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):

According to ACM0001, Version 12.0.0 guidance, the additionality of the project activity is demonstrated and assessed using the “Combined tool to identify the baseline scenario and demonstrate additionality”, Version 03.0.1

Step 1: Identification of alternative scenarios

As demonstrated in Section B.4 the realistic and credible alternatives to the project activity that are consistent with current laws and regulations can be compiled into two main scenarios identified as follows:

LFG1: The project activity (i.e. capture of landfill gas and its flaring) undertaken without being registered as a CDM project activity;

LFG2: Partial capture of landfill gas and destruction to address safety and odor concerns, which represents the business as usual situation.

Step 2:Barrier analysis

This step serves to identify barriers and to assess which alternative scenarios are prevented by these barriers, by applying the following Sub-steps:

Sub-step 2a: Identify barriers that would prevent the implementation of alternative scenarios

Investment Barrier: The project activity that will be implemented involves the LFG capture and flaring, where there is no legal requirement to do such activity. The only income from the project activity will be the CERs revenue, since there are no public grants or incentives to implement such type of projects in Brazil. Therefore, the project participant would not disburse the high investment involved in the project activity (enhancement of the LFG capture and collection system, installation of the flaring and monitoring systems) without the revenues provided by the CDM.

According to the Guidelines for the Objective Demonstration and Assessment of Barriers, Barriers that can be mitigated by additional financial means can be quantified and represented as costs and should not be identified as a barrier for implementation of project while conducting the barrier analysis, but rather should be considered in the framework of investment analysis. However in this case there are significant investment costs for the proposed project that will be financed by the project owners, whilst there are no revenues. This is not a situation that can be mitigated since it is not possible to generate revenues (other than CER revenues) from flaring of LFG, therefore the project owners take explicitly the CDM registration into account, reason why they does not intend to purchase the equipment before knowing the CDM project has been registered.

Given the alternative scenarios LFG1 and LFG2 generate no financial or economic benefits other than CDM related income, the investment barrier is demonstrated through a simple cost analysis by evidencing below the costs associated with UTGR-Jambeiro project activity and taking into account that for scenario LFG2, no investment is undertaken.

The total cost to implement the project activity is estimated to be € 1,268,213 as showed in Table 4:

Table 4 – Main Assumptions – UTGR - Jambeiro project activity

Parameter	Value	Unit	Reference
Biogas extraction and collection system	408,082.70	€	Manufacturer's specification. File: BTG033/11
Manifolds	199,450.00	€	
Extraction and combustion units (3 flares)	660,680.00	€	
Total	**1,268,213**	**€**	

Sub-step 2b: Eliminate alternative scenarios which are prevented by the identified barriers

As conclusion, given such a high investment cost, Scenario LFG1 (the project activity undertaken without being registered as a CDM project) is not economically attractive. The only way to alleviate this barrier is with the CDM revenues.

Thus, the only plausible scenario is the business as usual scenario - LFG2 “Partial capture of landfill gas and destruction to address safety and odor concerns”, which is the baseline scenario as per the guidelines from the “Combined tool to identify the baseline scenario and demonstrate additionality”, Version 03.0.1: “if there is only one alternative scenario that is not prevented by any barrier, and if this alternative scenario is not the proposed project activity undertaken without being registered as a CDM project activity, then this alternative scenario is identified as the baseline scenario.”

Step 3: Investment analysis

Not applicable, since the CDM is the only resource to alleviate the investment barrier demonstrated in the previous section.

Step 4. Common practice analysis

The “Combined tool to identify the baseline scenario and demonstrate additionality”, Version 03.0.1, states: “Similar activities are defined as activities (i.e. technologies or practices) that are of similar scale, take place in a comparable environment, inter alia, with respect to the regulatory framework and are undertaken in the relevant geographical area, as defined in Sub-step 1a above. Other registered CDM project activities are not to be included in this analysis.”. In the case of UTGR-Jambeiro project activity, similar activities correspond to landfills located in Brazil with LFG capture and high efficiency combustion systems.

In the last years, the Brazilian Ministry of Cities has published a study called “Diagnosis of Urban Solid Waste Management”, compiling the data from the National Information System on Sanitation (SNIS). This study is very representative of Brazilian conditions, given it encompasses cities in all states and the Federal District, that are related to more than 91 million urban residents representing over 58% of this population; covers more than 72% of the number of municipalities with more than 250,000 inhabitants, which corresponds to more than 87% of urban population of this contingent. According to the seventh edition (2008) of the “Diagnosis of Urban Solid Waste Management”[9], published in November 2010, only 7.8% of the solid waste processing units (23 sites) make some use of the LFG. But these sites are related to CDM project activities, as presented by Magalhães et all[10] at the 3rd International Workshop on Uncertainty in Greenhouse Gas Inventories, referring that “all of landfills with high methane collection and destruction efficiency (active system) are activities implemented under the CDM”.

Based on the described above, there are no similar activities like the proposed project activity in Brazil, given the landfills that have active systems to capture and destroy/use LFG have been developed as CDM project activities.

Outcome of Step 4:

Given similar activities involving landfills with LFG capture and high efficiency combustion systems cannot be observed, the proposed project activity for UTGR - Jambeiro is additional.

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[9] Ministry of the Cities. SNIS. Diagnosis of Urban Solid Waste Management, page 138. Available at http://www.snis.gov.br/PaginaCarrega.php?EWRErterterTERTer=88 (accessed May 2011).

[10] 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. Available at http://ghg.org.ua/fileadmin/user_upload/book/Proceedengs_UncWork.pdf (accessed Sep 2011).

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The calculation of baseline emissions, project emissions, leakage and emission reductions are based on the equations provided by methodology ACM0001, Version 12.0.0 and the referred tools.

EMISSIONS REDUCTION

According to ACM0001, Version 12.0.0, no leakage effects need to be accounted for. Therefore, the calculation of Emissions Reduction for a landfill project activity is represented by Equation 1 below:

Equation 1 $$\mathbf{ER_y = BE_y - PE_y}$$

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_2/yr)

Baseline Emissions represents the total amount of emissions at the landfill in the absence of the project activity and the Project Emissions represents the amount of emissions that occurred due to the project activity, which shall be discounted from the baseline emissions in order to get the final amount of Emissions Reduction.

BASELINE EMISSIONS

ACM0001, Version 12.0.0 determines the Baseline Emissions shall be estimated according to Equation 2:

Equation 2 $$\boldsymbol{BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}}$$

Where:

$\boldsymbol{BE_y}$ Baseline emissions in year *y* (tCO_2e);

$\boldsymbol{BE_{CH4,y}}$ Baseline emissions of methane from the SWDS in year y (t CO2e/yr);

$\boldsymbol{BE_{EC,y}}$ Baseline emissions associated with electricity generation in year y (t CO2/yr);

$\boldsymbol{BE_{HG,y}}$ Baseline emissions associated with heat generation in year y (t CO2/yr);

$\boldsymbol{BE_{NC,y}}$ Baseline emissions associated with natural gas use in year y (t CO2/yr);

Given there will be no electricity / thermal energy production nor natural gas use from the landfill gas in the UTGR - Jambeiro project activity ($BE_{EC,y}$; $BE_{HG,y}$; $BE_{NG,y}$ = 0), Equation 2 can be simplified in Equation 3:

Equation 3 $$\mathbf{BE_y = BE_{CH4}}$$

Step (A): Determination of the Baseline emissions of methane from the SWDS (*$BE_{CH4,y}$*)

According to methodology ACM0001, Version 12.0.0, baseline emissions of methane from the SWDS are determined as per Equation 4, based on the amount of methane that is captured under the project activity and the amount that would be captured and destroyed in the baseline (such as due to regulations). In addition, the effect of methane oxidation that is present in the baseline and absent in the project is taken into account:

Equation 4 $$\mathbf{BE_{CH4,y} = \left(1 - OX_{top\_layer}\right) * \left(F_{CH4,PJ,y} - F_{CH4,BL,y}\right) * GWP_{CH4}}$$

Where:

$BE_{CH4,y}$	Baseline emissions of LFG from the SWDS in year y (t CO2e/yr);
OX_{top_layer}	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless). Default value: 0.1;
$F_{CH4,PJ,y}$	Amount of methane in the LFG which is flared and/or used in the project activity in year y (t CH4/yr);
$F_{CH4,BL,y}$	Amount of methane in the LFG that would be flared in the baseline in year y (t CH4/yr);
GWP_{CH4}	Global warming potential of CH4 (t CO2e/t CH4);

Step A.1: Ex post determination of ($F_{CH4,PJ,y}$)

During the crediting period, $F_{CH4,PJ,y}$ is determined as the sum of the quantities of methane flared and used in power plant(s), boiler(s), air heater(s), kiln(s) and natural gas distribution network, as follows:

Equation 5 $$\mathbf{F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y}}$$

Where:

$F_{CH4,PJ,y}$	Amount of methane in the LFG which is flared and/or used in the project activity in year y (t CH4/yr);
$F_{CH4,flared,y}$	Amount of methane in the LFG which is destroyed by flaring in year y (t CH4/yr);
$F_{CH4,EL,y}$	Amount of methane in the LFG which is used for electricity generation in year y (t CH4/yr);
$F_{CH4,HG,y}$	Amount of methane in the LFG which is used for heat generation in year y (t CH4/yr);
$F_{CH4,NG,y}$	Amount of methane in the LFG which is sent to the natural gas distribution network in year y (t CH4/yr);

Since UTGR - Jambeiro project activity will not generate electricity ($F_{CH4,EL,y}$ **=0**), nor thermal energy ($F_{CH4,HG,y}$ **=0**), nor will feed with methane to any natural gas distribution network ($F_{CH4,NG,y}$ **=0**), $F_{CH4,PJ,y}$ will be determined by monitoring the amount of methane actually flared ($F_{CH4,flared,y}$).

a. Determination of the Amount of methane destroyed by flaring ($F_{CH4,flared,y}$)

$F_{CH4,flared,y}$ is determined as the difference between the amount of methane supplied to the flares and any methane emissions from the flare(s), as per Equation 6:

Equation 6

$$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}}$$

Where:

$F_{CH4,flared,y}$ Amount of methane in the LFG which is destroyed by flaring in year y (t CH4/yr);

$F_{CH4,sent\_flare,y}$ Amount of methane in the LFG which is sent to the flares in year y (t CH4/yr);

$PE_{flare,y}$ Project emissions from flaring of the residual gas stream in year y (t CO2e/yr);

GWP_{CH4} Global warming potential of CH4 (t CO2e/t CH4);

ACM0001, Version 12.0.0 establishes that $F_{CH4,sent\_flare,y}$ is determined directly using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", Version 02.0.0, applying the requirements described above where the gaseous stream of the tool that shall be applied to is the LFG delivery pipeline to the flares.

According to the tool referred above, the mass flow of a greenhouse gas *i* in a gaseous stream ($F_{i,t}$) is determined through measurement of the flow and volumetric fraction of the gaseous stream, as per **Table 1 of the tool, Option A** applies to this project, since the volumetric fraction of the LFG delivered to the flares will be measured on dry basis and it will be demonstrated that the gaseous stream is dry.

Option A

According to the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", Version 02.0.0, the flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option.

Given the temperature of the LFG coming from the landfill usually is below 60°C, project proponents have chosen item (b) of the referred tool:

"(b) Demonstrate that the temperature of the gaseous stream (Tt) is less than 60ºC (333.15 K) at the flow measurement point."

The mass flow of greenhouse gas *i* ($F_{i,t}$) will be determined as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t}$$

With

$$\boldsymbol{\rho}_{\boldsymbol{i,t}} = \frac{P_t * MM_i}{R_u * T_t}$$

Where:

$\boldsymbol{F_{i,t}}$	Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h);
$\boldsymbol{V_{t,db}}$	Volumetric flow of the gaseous stream in time interval t on a dry basis (m^3 dry gas/h);
$\boldsymbol{v_{i,t,db}}$	Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m^3 gas i/m^3 dry gas);
$\boldsymbol{\rho_{i,t}}$	Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i/m^3 gas i);
P_t	Absolute pressure of the gaseous stream in time interval t (Pa);
MM_i	Molecular mass of greenhouse gas i (kg/kmol). As a simplification allowed by this tool, project proponents will monitor only the volumetric fraction of only the gas that is greenhouse gas and is considered in the emission reduction calculation in the underlying methodology, i.e. **i = CH_4** and the difference to 100% will be considered as pure nitrogen;
R_u	Universal ideal gases constant (Pa.m3/kmol.K);
T_t	Temperature of the gaseous stream in time interval t (K);

The “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, Version 02.0.0 also determines that “if it cannot be demonstrated that the gaseous stream is dry, then the flow measurement should be assumed to be on a wet basis and the corresponding option from Table 1 should be applied instead.” Therefore, at the intervals it cannot be demonstrated the temperature of the gaseous stream (LFG delivered to the flare) is less than 60^{o}C, the mass flow of the greenhouse gas ($\boldsymbol{F_{i,t}}$) will be determined as per **Option B,** using the following procedure:

i. Determination of the absolute humidity of the gaseous stream

When using calculation procedure from **Option B**, the tool requires to determine the absolute humidity of the gaseous stream, in which project participants choose for the simplified conservative approach (**Option 2)**, by assuming the gaseous stream is saturated, since an assumption that the gaseous stream is saturated is conservative for the situation that the mass flow of greenhouse gas i is underestimated when used for calculating baseline emissions.

a. **Option 2: Simplified calculation without measurement of the moisture content**

Since it is conservative to assume that the gaseous stream is saturated, the tool determines that $\boldsymbol{m_{H2O,t,db}}$ is assumed to be equal to the saturation absolute humidity ($\boldsymbol{m_{H2O,t,db,sat}}$) and calculated using Equation 7:

Equation 7 $$\mathbf{m_{H2O,t,db,Sat}} = \frac{\mathbf{p_{H2O,t,Sat}} * \mathbf{MM_{H2O}}}{(\mathbf{P_t} - \mathbf{p_{H2O,t,Sat}}) * \mathbf{MM_{t,db}}}$$

Where:

$\boldsymbol{m_{H2O,t,db,Sat}}$	Saturation absolute humidity in time interval t on a dry basis (kg H2O/kg dry gas), which in this case stands for the absolute humidity of the gaseous gas stream ($\boldsymbol{m_{H2O,t,db}}$);
$\boldsymbol{p_{H20,t,Sat}}$	Saturation pressure of H2O at temperature Tt in time interval t (Pa);
$\boldsymbol{T_t}$	Temperature of the gaseous stream in time interval t (K);
$\boldsymbol{P_t}$	Absolute pressure of the gaseous stream in time interval t (Pa);
$\boldsymbol{MM_{H2O}}$	Molecular mass of H2O (kg H2O/kmol H2O);
$\boldsymbol{MM_{t,db}}$	Molecular mass of the gaseous stream in a time interval t on a dry basis (kg dry gas/kmol dry gas);

The molecular mass of the gaseous stream ($\boldsymbol{MM_{t,db}}$) is estimated using Equation 8:

Equation 8 $$\mathbf{MM_{t,db}} = \sum_{\mathbf{k}} \left(\mathbf{v_{k,t,db}} * \mathbf{MM_k}\right)$$

Where:

$\boldsymbol{MM_{t,db}}$	Molecular mass of the gaseous stream in time interval t on a dry basis (kg dry gas/kmol dry gas);
$\boldsymbol{v_{k,t,db}}$	Volumetric fraction of gas k in the gaseous stream in time interval t on a dry basis (m³ gas k/m³ dry gas);
$\boldsymbol{MM_k}$	Molecular mass of gas k (kg/kmol);
$\boldsymbol{k}$	All gases, except H2O, contained in the gaseous stream (e.g. N2, CO2, O2, CO, H2, CH4, N2O, NO, NO2, SO2, SF6 and PFCs). As a simplification allowed by this tool, project proponents will monitor the volumetric fraction of only the gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology, i.e. **k = CH_4** and the difference to 100% will be considered as pure nitrogen.

The next step is to the volumetric flow of the gaseous stream in time interval t on a dry basis ($V_{t,db}$), which as per Option B is determined by converting the measured volumetric flow from wet basis to dry basis as per Equation 9:

Equation 9 $$V_{t,db} = {V_{t,wb}}/{(1 + V_{H2O,t,db})}$$

Where:

$V_{t,db}$	Volumetric flow of the gaseous stream in time interval t on a dry basis (m³ dry gas/h);
$V_{t,wb}$	Volumetric flow of the gaseous stream in time interval t on a wet basis (m³ wet gas/h);
$v_{H2O,t,db}$	Volumetric fraction of H2O in the gaseous stream in time interval t on a dry basis (m³ H2O/m³ dry gas);

The volumetric fraction of H2O in time interval t on a dry basis ($v_{H2O,t,db}$) is estimated according to Equation 10:

Equation 10 $$v_{H2O,t,db} = \frac{m_{H2O,t,db} * MM_{t,db}}{MM_{H2O}}$$

Where:

$v_{H2O,t,db}$	Volumetric fraction of H2O in the gaseous stream in time interval t on a dry basis (m³ H2O/m³ dry gas);
$m_{H2O,t,db}$	Absolute humidity in the gaseous stream in time interval t on a dry basis (kg H2O/kg dry gas);
$MM_{t,db}$	Molecular mass of the gaseous stream in time interval t on a dry basis (kg dry gas/kmol dry gas);
MM_{H2O}	Molecular mass of H2O (kg H2O/kmol H2O)

As per methodology ACM0001, Version 12.0.0, $PE_{flare,y}$ is determined using the procedure described in the “Tool to determine project emissions from flaring gases containing methane”, Version 01. Given the LFG will be flared through up to three flares, then $PE_{flare,y}$ will be the sum of the emissions for each flare determined separately.

This tool provides procedures to determine the flare efficiency in hour *h* based on measurements (Table 6) or default values ($\eta_{flare,h}$) presented in Table 5:

Table 5 – Constants used in equations to determine $PE_{flare,y}$

Parameter	SI Unit	Description	Value
MM_{CH4}	kg/kmol	Molecular mass of methane	16.04
MM_{N2}	kg/kmol	Molecular mass of nitrogen	28.02
AM_c	kg/kmol (g/mol)	Atomic mass of carbon	12.00
AM_h	kg/kmol (g/mol)	Atomic mass of hydrogen	1.01
AM_o	kg/kmol (g/mol)	Atomic mass of oxygen	16.00
AM_n	kg/kmol (g/mol)	Atomic mass of nitrogen	14.01
P_n	Pa	Atmospheric pressure at normal conditions	101 325
R_u	$Pa.m^3/kmol.K$	Universal ideal gas constant	8 314.472
T_n	K	Temperature at normal conditions	273.15
MF_{O2}	Dimensionless	O_2 volumetric fraction of air	0.21
GWP_{CH4}	tCO_2/tCH_4	Global warming potential of methane	21
MV_n	$m^3/Kmol$	Volume of one mole of any ideal gas at normal temperature and pressure	22,414
$\rho_{CH4,n}$	kg/m^3	Density of methane gas at normal conditions	0.716

According to the baseline methodology procedures provided by the tool: "project emissions from flaring of the residual gas stream are calculated based on the flare efficiency and the mass flow rate of methane in the residual gas stream that is flared. The flare efficiency depends on both the actual efficiency of combustion in the flare and the time that the flare is operating. The efficiency of combustion in the flare is calculated from the methane content in the exhaust gas of the flare, corrected for the air used in the combustion process, and the methane content in the residual gas".

Given UTGR - Jambeiro will have enclosed flares with continuous monitoring of the methane destruction efficiency of the flare, the following data required by this tool (Table 6) will be obtained ex post based on measurements made by specialized equipment during monitoring:

Table 6 – Parameters measured ex post to determine project emissions from flaring of the residual gas stream in year *y*

Parameter	SI Unit	Description
$fv_{i,h}$	-	Volumetric fraction of component *i* in the residual gas in the hour *h*
$FV_{RG,h}$	m^3/h	Volumetric flow rate of the residual gas in dry basis at normal (NTP) conditions[a] in the hour h
$t_{O2,h}$	-	Volumetric fraction of O_2 in the exhaust gas of the flare in the hour *h*
$fv_{CH4,FG,h}$	Mg/m^3	Concentration of methane in the exhaust gas of the flare in dry basis at
T_{flare}	°C	Temperature in the exhaust gas of the enclosed flare
		Any other parameters required to monitor proper operation of the flare according to the manufacturer's specification (only in the case of use of a default value for the flare efficiency of enclosed and open flares)

[a] Normal (NTP) conditions are 101.325 Kpa and 273.15 K.

This tool involves the following seven steps:

STEP 1: determination of the mass flow rate of the residual gas that is flared:

This step calculates the residual gas mass flow rate in each hour *h*, based on the volumetric flow rate and the density of the residual gas.

As a simplified approach provide by this tool, project participants will only measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N2). Therefore, the molecular mass of the residual gas in hour *h* will be determined as per Equation 11:

Equation 11 $$MM_{RG,h} = \sum_i \left(fv_i * MM_i \right)$$

Where:

$MM_{RG,h}$	Molecular mass of the residual gas in hour *h* (kg/kmol);
$Fv_{i,h}$	Volumetric fraction of component *i* in the residual gas in the hour *h*. Only CH_4 will be measured, considering the difference to 100% as being N_2;
MM_i	Molecular mass of methane (kg/kmol);
i	The components CH_4 and N_2;

The density of the residual gas is determined based on the volumetric fraction of all components in the gas calculated as per Equation 12:

Equation 12 $$\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \times T_n}$$

Where:

$\rho_{RG,n,h}$	Density of the residual gas at normal conditions in hour *h* (kg/m^3);
P_n	Atmospheric pressure at normal conditions (101,325 Pa);
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);

Finally, the residual gas mass flow rate in each hour *h* will be calculated as per Equation 13:

Equation 13 $$FM_{RG,h} = \rho_{RG,n,h} \times FV_{RG,h}$$

Where:

$FM_{RG,h}$	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* (m^3/h);

STEP 2: determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas:

This step, determines the mass fractions of carbon, hydrogen, oxygen and nitrogen in the residual gas, calculated from the volumetric fraction of each component *i* in the residual gas, as follows in Equation 14:

Equation 14 $$fm_{j,h} = \frac{\sum_i fv_{i,h} \times AM_j \times NA_{j,i}}{MM_{RG,h}}$$

Where:

$Fm_{j,h}$	Mass fraction of element j in the residual gas in hour *h*;
$Fv_{i,h}$	Volumetric fraction of component i in the residual gas in the 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 and nitrogen;

i The components CH_4 and N_2;

STEP 3: determination of the volumetric flow rate of the exhaust gas on a dry basis:

This step is applicable since the methane combustion efficiency of the flare will be continuously monitored in this project activity.

Determine the average volumetric flow rate of the exhaust gas in each hour *h* based on a stoichiometric calculation of the combustion process, which depends on the chemical composition of the residual gas, the amount of air supplied to combust it and the composition of the exhaust gas.

Given $\boldsymbol{fm_{j,h}}$ has been determined as per STEP 2, it is possible to first of all to calculate the stoichiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in the hour *h*, as per Equation 15:

Equation 15

$$\boldsymbol{F_h = \frac{fm_{C,h}}{AM_C} + \frac{fm_{H,h}}{4AM_H} - \frac{fm_{O,h}}{2AM_O} = \frac{fm_{C,h}}{AM_C} + \frac{fm_{H,h}}{4AM_H} - 0}$$

Where:

$\boldsymbol{F_h}$ Stoichiometric quantity of moles of O2 required for a complete oxidation of one kg residual gas in hour *h*(kmol O2/kg residual gas);

$\boldsymbol{Fm_{j,h}}$ Mass fraction of element j in the residual gas in hour *h* (from Equation 14). Since project proponents has chosen the simplified approach of only measure the volumetric fraction of methane to determine $\boldsymbol{fm_{j,h}}$, the component oxygen is not measured, therefore the mass fraction of Oxygen ($fm_{O,h}$) is deemed to be zero;

$\boldsymbol{AM_j}$ Atomic mass of element *j* (kg/kmol);

j The elements carbon (index C), hydrogen (index H) and oxygen (index O).

Then, the quantity of moles O2 in the exhaust gas of the flare per kg residual gas flared in our *h* can be calculated as follows in Equation 16:

Equation 16

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

Where:

$\boldsymbol{N_{O2,h}}$ Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h* (kmol/kg residual gas);

$\boldsymbol{T_{O2,h}}$ Volumetric fraction of O2 in the exhaust gas in the hour *h*;

MF_{O2} Volumetric fraction of O_2 in the air (0.21);

F_h Stoichiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h* (kmol/kg residual gas);

$Fm_{j,h}$ Mass fraction of element j in the residual gas in hour *h* (from Equation 14);

AM_j Atomic mass of element *j* (kg/kmol);

j The elements carbon (index C) and nitrogen (index N);

Next, the quantity of free volumes of CO_2, N_2 and O_2 in the exhaust gas of the flare at normal conditions shall be determined respectively as per the following equations (Equation 17, Equation 18 and Equation 19):

Equation 17 $$V_{n,CO2,h} = \frac{fm_{C,h}}{AM_c} \times MV_n$$

Where:

$V_{n,CO2,h}$ 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);

$fm_{C,h}$ 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 m^3/Kmol);

Equation 18 $$V_{n,N2,h} = MV_n \times \left\{\frac{fm_{N,h}}{200AM_N} + \left(\frac{1-MF_{O2}}{MF_{O2}}\right) \times \left[F_h + n_{O2,h}\right]\right\}$$

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);

MV_n Volume of one mole of any ideal gas at normal temperature and pressure (22.4 m^3/Kmol);

$Fm_{N,h}$ 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;

F_h Stoichiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas 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);

Equation 19 $$V_{n,O2,h} = n_{O2,h} \times MV_n$$

Where:

$V_{n,O2,h}$ Quantity of O2 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);

$N_{O2,h}$ 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 m^3/Kmol);

So, it is possible to determine the volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas as showed in Equation 20:

Equation 20 $$V_{n,FG,h} = V_{n,CO2,h} + V_{n,O2,h} + V_{n,N2,h}$$

Where:

$V_{n,FG,h}$ Volume of the exhaust gas of the flare in dry basis 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);

$V_{n,N2,h}$ 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 O2 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);

Finally, STEP 3 will be concluded after using Equation 21:

Equation 21 $$TV_{n,FG,h} = V_{n,FG,h} \times FM_{RG,h}$$

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 the hour *h* (m^3/kg residual gas);

$FM_{RG,h}$ Mass flow rate of the residual gas in hour *h* (kg/h);

Further, STEP 4 of "Tool to determine project emissions from flaring gases containing methane", Version 01is followed.

STEP 4: determination of methane mass flow rate of 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 in Equation 22:

Equation 22
$$TM_{FG,h} = \frac{TV_{n,FG,h} \times fv_{CH4,RG,h}}{1000000}$$

Where:

$TM_{FG,h}$	Mass flow rate of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h* (kg/h);
$TV_{n,FG,h}$	Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour *h* (m^3/h exhaust gas);
$Fv_{4,FG,h}$	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 of the residual gas on a dry basis:

As per ACM0001, Version 12.0.0, the amount of methane in the LFG which is sent to the flare is determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", Version 02.0.0.

Therefore, the parameter $TM_{RG,h}$ (of the "Tool to determine project emissions from flaring gases containing methane", Version 01) is the same of $F_{i,t}$ (of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", Version 02.0.0) and will be determined as previously described in ***Step A.1.a.*** in this section.

STEP 6: determination of the hourly flare efficiency:

The flare efficiency ($\eta_{flare,h}$) will be determined separately for each flare and calculated for each hour of a year based either on measurements or default values plus operational parameters. Temperature and emissions from the flare will be continuously monitored, being $\eta_{flare,h}$ determined according to the following rule provided in Step 6:

- 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*; and
- Determined according to 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* :

Equation 23 $$\boldsymbol{\eta_{flare,h} = 1 - \frac{TM_{FG,h}}{TM_{RG,h}}}$$

Where:

$\eta_{flare,h}$	Flare efficiency in the hour *h* (fraction);
$TM_{FG,h}$	Methane mass flow rate in exhaust gas averaged in a period of time *t* (hour, two months or year) in kg/h;
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour *h*, in kg/h;

In case the exhaust gas analyzer fails to operate in a given moment, the flare efficiency in that hour *h* ($\boldsymbol{\eta_{flare,h}}$) will be determined using the default values provided by the tool, as follows:

- 0% if the temperature in the exhaust gas of the flare (Tflare) is below 500 °C for more than 20 minutes during the hour h .
- 50%, if the temperature in the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour h, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour h.
- 90%, if the temperature in the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour h and the manufacturer's specifications on proper operation of the flare are met continuously during the hour h.

STEP 7: calculation of annual project emissions from flaring based on measured hourly values or based on default flare efficiencies:

Finally, Step 7 determines $PE_{flare,y}$ shall be calculated shall be calculated as the sum of emissions from each hour *h*, based on the methane flow rate in the residual gas ($TM_{RG,h} = F_{i,t}$) and the flare efficiency during each hour *h* ($\eta_{flare,h}$), as showed in Equation 24:

Equation 24 $$\boldsymbol{PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH4}}{1000}}$$

Where:

$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year *y* (tCO_2e);
$\boldsymbol{TM_{RG,h} = F_{i,t}}$	Mass flow rate of methane in the residual gas in the hour *h*, in kg/h. $\boldsymbol{F_{i,t}}$ as per "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", Version 02.0.0, according to ACM0001, Version 12.0.0;
$\eta_{flare,h}$	Flare efficiency in the hour *h* (fraction);
GWP_{CH4}	Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4;

For ex ante calculation purposes, ACM0001, Version 12.0.0 provides guidance for estimation of $F_{CH4,PJ,y}$ presented in Step A.1.1

Step A.1.1: Ex ante estimation of $F_{CH4,PJ,y}$

The ex ante estimate of $F_{CH4,PJ,y}$ is determined as per Equation 25:

Equation 25 $$\mathbf{F_{CH4} = n_{PJ,y} \cdot BE_{CH4,SWDS,y} / GWP_{CH4}}$$

Where:

$F_{CH4,PJ,y}$	Amount of methane in the LFG which is flared and/or used in the project activity in year y (t CH4/yr);
$BE_{CH4,SWDS,y}$	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y (t CO2e/yr). Is determined using the methodological tool "Emissions from solid waste disposal sites", Version 06.0.1;
$n_{PJ,y}$	Efficiency of the LFG capture system that will be installed in the project activity - **85%** according to the assessment performed by the technology provider (for more details, please refer to section B.6.2);
GWP_{CH4}	Global Warming Potential of CH_4 , the value valid for the fixed commitment period is **21** tCO_2e/tCH_4;

As per the "Emissions from solid waste disposal sites", Version 06.0.1, the amount of methane produced in the year *y* ($BE_{CH4,SWDS,y}$) is calculated as showed in Equation 26:

Equation 26 –

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

Where:

$BE_{CH4,SWDS,y}$	Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS to the end of the year *y* (tCO_2e);
φ_y	Model correction factor to account for model uncertainties (**0.8095**) as per Option 2 of the tool: Determine φy based on specific situation of the project activity;

Option 2 has been chosen to determine φ_y based on specific situation of the project activity. The overall uncertainty of the determination of methane generation in year y (v_y) is calculated as showed in Equation 27 according to instructions provided by the tool:

Equation 27 $$v_y = \sqrt{a^2 + b^2 + c^2 + d^2 + e^2 + g^2} = 0.23537$$

Table 7 – Parameters and values used for determining φ_y :

Factor	Parameter	Value	Justification
a	*W*	2%	Use the lower value if solid waste is weighed using accurate weighbridges. UTGR – Jambeiro will have precise scales, being the waste weight provided since the beginning of the landfill operations.
b	DOC_j	10%	Use the higher value if default values are used.
c	DOC_f	5%	Use the lower value if more than 50% of the waste is rapidly degradable organic material or if the SWDS is located in a tropical climate. UTGR-Jambeiro is located in a tropical climate.
d	*F*	5%	Use the lower value if more than 50% of the waste is rapidly degradable organic material. As showed in Table 10, 45.3% of the waste composition correspond to food waste, therefore the higher value (5%) is applied.
e	MCF_y	0%	Use the lower value for managed SWDS. As previously explained, UTGR-Jambeiro will count with all aspects related to well managed SWDS.
g	$e^{-kj.(y-x)}.(1-e^{-kj})$	20%	Use the lower uncertainty value when using the Application A if the SWDS compartments where the project is implemented were closed less than 3 years ago. In all other cases, use the higher value. As previously explained, UTGR-Jambeiro is a brand new landfill to start operations in 2012, therefore the higher values is applied.

As a conclusion, φ_y is then calculated as presented Equation 28:

Equation 28 $$\varphi_y = \frac{1}{(1+v_y)} = \frac{1}{(1+0.13379)} = 0.8095$$

f_y Fraction of methane captured at the SWDS and flared, combusted or used in another manner. As this is already accounted for in Equation 4, "f" in the tool shall be assigned a value **<u>0</u>**;

GWP_{CH4} Global Warming Potential of methane, the value valid for the fixed commitment period is **<u>21</u>** tCO_2e/tCH_4;

OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste). Used the default value of **0.1**, given the solid waste from UTGR - Jambeiro will be covered with oxidizing material such as soil;
F	Fraction of methane in the SWDS gas (volume fraction) (**0.5**);
DOC_f	Fraction of degradable organic carbon (DOC) that can decompose. According to the guidelines of the tool in determining the fraction of DOC that decomposes in the SWDS ($DOC_{f,y}$) for Application A, $DOC_{f,y}$ is given as a default value ($DOC_{f,y}$ = $DOC_{f,default}$), therefore applied IPCC 2006 Guidelines default value of **0.5**;
MCF	Methane correction factor. According to the procedure to determine the methane correction factor in the tool for Application A, The MCF should be selected as a default value (MCF_y = $MCF_{default}$), therefore default value of **1.0** for anaerobic managed solid waste disposal sites, since UTGR - Jambeiro has controlled placement of waste (i.e., waste directed to specific deposition areas with a degree of control of scavenging and a degree of control of fires) and includes: cover material; mechanical compacting and leveling of the waste;
j	Waste type category (index);
x	Year during the crediting period: *x* refer to the year since the landfill started receiving wastes [x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)];
y	Year for which methane emissions are calculated;
$W_{j,x}$	Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tonnes). As per the guidelines of the tool in determining the amounts of waste types j disposed in the SWDS for Application A, calculate Wj,x based on information from the SWDS owner and administration and from interviews with senior employees. Wj,x as showed in Table 10, has been determined based on waste composition (Table 8) and the expected amount of waste to be deposited in UTGR - Jambeiro (Table 9), as per data provided by UTGR-Jambeiro staff;

Table 8 - Composition of the municipal solid waste at UTGR - Jambeiro[11]

Waste Type *j*	Percentage
Wood and wood products	0.2%
Pulp, paper and cardboard	13.3%
Food, food waste, beverages and tobacco	45.3%
Textiles	8.8%
Garden, yard and park waste	4.5%
Glass, plastic, metal, other inert waste	27.8%

[11] Data provided by UTGR - Jambeiro staff.

Table 9 – Total amount of waste deposited in UTGR - Jambeiro

Year	Waste (tons)	Landfill Phase
2012	155,000	Phase I
2013	310,000	
2014	310,000	Phase II
2015	310,000	
2016	310,000	
2017	310,000	Phase III
2018	310,000	
2019	465,000	
2020	465,000	
2021	496,000	Phase IV
2022	496,000	
2023	527,000	

Table 10 – Ex ante estimation of the amount of organic waste type *j* deposited in UTGR - Jambeiro

Year x	$W_{j,x}$	Wood and wood products	Pulp, paper and cardboard	Food, food waste, beverages and tobacco	Textiles	Garden, yard and park waste	Glass, plastic, metal, other inert waste
2012	155,000	318	20,615	70,254	13,710	7,014	43,098
2013	310,000	636	41,230	140,508	27,420	14,028	86,196
2014	310,000	636	41,230	140,508	27,420	14,028	86,196
2015	310,000	636	41,230	140,508	27,420	14,028	86,196
2016	310,000	636	41,230	140,508	27,420	14,028	86,196
2017	310,000	636	41,230	140,508	27,420	14,028	86,196
2018	310,000	636	41,230	140,508	27,420	14,028	86,196
2019	465,000	953	61,845	210,761	41,129	21,041	129,293
2020	465,000	953	61,845	210,761	41,129	21,041	129,293
2021	496,000	1,017	65,968	224,812	43,871	22,444	137,913
2022	496,000	1,017	65,968	224,812	43,871	22,444	137,913
2023	527,000	1,080	70,091	238,863	46,613	23,847	146,532

DOC_j Fraction of degradable organic carbon (by weight) in the waste type *j*. Used default values from IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5) for wet waste (Table 11);

Table 11 – DOC_j default values for the different waste types *j* applied for UTGR - Jambeiro

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

k_j Decay rate for the waste type *j*. Applied default values (Table 12) from IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3) for tropical (> 20°C) wet (MAP> 1000mm) conditions, since in the area around UTGR - Jambeiro the mean annual temperature is 20.5°C and the annual precipitation is 1,329 mm[12];

Table 12 – Default values of decay rate for the different waste types j applied for UTGR – Jambeiro

Waste type *j*	Tropical
Pulp, paper, cardboard (other than sludge),	0.07
Wood, wood products and straw	0.035
Other (non-food) organic putrescible garden	0.17
Food, food waste, sewage sludge,	0.40
NB: MAT - mean annual temperature;	
MAP - Mean annual precipitation	

Step A.2: Determination of $F_{CH4,BL,y}$

ACM0001, Version 12.0.0, determines in cases that the requirement to destroy methane exists and LFG capture system exists (Case 4), $F_{CH4,BL,y}$ shall be determined based on information in contract of regulation requirements and data related to the existing LFG capture system, as per Equation 29:

Equation 29

$$F_{CH4,BL,y} = max\{F_{CH4,BL,R,y}; F_{CH4,BL,sys,y}\}$$

Where:

$F_{CH4,BL,R,y}$ Amount of methane in the LFG which is flared in the baseline due to a requirement in year y (t CH4/yr);

[12] Source: CEPAGRI - Centro de Pesquisas Meteorológicas e Climáticas Aplicadas à Agricultura. Available at http://www.cpa.unicamp.br/outras-informacoes/clima_muni_285.html (accessed October, 2011).

$F_{CH4,BL,sys,y}$ Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system (t CH4/yr);

It is important to mention that UTGR – Jambeiro has not started the SW disposal yet[13] (estimated to July 2012), therefore is not currently burning methane. However, in typical modern well managed landfill operations in Brazil the practice is to collect and burn the gas only through a passive gas venting system, which also works as a leachate drainage system. As there is no mandatory legislation to capture and flare LFG in Brazil, the wells are built with the main purpose of reducing bad odor and due to safety concerns, but not to burn LFG with high efficiency. It means that the LFG is burned in open flares at the top of the wells, without any systematic procedure and no measurements of the amount of the destroyed methane are available. Based on the explained above and on the Executive Project of UTGR – Jambeiro, which contains an elementary passive venting system with low efficiency LFG destruction, PPs considered this situation in the baseline scenario, since it is part of the initial executive project approved by the local Environmental Agency. This is conservative.

ACM0001, Version 12.0.0 further guidance refers that $F_{CH4,BL,R,y}$ and $F_{CH4,BL,sys,y}$ shall be determined according to the respective procedures for Case 2 and Case 3. Therefore, as for UTGR-Jambeiro specific situation the requirement does not specify any amount or percentage of LFG that should be destroyed but requires the installation of a system to capture and flare the LFG (for Case 2) and there is no monitored or historic data on the amount of methane that was captured in the year prior to the implementation of the project situation (for Case 3), then Equation 30 applies:

Equation 30
$$F_{CH4,BL,R,y} = F_{CH4,BL,sys,y} = 20\% * F_{CH4,PJ,y}$$

PROJECT EMISSIONS

As per methodology ACM0001, Version 12.0.0, project emissions (PE_y) is determined as demonstrated in Equation 31:

Equation 31
$$PE_y = PE_{EC,y} + PE_{FC,j,y}$$

Where:

$PE_{EC,y}$ Emissions from consumption of electricity due to the project activity in year y (t CO2/yr);

$PE_{FC,y}$ Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year y (t CO2/yr);

Given, UTGR - Jambeiro project activity will not consume fossil fuels for purpose other than electricity generation, $PE_{FC,j,y}$ is zero.

1- **Determination of emissions from consumption of electricity in the project case** ($PE_{EC,y}$)

[13] At the time this PDD was elaborated.

The electricity consumed by the project activity for the purpose of powering the LFG collection system is expected to be sourced by fossil fuelled electricity generators, but might also be sourced from the grid. Therefore, the project emissions from electricity consumption ($PE_{EC,y}$) will be calculated following the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", Version 01. The tool provides for an alternative approach to estimate project emissions if the electricity consumption source is a project source, which is applicable to UTGR – Jambeiro. Hence, project proponents choose Option B4 to determine project emissions from electricity consumption:

"Option B4: Project or leakage emissions from consumption of electricity are determined based on the rated capacity of the captive power plant(s), assuming, as a very conservative simplification, an emission factor of 1.3 tCO_2/MWh and an operation of 8,760 hours per year at the rated capacity, as follows:

Equation 32

$$\mathbf{PE_{EC,j,y} = 11{,}400\,\frac{tCO_2}{MW} * PP_{CP,j}}$$

Where:

$PE_{EC,j,y}$	Project emissions from electricity consumption by source(s) *j* in year *y* (tCO_2/yr);
$PP_{CP,j}$	Rated capacity of the captive power plant(s) that provide the project electricity consumption source(s) *j* with electricity (MW). UTGR-Jambeiro will count with a 150 KW diesel generator capacity, which is plenty enough to cover all equipment used in the project activity, comprising the blowers, flow meters, gas analysers, PLC devices, etc);
j	Project electricity consumption sources that are supplied with power from captive power plant(s) installed at one site;

Therefore, even if the project consumes a part of its electricity from the grid, this simplified approach based on $PP_{CP,j}$ will be used to determine $PE_{EC,j,y}$, which is very conservative, since the grid emissions are significantly lower than 1.3 tCO_2/MWh.

According to the tool, this option does not require monitoring any parameters.

LEAKAGE

According to ACM0001, Version 12.0.0, no leakage effects need to be accounted under this methodology.

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

Data / Parameter:	***OX_{top_layer}*** *
Data unit:	Dimensionless
Description:	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data used:	Consistent with how oxidation is accounted for in the methodological tool "Emissions from solid waste disposal sites", Version 06.0.1"

Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per ACM0001"Flaring or use of landfill gas", Version 12.0.0
Any comment:	Applicable to Step A. *OX_{top_layer} and OX of the "Emissions from solid waste disposal sites", Version 06.0.1 are the same parameters.

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential of CH_4
Source of data used:	IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to methodology ACM0001, Version 12.0.0, for the fixed commitment period.
Any comment:	---

Data / Parameter:	n_{PJ}
Data unit:	Dimensionless
Description:	Efficiency of the LFG capture system that will be installed in the project activity
Source of data used:	Project Proponents
Value applied:	85%.
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is based on the project[14] provided by Biotecnogas, the company responsible for the engineering and supervision of the installation of the LFG system at UTGR-Jambeiro. Biotecnogas is a renowned by its extensive expertise in this sector. Given UTGR-Jambeiro is a new SWDS to yet start operations, it will be possible to install since its beginning all the enhanced LFG capture system engineered for the purpose of a more efficient LFG collection, including the HDPE impermeable liner underneath the leachate drainage system, the collection pipes dimensioned for a forced extraction with a grid covering a ratio of $50m^2$, the multi-phase blowers, etc. Hence these aspects will allow reaching higher methane collection efficiencies, more related to modern landfill operations.
Any comment:	---

Data / Parameter:	φ
Data unit:	--
Description:	Model correction factor to account for model uncertainties
Source of data used:	"Emissions from solid waste disposal sites", Version 06.0.1

[14] "Projeto para instalação do sistema de capatação e combustão de biogás - Aterro Sanitário de Jambeiro, São Paulo, Brasil"- Biotecnogas. Ref: BTG126/11

Value applied:	0.8095
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per Option 2 of the tool: Determine φy based on specific situation of the project activity. Please refer to Step A.1.1 from Section B.6.1 of this PDD for more details.
Any comment:	---

Data / Parameter:	***F***
Data unit:	--
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC 2006 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 “Emissions from solid waste disposal sites”, Version 06.0.1
Any comment:	---

Data / Parameter:	$DOC_{f,default}$
Data unit:	Weight fraction
Description:	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data used:	IPCC 2006 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, in the SWDS. This default value can be used for Application A, as determined by the tool “Emissions from solid waste disposal sites”, Version 06.0.1.
Any comment:	---

Data / Parameter:	$MCF_{Default}$
Data unit:	--
Description:	Methane correction factor
Source of data used:	IPCC 2006 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 :	UTGR - Jambeiro is an anaerobic managed solid waste disposal site, due to the fact that the landfill has controlled placement of waste, a degree of control over scavenging and fires, and includes a cover material and the leveling of waste. According to IPCC: “Use the following values for MCF: • 1.0 for anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires)

	and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste; • 0.5 for semi-aerobic managed solid waste disposal sites. These must have controlled placement of waste and will include all of the following structures for introducing air to waste layer: (i) permeable cover material; (ii) leachate drainage system; (iii) regulating pondage; and (iv) gas ventilation system; • 0.8 for unmanaged solid waste disposal sites – deep and/or with high water table. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters and/or high water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste; • 0.4 for unmanaged-shallow solid waste disposal sites. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 meters
Any comment:	The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

Data / Parameter:	***DOC_j***
Data unit:	---
Description:	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5).
Value applied:	(see table below)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Used values provided by "Emissions from solid waste disposal sites", Version 06.0.1 for wet waste allowed for Application A, since the data for UTGR - Jambeiro regarding waste quantities and composition are available on a wet basis.
Any comment:	--

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

Data / Parameter:	***k_j***
Data unit:	l/yr
Description:	Decay rate for the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3).

<table>
<tr><td>Value applied:</td><td>
<table>
<tr><th>Waste type j</th><th>Tropical</th></tr>
<tr><td>Pulp, paper, cardboard (other than sludge),</td><td>0.07</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.035</td></tr>
<tr><td>Other (non-food) organic putrescible garden</td><td>0.17</td></tr>
<tr><td>Food, food waste, sewage sludge,</td><td>0.40</td></tr>
<tr><td colspan="2">NB: MAT - mean annual temperature;</td></tr>
<tr><td colspan="2">MAP - Mean annual precipitation</td></tr>
</table>
</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>In the area around UTGR-Jambeiro, the mean annual temperature is 20.5°C and the annual precipitation is 1,329 mm[12], therefore characterizing a tropical (> 20°C) wet (MAP> 1000mm) climate.
Therefore, values provided by “Emissions from solid waste disposal sites”, Version 06.0.1 for a tropical, wet climate were applied.</td></tr>
<tr><td>Any comment:</td><td>--</td></tr>
</table>

Data / Parameter:	Fixed constants used to estimate PE_{flare}
Data unit:	--
Description:	--
Source of data used:	“Tool to determine project emissions from flaring gases containing methane”, Version 01(Table 1 of the tool)

Value applied:	(see table below)

Parameter	SI Unit	Description	Value
MM_{CH4}	kg/kmol	Molecular mass of methane	16.04
MM_{N2}	kg/kmol	Molecular mass of nitrogen	28.02
AM_c	kg/kmol (g/mol)	Atomic mass of carbon	12.00
AM_h	kg/kmol (g/mol)	Atomic mass of hydrogen	1.01
AM_o	kg/kmol (g/mol)	Atomic mass of oxygen	16.00
AM_n	kg/kmol (g/mol)	Atomic mass of nitrogen	14.01
P_n	Pa	Atmospheric pressure at normal conditions	101 325
R_u	Pa.m^3/kmol.K	Universal ideal gas constant	8 314.472
T_n	K	Temperature at normal conditions	273.15
MF_{O2}	Dimensionless	O_2 volumetric fraction of air	0.21
GWP_{CH4}	tCO_2/tCH_4	Global warming potential of methane	21
MV_n	m^3/Kmol	Volume of one mole of any ideal gas at normal temperature and pressure	22,414
$\rho_{CH4,n}$	kg/m^3	Density of methane gas at normal conditions	0.716

Justification of the choice of data or description of measurement methods and procedures actually applied :	Fixed value provided by the "Tool to determine project emissions from flaring gases containing methane", Version 01 to estimate project emissions from flaring of the residual gas stream.
Any comment:	---

Data / Parameter:	***$PP_{CP,j}$***
Data unit:	MW
Description:	Rated capacity of the captive power plant(s) that provide the project consumption source(s) *j* with electricity.
Source of data used:	Project proponents - Name plate capacity of the captive power plant, manufacturer's specifications or catalogue references.
Value applied:	0.150
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", Version 01, option B4. Since the great majority of the electricity consumption is given by the blowers and when fully implemented, the project activity will count with 3 blowers that totalize electric motors with a nominal power rating of 97 KW, the

	rated capacity is plenty sufficient to attend all the project activity equipment.
Any comment:	In case of uncertainty a conservative value should be chosen.

Data / Parameter:	$\boldsymbol{R_u}$
Data unit:	$Pa.m^3/kmol.K$
Description:	Universal ideal gases constant
Source of data used:	As per “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, Version 02.0.0
Value applied:	8,314
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value according to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, Version 02.0.0
Any comment:	--

Data / Parameter:	$\boldsymbol{MM_i=MM_{CH4}}$
Data unit:	Kg/kmol
Description:	Molecular mass of greenhouse gas *i*
Source of data used:	As per “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, Version 02.0.0
Value applied:	Methane (CH4) = 16.04
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default values according to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, Version 02.0.0 CH_4 is the greenhouse gas involved in the emissions reductions calculation of the gaseous stream of this project activity. As a simplification allowed by this tool, project proponents will monitor only the volumetric fraction of only the gas that is greenhouse gas and is considered in the emission reduction calculation in the underlying methodology, i.e. **i = CH_4** and the difference to 100% will be considered as pure nitrogen.
Any comment:	---

Data / Parameter:	$\boldsymbol{MM_k}$
Data unit:	Kg/kmol
Description:	Molecular mass of greenhouse gas *k*
Source of data used:	As per “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, Version 02.0.0
Value applied:	(see table below)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default values according to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, Version 02.0.0

Parameter	SI Unit	Description	Value
MM_{CH4}	kg/kmol	Molecular mass of methane	16.04
MM_{N2}	kg/kmol	Molecular mass of nitrogen	28.02

Any comment:	For gases k that are greenhouse gases apply values for MM_i, which in the case of this project is MM_{CH4}.

Data / Parameter:	MM_{H2O}
Data unit:	Kg/kmol
Description:	Molecular mass of water
Source of data used:	As per “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, Version 02.0.0
Value applied:	18.0152
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default values according to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, Version 02.0.0, when using procedures of Option B at the intervals where the temperature of the gaseous stream reaches 60°C or more.
Any comment:	--

Data / Parameter:	W_x
Data unit:	t
Description:	Total amount of waste disposed in a SWDS in year *x*
Source of data to be used:	Project participants
Value applied:	see table below
Justification of the choice of data or description of measurement methods and procedures actually applied :	The quantities used as input assumptions of the waste disposed in UTGR - Jambeiro, took into consideration that currently 4 cities of the North Coast of São Paulo State (Ubatuba, Caraguatatuba, São Sebastião and Ilhabela), dispose their waste in the municipalities of Santa Isabel and Tremembé, located in the Paraíba Valley, distant about 175 km away. Considering that UTGR - Jambeiro is located at 100 km from the furthest city, project proponents expect that UTGR-Jambeiro will be the immediate option for SW disposal from these cities, as the transport costs, which correspond to the major cost, will suffer a drastic reduction. For the forthcoming years, project proponents took into account the growth in industrial waste input from other 7 cities in the surroundings and in the

Year	**Waste (tons)**	**Landfill Phase**
2012	155,000	Phase I
2013	310,000	
2014	310,000	Phase II
2015	310,000	
2016	310,000	
2017	310,000	Phase III
2018	310,000	
2019	465,000	
2020	465,000	
2021	496,000	Phase IV
2022	496,000	
2023	527,000	

	last phase, project proponents estimate the addition of the waste from other 3 cities plus an increment of industrial waste.
Any comment:	--

Data / Parameter:	$p_{n,j,x}$
Data unit:	fraction
Description:	Weight fraction of the waste type j in the sample n collected during the year x
Source of data to be used:	EIA – UTGR-Jambeiro
Value applied:	see table below
Justification of the choice of data or description of measurement methods and procedures actually applied :	Average of the waste composition, using the waste categories j, as provided in the table for DOCj and kj, and weigh each waste fraction from 2 studies of the gravimetric composition of the waste: the 1st from the city of Belo Horizonte and the 2nd from Caximba landfill.
Any comment:	---

Waste Type *j*	**Percentage**
Wood and wood products	0.2%
Pulp, paper and cardboard	13.3%
Food, food waste, beverages and tobacco	45.3%
Textiles	8.8%
Garden, yard and park waste	4.5%
Glass, plastic, metal, other inert waste	27.8%

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

According to ACM0001, Version 12.0.0, project proponents should provide an ex ante estimate of emissions reductions, by projecting the future GHG emissions of the landfill.

BASELINE EMISSIONS (EX ANTE)

Baseline emissions are calculated as per Equation 3, which as previously presented in Section B.6.1, corresponds for BE_{CH4} estimated in Step A by Equation 4:

Equation 4 $$BE_{CH4,y} = (1 - OX_{top\_layer}) * (F_{CH4,PJ,y} - F_{CH4,BL,y}) * GWP_{CH4}$$

For ex ante calculation purposes, ACM0001, Version 12.0.0 provides guidance for estimation of $F_{CH4,PJ,y}$ presented in Step A.1.1, where $F_{CH4,PJ,y}$ is determined as per **Equation 25:**

Equation 25 $$F_{CH4} = n_{PJ,y} \cdot {BE_{CH4,SWDS,y}}/{GWP_{CH4}}$$

Table 13 shows the values for $F_{CH4,PJ,y}$ calculated ex ante for the crediting period (details of the calculation are presented in the Excel spreadsheet).

Table 13 - Ex ante values of $F_{CH4,PJ,,y}$, $BE_{CH4,SWDS,y}$ and $n_{PJ,y}$ for the crediting period of UTGR – Jambeiro

		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
$F_{CH4,PJ,y}$	Amount of methane in the LFG which is flared and/or used in the project activity in year y	3,683.9	4,553.7	5,218.5	5,739.4	6,158.0	7,427.1	8,387.3	9,316.9	10,043.3	10,810.5	tCH_4
$BE_{CH4,SWDS,y}$	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y	91,014	112,504	128,928	141,797	152,139	183,493	207,216	230,182	248,129	267,082	tCO_2e
$n_{PJ,y}$	Efficiency of the LFG capture system that will be installed in the project activity	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	%
GWP_{CH4}	Global warming potential CH_4	21	21	21	21	21	21	21	21	21	21	tCO_2e/tCH_4

Step A.2: Determination of $F_{CH4,BL,y}$

As explained in Section B.6.1, for UTGR - Jambeiro, $F_{CH4,BL,y}$ is 20% * $F_{CH4,PJ,y}$.

The figures of this parameter are showed in Table 14.

Table 14 - Determination of $F_{CH4,BL,y}$ at UTGR – Jambeiro

		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
$F_{CH4,BL,y} =$ $F_{CH4,BL,R,y}$	Amount of methane in the LFG that would be flared in the baseline in year y	736.8	910.7	1,043.7	1,147.9	1,231.6	1,485.4	1,677.5	1,863.4	2,008.7	2,162.1	tCH_4
$F_{CH4,PJ,y}$	Amount of methane in the LFG which is flared and/or used in the project activity in year y	3,684	4,554	5,219	5,739	6,158	7,427	8,387	9,317	10,043	10,810	tCH_4
	Typical destruction rate*	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	%

* As per ACM0001 v12.0.0 - Step A.2: Case 2 "If the requirement does not specify any amount or percentage of LFG that should be destroyed but requires the installation of a system to capture and flare the LFG, then a typical destruction rate of 20% is assumed."

Therefore, Step A of ACM0001, Version 12.0.0 is concluded allowing the estimation of $BE_{CH4,y}$ values, which are showed in Table 15.

Table 15 – Estimation of BE_{CH4} of UTGR - Jambeiro for the crediting period

		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
$BE_{CH4,y}$	Baseline emissions of methane from the SWDS in year y	55,700	68,853	78,904	86,780	93,109	112,297	126,816	140,871	151,855	163,454	tCH_4
OX_{top_layer}	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	dimensionless
$F_{CH4,PJ,y}$	Amount of methane in the LFG which is flared and/or used in the project activity in year y	3,684	4,554	5,219	5,739	6,158	7,427	8,387	9,317	10,043	10,810	tCH_4
$F_{CH4,BL,y}$	Amount of methane in the LFG that would be flared in the baseline in year y	737	911	1,044	1,148	1,232	1,485	1,677	1,863	2,009	2,162	tCH_4
GWP_{CH4}	Global warming potential CH_4	21	21	21	21	21	21	21	21	21	21	tCO_2e/tCH_4

As a result, the ex ante values for baseline emissions of UTGR - Jambeiro, calculated according Equation 3, are presented in Table 16.

Table 16 – Ex ante Baseline Emissions of UTGR - Jambeiro for the crediting period

		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
BE_y	Baseline emissions for year *y*	55,700	68,853	78,904	86,780	93,109	112,297	126,816	140,871	151,855	163,454	tCO_2e
$BE_{CH4,y}$	Baseline emissions of methane from the SWDS in year y	55,700	68,853	78,904	86,780	93,109	112,297	126,816	140,871	151,855	163,454	tCO_2e
$BE_{EC,y}$	Baseline emissions associated with electricity generation in year y (t CO2/yr)	0	0	0	0	0	0	0	0	0	0	tCO_2
$BE_{HG,y}$	Baseline emissions associated with heat generation in year y (t CO2/yr)	0	0	0	0	0	0	0	0	0	0	tCO_2
$BE_{NG,y}$	Baseline emissions associated with natural gas use in year y	0	0	0	0	0	0	0	0	0	0	tCO_2

PROJECT EMISSIONS (EX ANTE)

The project activity will not consume thermal energy, and is expected to consume electricity generated on-site using fossil fuelled electricity generators or sourced from the grid. The ex ante value of $PE_{EC,y}$ and consequently PE_y is showed in Table 17:

Table 17 - Ex ante values of project emissions for UTGR - Jambeiro during the crediting period

		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
PE_y	Project emissions for year *y*	1,710	1,710	1,710	1,710	1,710	1,710	1,710	1,710	1,710	1,710	tCO_2e
$PE_{EC,j,y}$	Emissions from consumption of electricity in the project case	1,710	1,710	1,710	1,710	1,710	1,710	1,710	1,710	1,710	1,710	tCO_2e
$PE_{FC,y}$	Emissions from consumption of heat in the project case	0	0	0	0	0	0	0	0	0	0	tCO_2e

EMISSION REDUCTIONS (EX ANTE)

As a conclusion, the calculated ex ante emission reductions achieved by the project activity are determined by deducting the project emissions from the baseline emissions, as presented in Equation 1, which values are as showed in Table 18.

Table 18 – Ex ante values of emission reduction for UTGR - Jambeiro during the crediting period

		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
ER_y	Emission reductions	53,990	67,143	77,194	85,070	91,399	110,587	125,106	139,161	150,145	161,744	tCO_2e
BE_y	Baseline emissions for year *y*	55,700	68,853	78,904	86,780	93,109	112,297	126,816	140,871	151,855	163,454	tCO_2e
PE_y	Project emissions for year *y*	1,710	1,710	1,710	1,710	1,710	1,710	1,710	1,710	1,710	1,710	tCO_2e

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

Table 19 - Summary of the ex-ante estimation of emission reductions

Years	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
2014	1,710	55,700	0	**53,990**
2015	1,710	68,853	0	**67,143**
2016	1,710	78,904	0	**77,194**
2017	1,710	86,780	0	**85,070**
2018	1,710	93,109	0	**91,399**
2019	1,710	112,297	0	**110,587**
2020	1,710	126,816	0	**125,106**
2021	1,710	140,871	0	**139,161**
2022	1,710	151,855	0	**150,145**
2023	1,710	163,454	0	**161,744**
Total (tonnes of CO_2e)	**17,100**	**1,078,640**	**0**	**1,061,540**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$V_{t,db}$ ($FV_{RG,h}$ *)
Data unit:	Nm^3 dry gas/h
Description:	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data to be used:	Measurements by project participants using flow meters.
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:	As per the tool, the flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it will be demonstrated that the gaseous stream is dry to use this option, by demonstrating the LFG coming from the landfill is less than 60°C, item (b) of Option A of the referred tool. The flow meters also measures temperature and pressure and automatically normalizes the data to normalized cubic meters. Instruments with recordable electronic signal (analogical or digital). Accuracy: ± 0.5 % of rate for gases. Continuous monitoring. Data will be aggregated monthly and yearly.
QA/QC procedures to be applied:	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications.
Any comment:	Monitored since PPs chose Options A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", Version 02.0.0 * $FV_{RG,h}$ from the "Tool to determine project emissions from flaring gases containing methane", Version 01 and $V_{t,wb}$ from the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", Version 02.0.0 are the same parameter.

Data / Parameter:	$v_{i,t,db}$ ($fv_{i,h}$*)
Data unit:	m^3 gas i/m^3 dry gas
Description:	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Source of data to be used:	Measurements by project participants using gas analyser.
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:	Continuous gas analyser operating in dry-basis. Volumetric flow measurement will always refer to the actual pressure and temperature. Continuous monitoring. Data will be aggregated monthly and yearly. Features: Drift < 1 % per month; Repeatability < 4 % of full scale; Resolution 0.2 % of full scale
QA/QC procedures to be applied:	Calibration should include zero verification with an inert gas (e.g. N2) and at least one reading verification with a standard gas (single calibration gas or

	mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Any comment:	Monitored since PPs chose Options A of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, Version 02.0.0 As a simplified approach provide by this tool, project participants will only measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2). *$fv_{i,h}$ from the “Tool to determine project emissions from flaring gases containing methane”, Version 01 and $V_{i,t,db}$ from “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, Version 02.0.0 are the same parameter, since in the case of this project activity *i* corresponds to CH_4.

Data / Parameter:	T_t
Data unit:	K
Description:	Temperature of the gaseous stream in time interval t
Source of data to be used:	Temperature sensor
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not Applicable
Description of measurement methods and procedures to be applied:	Continuous monitoring through thermo resistance temperature sensor Accuracy class: minimum precision class AA.
QA/QC procedures to be applied:	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration will be made according to manufacturer’s specifications.
Any comment:	As per Option A of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, Version 02.0.0 this parameter is needed to determine the gaseous stream flow temperature is below 60ºC, which will assure that the applicability condition is met and to determine the mass flow of the greenhouse gas (CH4).

Data / Parameter:	P_t
Data unit:	Pa
Description:	Pressure of the gaseous stream in time interval t
Source of data to be used:	Pressure transmitter with recordable electronic signal.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not Applicable
Description of measurement methods and procedures to be applied:	Continuous monitoring through pressure transmitter with recordable electronic signal. . Accuracy of 0.5%.
QA/QC procedures to be applied:	Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either

	capacitive or resistive) must be calibrated monthly.
Any comment:	As per Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", Version 02.0.0 this parameter is needed to determine the mass flow of the greenhouse gas (CH4).

Data / Parameter:	$p_{H2O,t,Sat}$
Data unit:	Pa
Description:	Saturation pressure of H_2O at temperature T_t in time interval t
Source of data to be used:	[1] Fundamentals of Classical Thermodynamics; Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4º Edition 1994, John Wiley & Sons, Inc.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not Applicable
Description of measurement methods and procedures to be applied:	This parameter is solely a function of the gaseous stream temperature T_t and can be found at reference [1] for a total pressure equal to 101,325 Pa
QA/QC procedures to be applied:	---
Any comment:	---

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:	Fixed-point automatic extractive sampling analyzer, in dry basis. The point of measurement will be at 80% of total flare height. Sampling will be conducted with appropriate sampling probes. Monitoring will be continuous using electrochemical cells and values will be averaged hourly or at a shorter time interval. Features: Drift < 1 % per month; Repeatability < 4 % of full scale; Resolution 0.2 % of full scale
QA/QC procedures to be applied:	Analyzers will 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 gas.
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	--
Description of measurement methods and procedures to be applied:	Fixed-point automatic extractive sampling analyzer, in wet basis. The point of measurement will be at 80% of total flare height. Sampling will be conducted with appropriate sampling probes. Monitoring will be continuous through infrared technology and values will be averaged hourly or at a shorter time interval. Features: Drift < 1 % per month; Repeatability < 4 % of full scale; Resolution 0.2 % of full scale
QA/QC procedures to be applied:	Analyzers will 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 gas.
Any comment:	Measurement instruments may read ppmv or % values. To convert from ppmv to mg/m^3 simply multiply by 0.716. 1% equals 10,000 ppmv.

Data / Parameter:	T_{flare}
Data unit:	^{o}C
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	Measurements by project participants using a thermocouple.
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:	Monitoring will be continuous, measuring the temperature of the exhaust gas stream in the flare by a thermocouple Type N, as per the "Tool to determine project emissions from flaring gases containing methane", Version 01. A temperature above 500ºC indicates that a significant amount of gases are still being burnt and that the flare is operating. The flare is designed to operate at a standard temperature of 1,000 ºC.
QA/QC procedures to be applied:	Thermocouples will be replaced or calibrated every year.
Any comment:	--

Data / Parameter:	***Other flare operation parameters***
Data unit:	---
Description:	This should include all data and parameters that are required to monitor whether the flare operates within the range of operating conditions according to the manufacturer's specifications including a flame detector in case of open flares.
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	These required flare operation parameters are: the volumetric flow of the

measurement methods and procedures to be applied:	LFG ($V_{t,db}$); the volumetric fraction of CH_4 ($v_{i,t,db}$) and the temperature in the exhaust gas of the flare (T_{flare}), which are already monitored continuously in the project activity. In case one of these parameters shows the flare was not operating within the range of operating conditions specified by the manufacturer, the readings during that period will not be accounted for emission reductions calculation.
QA/QC procedures to be applied:	
Any comment:	Only applicable in case of use of a default value.

Data / Parameter:	**a, b, c, d, e, g**
Data unit:	%
Description:	Effect of the uncertainty of different parameters
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**a** = 2%**; b** = 10%; **c** = 5%; **d** = 5%; **e** = 0%; **g** = 20%
Description of measurement methods and procedures to be applied:	Using the instructions in Table 3 of "Emissions from solid waste disposal sites", Version 06.0.1. Monitoring frequency will be annual if the conditions described in the Instructions for selecting the factor in Table 3 have changed (e.g. a change in how the weight of the waste is measured). Once for the crediting period, if these conditions do not change.
QA/QC procedures to be applied:	---
Any comment:	Used in Option 2 for determining the model correction factor.

B.7.2. Description of the monitoring plan:

<u>Data collection procedures</u>

All the monitoring information collected during the 10 years of crediting period will be kept and archived electronically for two years after the end of the crediting period or the last issuance of CERs, whichever occurs later.

The recorded data will be organized according to the manual of procedures prepared specifically for UTGR-Jambeiro, which comprises the instructions for appropriate management of the files such as their: identification, archiving, protection, recovery and deletion.

The monitoring methodology for UTGR **-** Jambeiro will be based on direct measurement of the amount of landfill gas captured and destroyed at the flare unit(s). The main variable that need to be determined is the quantity of methane actually captured ($F_{CH4,PJ,y}$), which for this project activity is equal to the quantity of methane flared ($F_{CH4,flared,y}$).

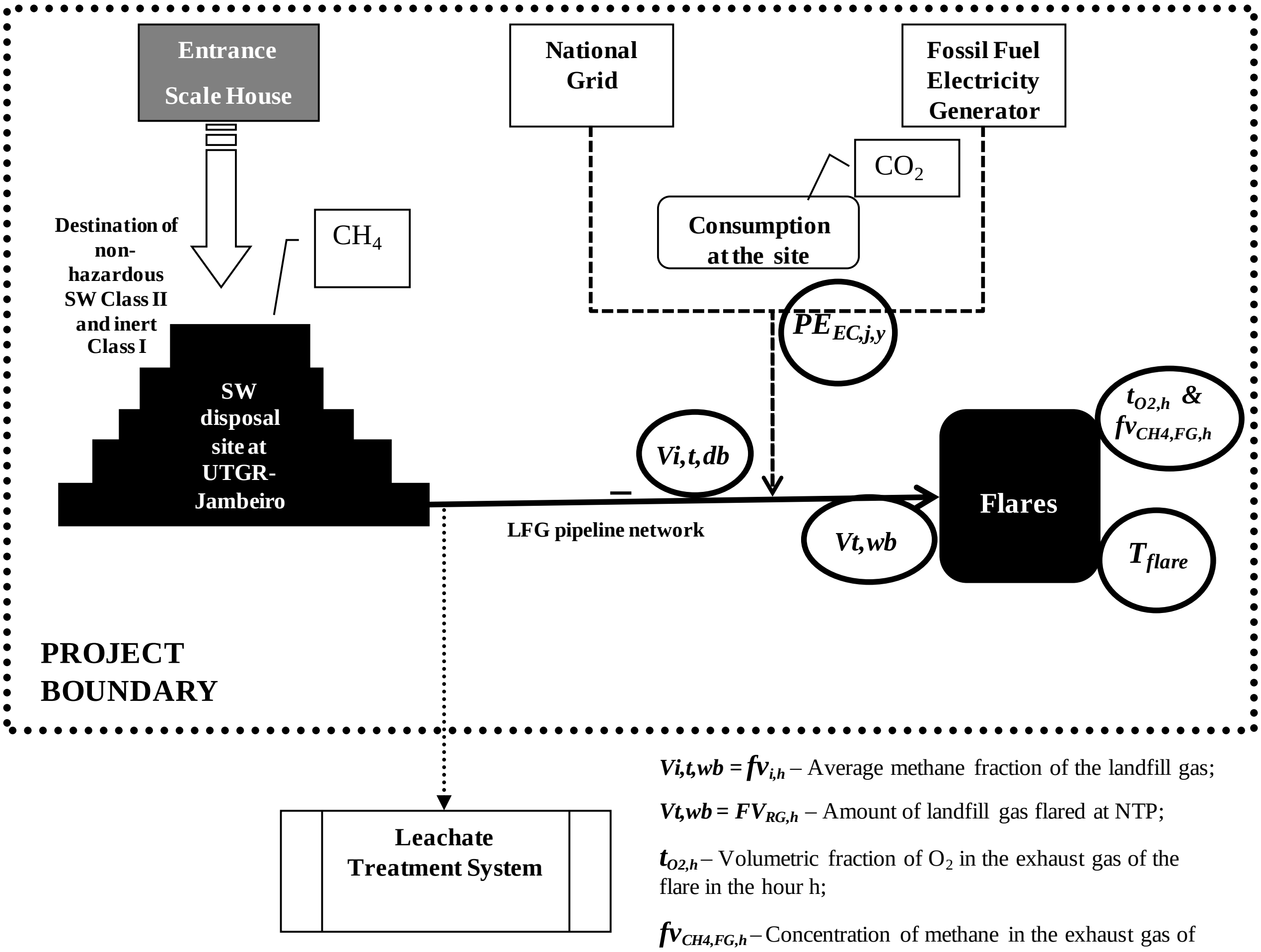
To determine these variables, the following parameters will be monitored:

1. The amount of landfill gas flared ($V_{t,wb}$) is measured continuously in Nm^3, using a continuous flow meters which also measure the LFG's temperature and pressure, which will be installed for each

flare (Figure 7). The biogas flow will be measured on wet basis, which corresponds to dry basis provided the biogas temperature is less than 60°C. Monitoring of the temperature (T_t) and pressure (P_t) will be made to determine the mass flow of the LFG delivered to the flares, following the standard approaches provided in the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", Version 02.0.0. These flow meters will be subject to a regular maintenance and testing regime by an officially accredited entity to ensure accuracy;

2. The fraction of methane in the landfill gas ($V_{i,t,db}$) will be measured with a continuous analyzer at a fixed point (Figure 7), in dry basis. The gas analyzer will be supplied by manufacturers with wide experience in landfill use. To ensure accuracy, the gas analyzer will undergo maintenance/calibration subject to appropriate industry standards, according to manufacturer's instruction.

Figure 7 - Diagrammatic representation of the project activity boundary including gases and sources



Vi,t,wb = $fv_{i,h}$ – Average methane fraction of the landfill gas;

Vt,wb = $FV_{RG,h}$ – Amount of landfill gas flared at NTP;

$t_{O2,h}$ – Volumetric fraction of O_2 in the exhaust gas of the flare in the hour h;

$fv_{CH4,FG,h}$ – Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour h;

Tflare – Temperature in the exhaust gas of the flare;

$PE_{EC,j,y}$ – Project emissions from electricity consumption by the project activity during the year y;

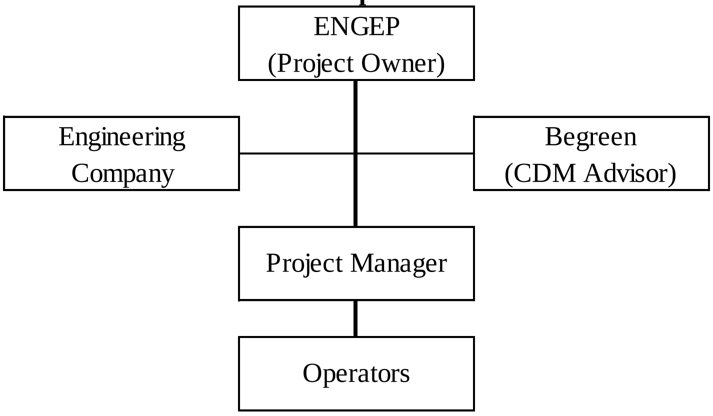
3. The parameters used for determining the project emissions from flaring of the residual gas stream in year *y* ($PE_{flare,y}$) will be monitored as per the "Tool to determine project emissions from flaring gases containing methane", Version 01. Flare emissions ($t_{O2,h}$ and $fv_{CH4,FG,h}$) will be measured by a fixed-point automatic extractive sampling analyzer, in dry basis. The point of measurement will be at 80% of total flare height. Sampling will be conducted with appropriate sampling probes. Monitoring will be continuous and values will be averaged hourly or at a shorter time interval. $PE_{flare,y}$ will be determined separately for each flare when more than one flare is installed.

4. The relevant regulations for LFG project activities will be monitored and updated. Changes to regulation will be converted to the amount of methane destroyed/combusted during the year in the absence of the project activity ($F_{CH4,BL,y}$);

Organization Structure with Roles and Responsibilities

UTGR-Jambeiro's organization structure is showed in Figure 8, having the roles and responsibilities of personnel further described below:

Figure 8 – Organization structure with roles and responsibilities at UTGR- Jambeiro



Responsibilities	
ENGEP	Is the project owner, in charge for the financing and the operation activities of the project activity.
Begreen	CDM Advisor, responsible for training the operation staff regarding the CDM procedures, quality assurance of the monitoring data and elaborating the Monitoring Reports.
Project Manager	Daily management of the project activity operations activities, monitoring data collection, storage and quality control.
Engineering	Responsible to transfer the technology, which includes designing, supervision of the installation and training on how to use the project activity equipment and advisory in optimizing the LFG capture and destruction. The engineering company is also in charge for providing remote access to the monitoring data, its remote storage and quality check.
Operation Staff	Execute the operation activities with regard to the LFG capture and collection as well as the flaring and monitoring equipment.

UTGR-Jambeiro will designate specific operators dedicated to work on the daily operation of the project activity. The specific staff will be properly trained by Begreen – the CDM advisor – and by equipment suppliers on operation, maintenance and monitoring of the installed facilities. Training sessions will be further repeated when required.

Begreen will support UTGR-Jambeiro's staff on the monitoring activities (data management, processing, quality control and storage - physical and electronic) of the proposed project throughout the project lifetime, being responsible for the preparation of monitoring reports and the coordination of the emission reduction Verifications.

All the equipment will be monitored by the operation team from UTGR-Jambeiro, guaranteeing that the project is achieving its objective of reducing GHG emissions. To support the operation team, an automated system furnished with alarms will control and monitor biogas flow and flaring.

A continuous monitoring system for methane fraction of the landfill gas and LFG flow will be installed, which will acquire data from the process, through continuous sampling, and deliver the required information as an average in a time interval not greater than an hour. Therefore, paired values of the methane fraction of the landfill gas and LFG flow which are averaged for the same time interval will be used in the calculation of emission reductions.

All the information related to biogas flow, temperature and pressure, plus methane concentration and flare efficiency will be registered in a data logger, wired and stored via internet to an independent system that will check and validate for precision and file the downloaded information. All the monitoring information will be available online to those related to the project and at the site of the project activity. This information will be also recorded manually by the operation staff in printed forms once a day. Monthly monitoring reports will be prepared by the operation team in specific format, including all the monitoring data, and sent to Begreen.

Quality Assurance / Quality Control Procedures

The monitoring data will have three levels of quality control. The first one will take place at the site, where data will be stored in the data logger and further in the computer at the landfill office. This data will be periodically checked for consistency by the plant manager and cross checked with the manual readings.

The second level occurs at the remote server managed by the Engineering Company, which will upload via internet and store all data registered in the data logger. The data will be checked for consistency and used for calculations by the Engineering Company.

The third level will occur at Begreen, which will perform a quality assurance of the monitoring data on a regular basis, by crosschecking the information provided by both the plant manager at the landfill and the Engineering Company and will use it to prepare the Monitoring Reports.

Records will be archived in both paper and electronic format. All the electronic and paper documents will be archived and be kept for 2 years after the end of the last crediting period or the last issuance of CERs, whichever occurs later.

Emergency preparedness

In case of preventive and corrective maintenance, the landfill maintenance team will be trained specifically for each type of equipment, to quickly assist in case of necessity. Depending on the type of maintenance required, service providers specialized in specific equipments or materials may be used.

A maintenance log book will be kept in the landfill office and every maintenance event will be recorded by the project operation staff. All equipment will undergo maintenance and calibration according to recommendations of the suppliers.

There will be spare devices of the main monitoring equipment (flow meter, portable gas analyser, thermocouple, pressure and temperature transmitters) stored in the storage house at the landfill site.

In case of a failure in the data logging, the PLC system will alert the Operators Staff, which will be trained for such events and will quickly provide the equipment replacement.

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):

31/10/2011.

Responsible entity: BEGREEN Consultoria em Projetos de Bioenergia e Sustentabilidade Ltda.
Project participant and project developer
Av. Conselheiro Rodrigues Alves, 948 - Room. 11 - Vila Mariana
São Paulo - SP - Brazil

Contact: Rodrigo F. Gatti or Fabio Saldanha Faria
Phone: +55 (11) 8689-7620 / +55 (11) 7063-3176
rodrigo@begreen.com.br; fabiosaldanha@begreen.com.br

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:

As per the Glossary of CDM terms (Version 05), the starting date of a CDM project activity is the earliest date at which either the implementation or construction or real action of a project activity begins. The start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity. Minor pre-project expenses, e.g. the contracting of services /payment of fees for feasibility studies or preliminary surveys, should not be considered in the determination of the start date as they do not necessarily indicate the commencement of implementation of the project.

As per the above definition, as of the GSP, the project proponents have yet to commit to the major expenditures related to the implementation of the project activity and as such, the starting date of the project activity has yet to occur.

The major expenditures entailed by the project activity are the construction of the LFG collection system and procurement of the methane destruction equipment. As of GSP, the project proponent has yet to sign the major equipment procurement contracts, due to the fact that the landfill has not started SW disposal yet. UTGR – Jambeiro is expected to start receiving SW in July 2012 and the project activity shall start to be implemented in June 2013, through the acquisition of the main equipment such as flare, blowers, etc. The project activity operations shall start in January 2014.

Therefore, the project start date is expected to occur in 01/06/2013.

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

The project is expected to last over 21 years, based on the expected amount of biogas recovered, given the total capacity of 9,656,025 tonnes of SW of UTGR - Jambeiro site.

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:

Not applicable.

C.2.1.2. Length of the first crediting period:

Not applicable.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/01/2014 or the date of the project registration, the one that occurs later.

C.2.2.2. Length:

10 years.

SECTION D. Environmental impacts

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

In Brazil, the proponent of any project that involves the construction, installation, expansion, and operation of any polluting or potentially polluting activity or any activity capable of causing environmental degradation is required to secure a series of permits from the respective state environmental agency. In addition, any such activity requires the preparation of an environmental assessment report, prior to obtaining construction and operation permits. Three types of permits are required. The first is the preliminary license (Licença Prévia or L.P.) issued during the planning phase of the project and which contains basic requirements to be complied with during the construction, and operating stages. The second is the construction license (Licença de Instalação or L.I.) and, the final one is the operating license (Licença de Operação or L.O.). UTGR – Jambeiro project activity will follow all the required licensing process in due course.

The project activity at UTGR - Jambeiro consists of the collection and combustion of LFG, hence avoiding its diffuse and uncontrolled emissions. The combustion of LFG causes a net beneficial impact on the environment, which is why flaring or other treatment is required by law in many developed countries.

The major components of LFG, methane and carbon dioxide, are colorless and odorless. The main global environmental concern over these compounds is the fact that they are greenhouse gases. Although the majority of LFG emissions are quickly diluted in the atmosphere, in confined spaces there is a risk of asphyxiation and/or toxic effects if LFG is present in high concentrations. Landfill gas also contains over 150 trace components that can cause other negative local and global environmental effects such as odor nuisances, stratospheric ozone layer depletion, and ground –level ozone creation. Through appropriate management of the UTGR - Jambeiro, the LFG will be captured and combusted, reducing the risks of toxic effects on the local community and local environment. Furthermore, the project activity will contribute to minimize the accumulation of LFG, therefore decreasing the risk of explosion.

Other aspects of the operation of the LFG to be combusted in the flare system have also been addressed, such as:

- Noise – usually there is an increase in noise from the site associated with the flare operation, but the impacts are likely to be marginal given the noise typically associated with operations at landfills (tractors, excavators, etc).
- Visual amenity – Placement of flare system facilities at the landfill site will increase the visual presence of the site, however the impacts are expected to be marginal given the visual intrusion currently associated with the waste disposal operations.

In summary, UTGR - Jambeiro project activity will contribute to enhance the overall landfill management and will reduce adverse global and local environmental effects of uncontrolled releases of landfill gas, improving the baseline scenario and the environmental quality of the UTGR - Jambeiro.

Regarding the landfill activities, UTGR - Jambeiro have undergone the required licensing process according to the federal, state and municipal legislation, the determination of the Environmental Ministry and the resolutions of the Brazilian Environment Advice (CONAMA). In 09/05/2011, UTGR - Jambeiro was granted with the preliminary environmental license (LP Nº 41444), valid up to 08/05/2016, issued by the Environmental Agency of the State of São Paulo – CETESB (Companhia Ambiental do Estado de São Paulo) and shall be receiving the construction license (L.I.) in the coming months.

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:

UTGR - Jambeiro project activity will not have significant environmental impacts. The infra-structure to collect and combust the gas will not likely generate significant impacts at the site.

SECTION E. Stakeholders' comments

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

According to the Resolutions Number 1, 4 and 7 of the Brazilian Designed National Authority (CIMGC – Comissão Interministerial de Mudança Global do Clima/Interministerial Commission on Global Climate Change), project participants sent letters to local stakeholders 15 days before the start of the validation period, in order to receive comments. To satisfy and comply with this ruling[15], invitation letters describing the project and requesting comments have been sent to the local stakeholders.

The invitation for comments was sent by official letter by ENGEP (project participant) through the Brazilian mail (Correios) on November 1st 2011.

Invitees include:

- City Hall Administration of Jambeiro – SP;
- Municipal Secretariat of Environment of Jambeiro – SP;
- Municipal Legislation Chamber of Jambeiro – SP;
- Public Prosecutor's Office of Jambeiro - SP;
- Environmental Agency of the State of São Paulo – CETESB (Companhia Ambiental do Estado de São Paulo));
- Public Prosecutor's Office of the State of São Paulo;
- Federal Prosecutor's Office;
- Secretary of Environment of the State of São Paulo – SP;
- Brazilian Forum of NGOs and Social Movement for Environment and Development - FBOMS (Fórum Brasileiro de ONG's e Movimentos Sociais para o Meio Ambiente e Desenvolvimento);
- Brazilian Institute of Environment and Natural Renewable Resources - IBAMA/SP (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis);
- Institute of Social and Environment affairs of Jambeiro;
- Public Prosecutor's Office of Caçapava - SP;

This PDD was published in the internet by ENGEP in November 7th 2011, as indicated in the invitation for comments. Commenting period is to end on November 21st 2011. The validation process is to start after this date.

E.2. Summary of the comments received:

No comments were received until the conclusion of this PDD.

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

Not applicable.

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[15] CMIGC - Manual para Submissão de Atividades de Projeto no Âmbito do MDL à Comissão Interministerial de Mudança Global do Clima, visando à obtenção da Carta de Aprovação do Governo Brasileiro. v.02. Available at http://www.mct.gov.br/index.php/content/view/37142.html (Accessed April 2011).

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	BEGREEN Consultoria em Projetos de Bioenergia e Sustentabilidade Ltda.
Street/P.O.Box:	Av. Conselheiro Rodrigues Alves, 948 - Room. 11 - Vila Mariana
Building:	--
City:	São Paulo
State/Region:	SP
Postcode/ZIP:	04014-002
Country:	Brazil
Telephone:	+55 (11) 7063-3176
FAX:	--
E-Mail:	fabiosaldanha@begreen.com.br
URL:	http://www.begreen.com.br
Represented by:	Fábio Saldanha Faria
Title:	Executive Director
Salutation:	Mr.
Last name:	Faria
Middle name:	Saldanha
First name:	Fábio
Department:	
Mobile:	+55 (11) 7063-3176
Direct FAX:	
Direct tel:	+55 (11) 7063-3176
Personal e-mail:	fabiosaldanha@terra.com.br

Organization:	BEGREEN Consultoria em Projetos de Bioenergia e Sustentabilidade Ltda.
Street/P.O.Box:	Av. Conselheiro Rodrigues Alves, 948 - Room. 11 - Vila Mariana
Building:	--
City:	São Paulo
State/Region:	SP
Postcode/ZIP:	04014-002
Country:	Brazil
Telephone:	+55 (11) 8689-7620
FAX:	--
E-Mail:	rodrigo@begreen.com.br
URL:	http://www.begreen.com.br
Represented by:	Rodrigo Fagundes Gatti
Title:	Project Director
Salutation:	Mr.
Last name:	Gatti
Middle name:	Fagundes
First name:	Rodrigo
Department:	
Mobile:	+55 (11) 8689-7620

Direct FAX:	
Direct tel:	+55 (11) 8689-7620
Personal e-mail:	gattiro@terra.com.br

Organization:	ENGEP – Engenharia e Pavimentação Ltda.
Street/P.O.Box:	Via Anhanguera, km 140 – Bairro dos Pereiras
Building:	
City:	Limeira
State/Region:	São Paulo
Postcode/ZIP:	13.487-170
Country:	Brazil
Telephone:	+55 (19) 3404-1600
FAX:	+55 (19) 3404-1604
E-Mail:	obras@engep.com.br
URL:	http://www.engep.com.br
Represented by:	Paulo Masuti Levy
Title:	CEO
Salutation:	Mr.
Last name:	Levy
Middle name:	Masuti
First name:	Paulo
Department:	
Mobile:	
Direct FAX:	
Direct tel:	+55 (19) 3404-1600
Personal e-mail:	paulo.levy@engep.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding from Parties included in Annex I is to be involved in this CDM project (see Section A.4.5)

Annex 3

BASELINE INFORMATION

Baseline information is addressed in Section B.6.

Annex 4

MONITORING INFORMATION

Monitoring information is addressed on Section B.7.