Project design document form for CDM project activities

(Version 05.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)		
Title of the project activity	Terrestre Ambiental Landfill Gás Project	
Version number of the PDD	03	
Completion date of the PDD	05/05/2015	
Project participant(s)	Brazil	Terrestre Ambiental Ltda Econergy Brasil Ltda.
	Switzerland	CM Capital Markets Holding, S.A. Econergy Brasil Ltda.
Host Party	Brazil	
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	Sectoral Scope: 13 Methodology: ACM0001 – version 15.0.0	
Estimated amount of annual average GHG emission reductions	113,834	

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The Terrestre Ambiental Landfill Gas Project's (hereinafter TALGP) aim is to capture and flare the landfill gas produced at CGR – Centro de Gerenciamento de Resíduos (Waste Management Center) Piaçaguera to avoid emissions of methane gas to the atmosphere. This landfill (class II-A and II-B[1]) is owned by Terrestre Ambiental Ltda. and located in Santos, State of São Paulo, Brazil.

Terrestre Ambiental Ltda is a society between Terracom Construções Ltda. and Estre Ambiental S/A.

CGR Piaçaguera counts on the best management practices for such business. Modern engineering has been applied during design, leachate is collected and sent for treatment, and all the pertinent environmental variables are continuously monitored.

In the situation prior to the implementation of the project activity, the landfill gas was collected only through a passive system, with no systematic and monitored flaring. Therefore, an extra-incentive was made necessary for ESTRE in order to make additional investments and enhance its landfill gas collection rate and install appropriate facilities to properly flare the methane produced at the site.

Prior to the implementation of the project activity the scenario is the release of landfill gas to the atmosphere (with minor share of generated LFG being partially destroyed) through LFG passive venting system (combustion drains).

The baseline scenario is the same as the scenario existing prior to the implementation of the project activity.

The situation prior the implementation of the project activity in the second crediting period is the same as the situation in the first crediting period, according to registered PDD. Therefore, there is no change in the configuration of the project activity.

Landfill gas generation will be guaranteed throughout TALGP's lifetime from various strategic aspects CGR Piaçaguera enjoys:

- CGR Piaçaguera is located in Baixada Santista Region, in the coast of the State of São Paulo, formed by 9 municipalities, which, in most cases, do not have feasible areas where landfills could be developed because the region is surrounded by the Serra do Mar State Park, an APP – Área de Preservação Permanente (Permanent Preserved Area). In fact, all of those municipalities are both facing problems regarding their rubbish dumps/landfills capacity or environmental demands by the environmental agency in the state of São Paulo (CETESB), requiring dumps' areas to be recovered and obliging the authorities to find proper destination to the waste generated.

- CGR Piaçaguera receives waste from the two main cities of the region (Santos and Cubatão), among from the private companies located in the region. Considering these clients, CGR Piaçaguera receives around 2,400 tonnes of waste daily.

- Studies conducted by ESTRE show that landfill development and operation is only feasible for waste disposition rates of at least 500 tonnes of waste per day. And moreover, there are no potential feasible areas for landfill development in the region, as the Serra do Mar State

[1] Residues in Brazil are classified under standard NBR 10004, from ABNT, from November 2004. Class I residues are classified as hazardous or present one of the following characteristics: flammability, power of corrosion, reactive properties, toxicity and pathogenicity. Class II residues are classified as non-hazardous residues and divided into II-A Class – Non-Inerts, not classified as Class I residues nor Class II-B, might present the following characteristics: biodegradability, power of combustion or water solubility. Class II-B residues are inert, not presenting constitutants when solubilised in standard above the potable water.

Park is protected by legislation.

TALGP has a major positive impact towards sustainable development. Firstly, while it is reducing methane emissions that would enhance climate change, it is also minimizing the risk that any explosions happen in the site – even though ESTRE’s landfills count on the best engineering and design to avoid accidents. Second, at the time of project implementation this sort of initiative has been incipient in Brazil, which means technology transfer has been needed to be in place for project’s implementation and operation. Third, specialized operators are be needed for project operation, which means a positive impact in employment and capacity-building. For all of these facts, it can be clearly seen the project contributes towards sustainable development.

The estimate of emission reductions:

- Annual average is 113,834 tCO_2e;
- Total GHG emission reduction is 796,840 tCO_2e.

A.2. Location of project activity

A.2.1. Host Party

>>
Brazil

A.2.2. Region/State/Province etc.

>>
São Paulo

A.2.3. City/Town/Community etc.

>>
Santos

A.2.4. Physical/Geographical location

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CGR Piaçaguera is located in Morro das Neves neighbourhood, Domênico Rangoni Highway, SP-055, km 75, CEP: 11100-000, Santos (SP).

The geographical coordinates are:
(Latitude, 23º 53' 34.670" S, Longitude, 46º 18' 58.653" W) or (-23.885835°; -46.312335°).

The Figure 1 shows the location of Santos.

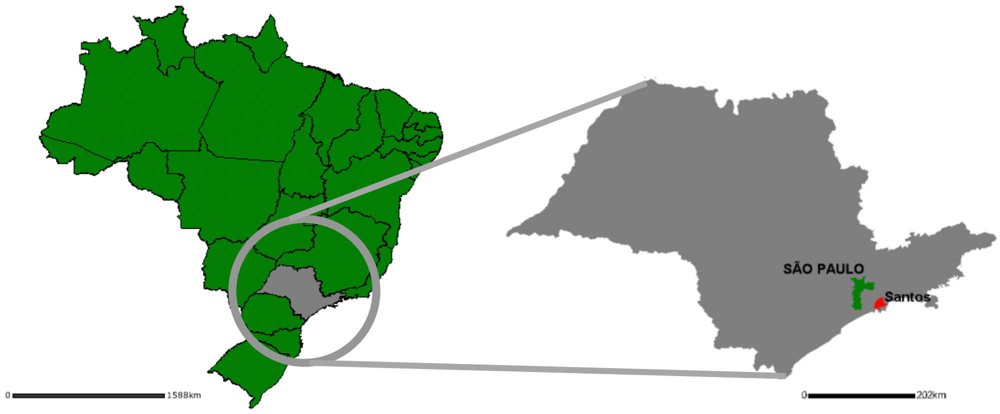

Figure 1. Santos location (Source: IBGE[2] and Google Earth)

Figure 2. Aerial view of CGR Piaçaguera
(Source: CGR Piaçaguera landfill)

A.3. Technologies and/or measures

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State of São Paulo environmental agency – CETESB – classifies the state's landfills according to technology used, management techniques and other criteria in its Landfill Quality Index (*IQR – Índice de Qualidade de Aterros de Resíduos*). CGR Piaçaguera landfill was qualified with an IQR of 9.2[3] (range 0 to 10).

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[2] Adapted from: http://mapas.ibge.gov.br , accessed on 07/10/2014

[3] According to "Domestic Solid Waste State Inventory - 2011" from the portuguese "*Inventário Estadual de Resíduos Sólidos Domiciliares - 2011*". Link: http://www.cetesb.sp.gov.br/userfiles/file/residuos-solidos/residuosSolidos2011.zip . Accessed on 07/10/2014.

The landfill operates under anaerobic conditions adopting the following conditions:

- Landfill surface every day covered;
- Mechanical compacting;
- Leveling of the waste.

In the proposed project activity, the used technology is the improvement of biogas collection and flare produced in the landfill, through the installation of an active recovery system composed for:

- Collection system;
- Biogas transport pipe system;
- Gas suction and flare system (located in the Biogas Station).

<u>Collection system</u>

The biogas collection infrastructure of landfill is based in vertical drains. The elements are connected to a collection pipe that accomplishes the transport of gas to control stations (manifolds), used to control the drains loss of load.

Figure 2 – Example of collection system (manifolds)
Source: CGR Piaçaguera

CGR Piaçaguera landfill is installing drains directly in the landfill. A covering layer is being installed around the drains to avoid the exhaust gases.

The top of the existing and new vertical drains are equipped with headstocks. This element is important because it makes the connection between the drain and pipe collection. The headstocks are made of HDPE or similar ø 200 mm to 1 m in length. In the body of the head, a derivation of HDPE or similar ø 50 to 200 mm is installed and attached to a butterfly valve which is connected to a hose ø 70 mm to 300 mm of HDPE or similar, which is finally connected to the tubing of collection.

Figure 3 - Example of collection system (well head)
Source: CGR Piaçaguera

The collection pipe is being built using HDPE or similar. The sizing of the piping was done considering the maximum production of landfill gas that can reach. Activities are intense welding tubing to connect each station of the adjustment. The pipe is covered with materials that do not pose any possibility of damage to the material.

Removers of condensate are provided to drain humidity from the LFG. These removers are constructed at points of lower elevation of the tubing and collection stations, located before the adjustment. The condensate removed is returned to the landfill, through pumps installed at the base of the removers.

All drains are connected to the adjustment of station located around the landfill, through the collection pipes. The basic functions of the stations promote the systematic control and monitoring of the characteristics of biogas extracted. Each station has an adjustment of additional condensate remover, valves and regulating valves-drawer.

Transport System

The transmission pipeline is the last step of the collecting system. It transports the collected LFG to the flare. The transmission pipeline might be connected to all gas regulation stations around the landfill.

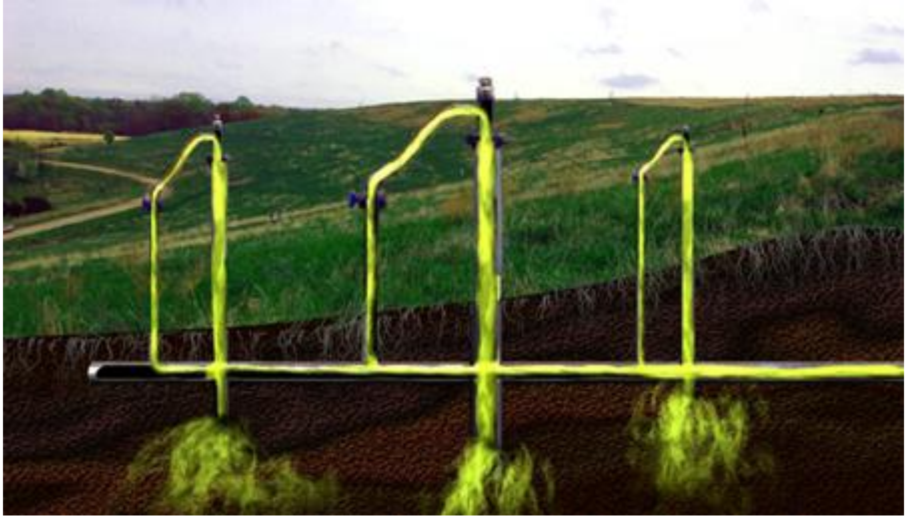

Figure 4 - Illustrative of transport system
Source: Landfill Methane Outreach Program - EPA

Blowering System

The blowering system is responsible to give negative pressure to the landfill, blowing the gas to the pipeline. The dimensioning of the blowers depends on flow of the landfill gas which may range around 2,500 Nm³/h per each blower and the installed capacity around 37 kW for each equipment.

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

Figure 5 - Example of blower system
Source: CGR Piaçaguera

Flare System

The destruction of the methane content in the LFG collected is made via enclosed flares, in order to assure higher methane destruction (enclosed flare).

The flare operational flow may range around 2,500 Nm³/h depending on the manufacturer and design that has been chosen in the purchasing moment. The standard combustion temperature is around 850º C and efficiency combustion around 99%.

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

Figure 6 - Detail of Enclosed Flare
Source: CGR Piaçaguera

<u>Biogas Station</u>

The collection of gas within the landfill is made by applying a pressure differential in each drain. The depressurization system shall be composed of a group of centrifugal multi-stage blowers, connected in parallel with the central collector. The depressurization of the system depends on the pressure of operation of flares. In addition, the biogas station has the following:

- Safety valve on/off;
- Remover of condensate;
- Gas analyzer;
- Meter flow.

The biogas station has, even a system of destruction of methane through flares. For the second crediting period, this system is composed initially by 2 enclosure flares and can get others units, according to the generation of gas. The flare is constructed in a vertical cylindrical combustion chamber, where the biogas is flared at a constant temperature, controlled by the admission of air, and with a minimum residence time.

Details on the main technology and the flare unit are described below:

Flare 1	Manufacturer	Biotecnogás (BTG)
	Model	2500 HT
	Serial number	091/06
	Year of manufacturing	2007
	Nominal gas flow	2500 Nm³/h

	Minimum retention time	greater than 0.3 sec
	Oxygen in the exhaust gas	greater than 3%
	Minimum methane content	30% of CH_4
	Minimum efficiency	97%
	Lowest operation temperature	850ºC
	Maximum operation temperature	1200 ºC
Flare 2	Manufacturer	Biotecnogás (BTG)
	Model	2500 HT
	Serial number	019/09
	Year of manufacturing	2009
	Nominal gas flow	2500 Nm³/h
	Minimum retention time	greater than 0.3 sec
	Oxygen in the exhaust gas	greater than 3%
	Minimum methane content	30% of CH_4
	Minimum efficiency	97%
	Lowest operation temperature	850ºC
	Maximum operation temperature	1200 ºC
Blower 1	Year	2007
	Commissioning date	01/02/2008
	Model	051A.03
	Serial number	07510023
	Maximum capacity	2,500 Nm³/h
	Manufacturer	Continental Industrie
	Motor Capacity	37kW
Blower 2	Year	2007
	Commissioning date	01/02/2008
	Model	051A.03
	Serial number	07510024
	Maximum capacity	2,500 Nm³/h
	Manufacturer	Continental Industrie
	Motor Capacity	37kW

Table 1 –Technical details of equipment installed at TALGP

The system has installed one backup diesel generator, to supply electricity for the project in case of power shortage. The specification of this equipment is presented in the table below:

Engine Manufacturer: WEG Engine Model: GTA Serial Number: CAT 0260311307 Capacity: 260 kVA Year: 2007 Commissioning date: 01/02/2008

Table 2 -– Diesel generator specifications

The monitoring equipment and their location in the systems along with the balance of the system are presented below:

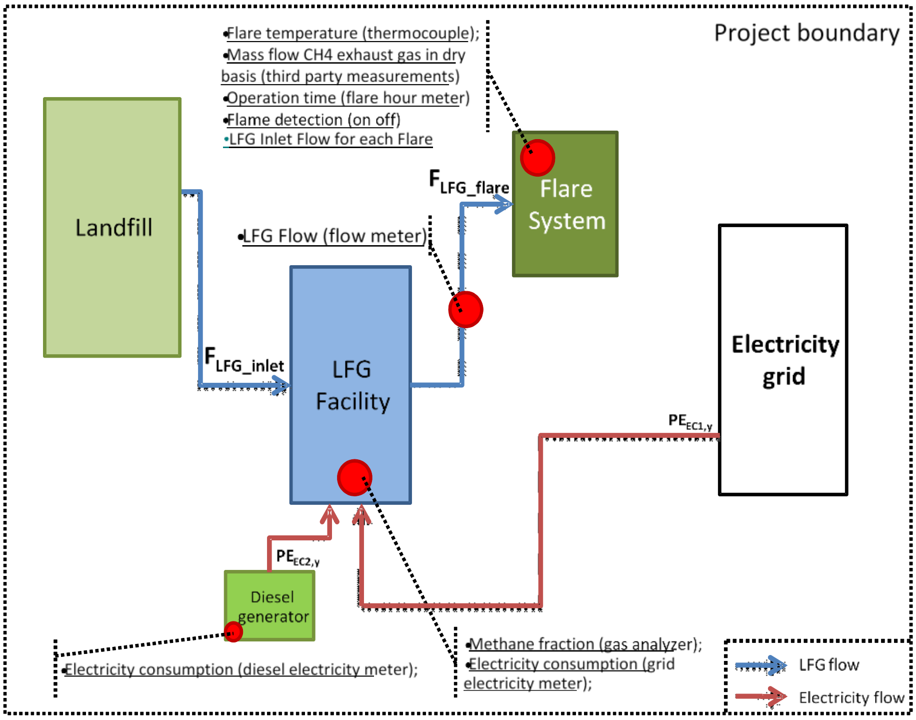

Figure 7 - Technologies and measures

Defined as:

F_{LFG_inlet}	Inlet LFG in the project activity
F_{LFG_flare}	LFG which is destroyed by flaring

Where:

$$\mathbf{F_{LFG\_inlet} = F_{LFG\_flare}}$$

And,

$PE_{EC1,y}$	Electricity consumption from the grid
$PE_{EC2,y}$	Electricity consumption from the diesel generators

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

The project activity scenario is the landfill operating with the following characteristics[4]:

- Landfill area: 2,536,189 m^2;
- The disposal waste is type Class II-A and Class II-B[5];

[4] The information was based on the internal studies provided by CGR Piaçaguera and it will be made available to the DOE in the revalidation visit.

[5] The waste classification is different from the one defined in the first crediting period registered PDD, referred to ABNT NBR 10004:1987. Even, receiving the same waste type, the waste classification for the second crediting period has changed to be in accordance with the Brazilian standard ABNT NBR 10004:2004. Source: http://www.aslaa.com.br/legislacoes/NBR%20n%2010004-2004.pdf Accessed on, 08/10/2014.

- The landfill lifetime is 13 years (from 2003 to 2015)[6];
- Waterproofing with geomembrane and drainage of leachate;
- Leachate is collected through designed grid system and treated in wastewater treatment plant;
- Drains venting the LFG through passive LFG capture system.

The only drains in operation under the baseline scenario are the vertical drains which vent (release to the atmosphere) the LFG through passive LFG capture system. According to the ACM0001 – version 15.0 (page 19), the baseline efficiency of the LFG capture system in the baseline is 20% (since there is no requirement specifying the amount or percentage of LFG that should be destroyed). For active capture system, these existing vertical drains has been converted into appropriate LFG collecting wells by reducing the drain diameter and increasing the LFG flow and capture efficiency in order to make possible the connection of such wells to the project's forced LFG collection pipeline network, according to described above.

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)*	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Terrestre Ambiental Ltda (private entity)	No
	Econergy Brasil Ltda (private entity)	No
Switzerland	Econergy Brasil Ltda (private entity)	No
	CM Capital Markets Holding, S.A. (private entity)	No

*The table above was filled out according to UNFCCC's website (http://cdm.unfccc.int/Projects/DB/DNV-CUK1179391286.32/view).

CGR Piaçaguera belongs 40% to Estre Ambiental S/A[7], which is one of the largest companies of waste management in South America and 40% to Terracom Construções Ltda, a company active in civil works and waste collection sectors.

A.5. Public funding of project activity

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There is no public funding involved in the project activity.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

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- ACM0001: "Flaring or use of landfill gas" (Version 15.0.0);

[6] Despite the landfill lifetime is 13 years (from 2003 to 2015), the project activity lifetime is 21 years, composed by the first crediting period from 06/05/08 to 05/05/15, the second crediting period from 06/05/2015 to 05/05/2022 and the third crediting period from 06/05/2022 to 05/05/2029. The currently operational licenses are valid until 2017, however the landfill operational lifetime can be postponed due to area extension works.

[7] Estre's website www.estre.com.br/

- Combined tool to identify the baseline scenario and demonstrate additionality (Version 05.0.0);
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (Version 02);
- Emissions from solid waste disposal sites (Version 06.0.1);
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01);
- Project emissions from flaring (Version 02.0.0);
- Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 02.0.0);
- Tool to determine the baseline efficiency of thermal or electric energy generation systems (Version 01);
- Tool to determine the remaining lifetime of equipment (Version 01);
- Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (Version 03.0.1);
- Project and leakage emissions from transportation of freight (Version 01.1.0);
- Tool to calculate the emission factor for an electricity system (Version 04.0).

B.2. Applicability of methodology and standardized baseline

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Applicability conditions as per methodology	**Project activity meets the eligibility criteria as follows**
ACM0001: "Flaring or use of landfill gas" (Version 15.0.0)	
Install a new LFG capture system in a new or existing SWDS; or 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 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.	<u>**Applicable**</u> The methodology is applicable because it was made an investment into an existing LFG capture system to increase the recovery rate (collection efficiency). The captured LFG was only vented and partially flared (no systematic/monitored flaring) in combustion drains and not used prior to the implementation of the project activity. In order to evidence the statement above, project participant internal documents such as the original Environmental Impact Assessment (EIA), pictures of the original drains of the landfill have been made available to the DOE to show the situation before the implementation of the project plant. Likewise, landfill gas plant pictures have also been made available to the DOE in order to clarify the situation after the implementation of the project activity.
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) or glass melting furnace; and/or	<u>**Applicable**</u> The project activity consists in an active landfill gas collection and LFG flaring system. There is no other use of the landfill gas in the project activity such as heat generation in boilers, etc. In order to evidence the statement above, the technical memory of the landfill gas plant project, indicating the components involved in

iii) Supplying the LFG to consumers through a natural gas distribution network.	the landfill gas plant have been made available to the DOE.
Do not reduce the amount of organic waste that would be recycled in the absence of the project activity.	**Applicable** There was no recycling of organic waste in the absence of the project activity nor in the project activity. In order to evidence the statement above, the project participant issued an internal declaration, made available to the DOE, emphasizing that no organic waste recycling of the waste amount that will be disposed in the landfill has been carried out in the past and likewise will not be carried out in the future. Also, an overview of the solid waste management in brazil at the national and regional level has been presented in item 4 of Appendix 4 of the PDD. It states that the share of organic waste which is recycled is negligible.
Most plausible baseline scenario is: a) 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 heater, glass melting furnace 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 equipment located within the project boundary.	**Applicable** As demonstrated in section B.4 of this PDD, the methodology is applicable because: • The most plausible baseline scenario is release of the LFG to atmosphere from the SWDS (with minor share of generated LFG being partially destroyed) through LFG passive venting system - combustion drains. In order to evidence the statement above, the original Environmental Impact Assessment (EIA) declaring that the organic waste anaerobic degradation generates LFG and the same is extracted from the landfill, jointly with pictures of the original drains evidencing the release of the LFG to atmosphere from the SWDS (with minor share of generated LFG being partially destroyed in a not systematic and/or continuous way) have been made available to DOE.
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 or glass melting furnace, where the purpose of the CDM project activity is to implement energy efficiency measures at kiln or glass melting furnace;	**Applicable** There is neither a combination with other approved methodologies nor change in management of the landfill due to the project activity (e.g. addition of liquids, pre-treating waste or changing the shape of the landfill to increase the methane generation). In order to evidence the statement above, the ACM0001 version 15 is the only methodology used in this project. Project participant has also issued an internal declaration, made available

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.	to the DOE, affirming that there has not been and will not be any change in the waste management in order to increase methane generation when compared to the situation prior to the implementation of the project activity.

Combined tool to identify the baseline scenario and demonstrate additionality (Version 05.0.0)

Applicable to the project activity where all potential alternatives scenarios to the proposed project activity available to project participants cannot be implemented in parallel to the proposed project activity.

For example, in the following situations a methodology could refer to this tool:

- For an energy efficiency CDM project where the identified potential alternative scenarios are: (a) retrofit of an existing equipment, or (b) replacement of the existing equipment by new equipment, or (c) the continued use of the existing equipment without any retrofits;
- For a CDM project activity related to the destruction of a greenhouse gas in one site where the identified potential alternative scenarios are: (a) installation of a thermal destruction unit, or (b) installation of a catalytic destruction system, or (c) no abatement of the greenhouse gas.

The project activity encompasses the destruction of a greenhouse gas in one site where one of the identified potential alternative scenarios is no abatement of the greenhouse gas.

In order to evidence the statement above, the Step 1 of the "Combined tool to identify the baseline scenario and demonstrate additionality" presented in section B.4, demonstrates that all alternative scenarios identified are realistic and credible to the project activity.

Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (Version 02)

Not Applicable to the project activity since electricity consumption from the diesel generators (electricity consumption from an off-grid fossil fuel fired captive power plant) is covered by the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

Emissions from solid waste disposal sites (Version 06.0.1)

Applicable to the project activity because the CDM project activity mitigates methane emissions from a specific existing SWDS (Application A).

In order to evidence the statement above, the technical project description issued by BIOTECNOGAS (flare manufacturer and company which has been responsible for assembly and testing of the equipment at the landfill site) including description of LFG emissions mitigation equipment (Flares) has been made available to the DOE.

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

Applicable to the project activity following one out of the three scenarios below applied to the sources of electricity consumption:

- **Scenario A: Electricity consumption from the grid.** The electricity is purchased from the grid only. Either no captive power plant is installed at the site of electricity consumption or, if any on-site captive power plant exits, it is not operating or it can physically not provide electricity to the source of electricity consumption;

- **Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s).** One or more fossil fuel fired captive power plants are installed at the site of the electricity consumption source and supply the source with electricity. The captive power plant(s) is/are not connected to the electricity grid;
- **Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s).** One or more fossil fuel fired captive power plants operate at the site of the electricity consumption source. The captive power plant(s) can provide electricity to the electricity consumption source. The captive power plant(s) is/are also connected to the electricity grid.

In order to evidence the application of Scenario A statement above, the technical memory of the landfill gas plant project, indicating the components involved in the landfill gas plant have been made available to the DOE.

In order to evidence the application of Scenario B statement above, the memory of the landfill gas plant project indicating specifications which refers to the diesel generators (to generate electricity occasionally) has been made available to the DOE. Additionally this scenario will be confirmed during site visit by the DOE.

Project emissions from flaring (Version 02.0.0)

Applicable since the project activity uses enclosed flares and project participant documents the same in the PDD including the type of flare used in the project activity. Tool is applicable to the flaring of flammable greenhouse gases where:

- Methane is the component with the highest concentration in the flammable residual gas; and
- The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).
- The flares used in the project site operate according to the specifications provided by the manufacturer.

In order to evidence the statement above, project participant has made available to the DOE a daily supervisory report containing data registered from LFG analysis from the first crediting period evidencing that methane is the component with the highest concentration in the flammable residual gas. Also, the original Environmental Impact Assessment (EIA) declares that the waste anaerobic degradation generates LFG. The technical memory of the landfill gas plant project, indicating the components involved in the landfill gas plant (for the case of the project activity, amongst others enclosed flares) and its respective specifications have also been made available to the DOE.

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

Applicable to the project activity because the applicable methodology (ACM0001 version 15) demands measuring flow and composition of residual and exhaust gases for the determination of baseline and project emissions.

In order to evidence the statement above, the technical memory of the landfill gas plant project, issued by BIOTECNOGAS (flare manufacturer and company which has been responsible for assembly and testing of the equipment at the landfill site) which indicates a total flow metering system and residual gas analysis system involved in the landfill gas plant has been made available to the DOE. Besides, flare efficiency analysis data report indicating that the composition of the exhaust gas is measured has also been made available to the DOE.

Tool to determine the baseline efficiency of thermal or electric energy generation systems (Version 01)

Not applicable to the project activity since there is no thermal or electric energy generation in the baseline scenario. Also, the project activity does not involve the improvement of the energy efficiency through retrofits or replacement of the existing system by a new system.
Tool to determine the remaining lifetime of equipment (Version 01) **Not applicable** since the project activity do not involve the replacement of existing equipment with new equipment or retrofit of existing equipment as part of energy efficiency improvement activities.
Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (Version 03.0.1) **Applicable** to the project activity since it is required to assess the continued validity of the baseline at the renewal of a crediting period.
Project and leakage emissions from transportation of freight (Version 01.1.0) **Not applicable** since the project activity do not involve the transportation of freight.
Tool to calculate the emission factor for an electricity system (Version 04.0) **Applicable** since the project activity demands electricity that is provided by the grid. This tool is also referred to in the “Tool to calculate project emissions from electricity consumption” for the purpose of calculating project and leakage emissions in case where a project activity consumes electricity from the grid or results in increase of consumption of electricity from the grid outside the project boundary. In order to evidence the statement above, a daily supervisory report containing data registered from LFG plant electricity consumption showing that the electricity is provided by the grid has been made available to the DOE.

B.3. Project boundary

The project boundary is limited to the area occupied by the CGR Piaçaguera landfill including:

(a) Sites where the LFG is flared or used (e.g. flare, power plant, boiler, air heater, glass melting furnace, kiln, natural gas distribution network or biogas processing facility);

(b) Captive power plant(s) (including emergency diesel generators) or power generation sources connected to the grid, which are supplying electricity to the project activity;

The table below summarizes the sources of gases included within the project boundary:

Source		GHGs	Included?	Justification/Explanation
Baseline	Emissions from decomposition of waste at the SWDS site	CH_4	Yes	The major source of emissions in the baseline.
		N2O	No	N_2O emissions are small compared to CH_4 emissions from SWDS. This is conservative.
		CO_2	No	CO_2 emissions from 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	There is no electricity generation
		CH_4	No	There is no electricity generation
		N_2O	No	There is no electricity generation
	Emissions from heat generation	CO_2	No	There is no heat generation.
		CH_4	No	There is no heat generation.
		N_2O	No	There is no heat generation.
	Emissions from the use of natural gas	CO_2	No	There is no use of natural gas.
		CH_4	No	There is no use of natural gas.
		N_2O	No	There is no use of natural gas.
Project activity	Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO_2	No	There is no fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity
		CH_4	No	There is no fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity
		N_2O	No	There is no fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity
	Emissions from electricity consumption due to the project activity	CO_2	Yes	It is an important emission source.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from flaring	CO_2	No	Emissions are considered negligible
		CH_4	Yes	It is an important emission source.
		N_2O	No	Emissions are considered negligible
	Emissions from distribution of LFG using trucks	CO_2	No	There is no distribution of LFG using trucks
		CH_4	No	There is no distribution of LFG using trucks
		N_2O	No	There is no distribution of LFG using trucks

The flow diagram is presented below:

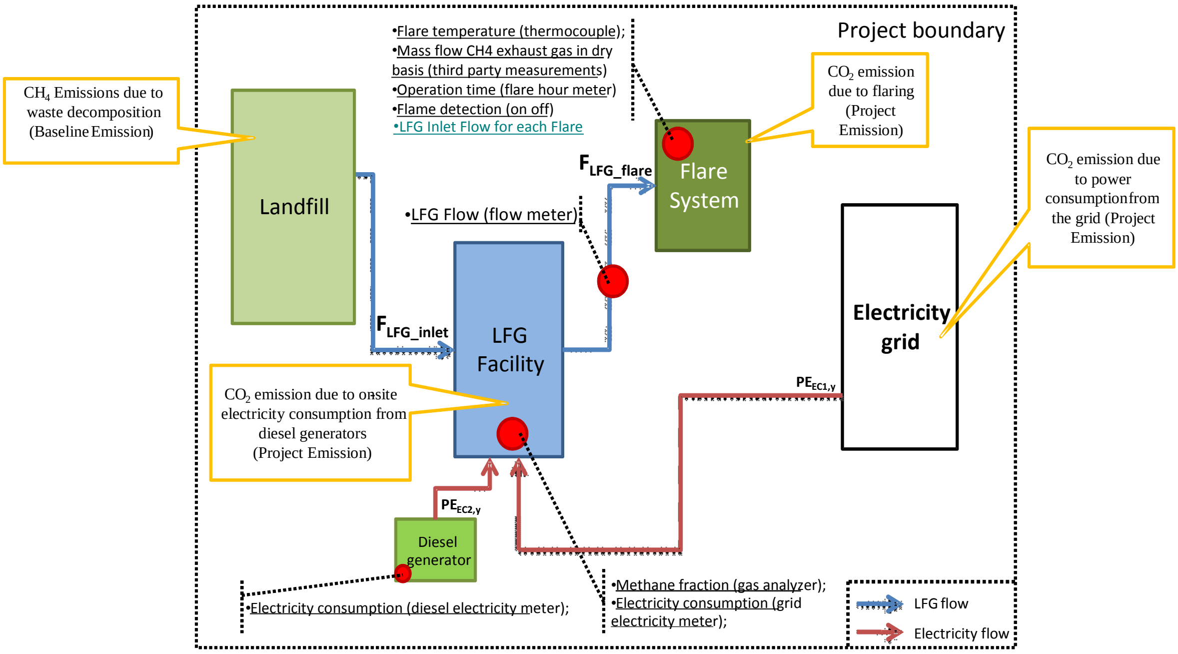

Figure 8 – Flow diagram project boundary

The electricity grid mentioned above is the Brazilian Interconnected Power System.

B.4. Establishment and description of baseline scenario

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The methodological tool “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” version 03.0.1, has been used to assess the continued validity of the baseline considering the renewal of the crediting period.

The stepwise procedure of the “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period are as follows:

Step 1: Assess the validity of the current baseline for the next crediting period

In order to assess the continued validity of the baseline, changes in the relevant national and/or sectorial regulations between two crediting periods has to be examined at the renewal of the crediting period. If at the start of the project activity, the project activity was not mandated by regulations, but at the time of renewal of the crediting period regulations are in place that enforce the practice or norms or technologies that are used by the project activity, the new regulation (formulated after the registration of the project activity) has to be examined to determine if it applies to existing project or not.

The baseline scenario does not have to be updated for the second crediting period as no new regulations requiring capture and combustion or use of LFG are in place.

The “CDM Project Cycle Procedure - version 07.0” approved by the CDM Executive Board require assessing the impact of new relevant national and/or sectorial policies and circumstances on the baseline.

The validity of the current baseline is assessed using the following Sub-steps:

Step 1.1: **Assess compliance of the current baseline with relevant mandatory national and/or sectorial policies**

At the start of the first crediting period of Terrestre Ambiental Landfill Gas Project in 2008[8], the Brazilian legislation did not require landfills to capture and/or flare and/or use the LFG. After the registration of the project activity in 06/05/2008, the project participant in order to assess if the current baseline complies with all relevant mandatory national and/or sectorial policies which have come into effect after the submission of the project activity for validation has verified that the current baseline complies with all applicable laws and regulations. Brazil's New National Solid Waste Policy (NSWP)[9], ratified by the President on 02/08/2010 after 19 years under discussion does not request the capture, flaring or use of LFG and there is no forecast to approve any regulation or policy in the next years for such a requirement.

In addition, in Appendix 4, item "4 - Overview of the solid waste management in brazil at the national and regional level" was made an evaluation about the waste treatment in national and regional levels and there is no obligation to capture and/or use LFG in landfills in Brazil.

Step 1.2: Assess the impact of circumstances

There is no impact of circumstances existing at the time of requesting renewal of the crediting period on the current baseline emissions.

Step 1.3: Assess whether the continuation of the use of current baseline equipment(s) is technically possible

This sub-step is not applicable since the baseline scenario of the project activity is the business as usual (BAU) scenario (passive venting system).

Step 1.4: Assessment of the validity of the data and parameters

Considering the applied methodology at the project activity registration ACM0001 version 5 has changed to consolidated methodology ACM0001 version 15 and all related applicable tools some ex-ante parameters published by IPCC have been updated accordingly.

According to the "Tool to assess the validity of the original/current baseline and to update the baseline at the renewal of a crediting period", where any data and parameter used and not monitored during the crediting period are not valid anymore they should be updated following the Step 2 as follows:

Step 2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

The baseline emissions for the second crediting period have been updated, without reassessing the baseline scenario, based on the latest approved version of the methodology ACM0001.

This update was applied in the context of the sectorial policies and circumstances that are applicable at the time of requesting for renewal of the crediting period, which has not changed as to affect the project. More details for the updated baseline emissions for the second crediting period can be seen in section B.6.

Step 2.2: Update the data and parameters

All parameters regarding the grid emission factor calculation have been updated for the 2nd crediting period (GWP_{CH4} updated and $EF_{grid,CM,}$y, $EF_{grid,OM,y}$ are ex-post monitored and $EF_{grid,BM,y}$ defined ex-

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[8] UNFCCC´s website: Project 1133 : Terrestre Ambiental Landfill Gás Project (TALGP): http://cdm.unfccc.int/Projects/DB/DNV-CUK1179391286.32/view

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

ante using the 2013 published value by Brazilian DNA). Further information can be seen in section B.6.
The baseline scenario for the project activity is identified using step 1 of the 'Combined tool to identify the baseline scenario and demonstrate additionality", as agreed in ACM0001 "Flaring or use of landfill gas".

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

STEP 0: Demonstration that a proposed project activity is the First-of-its-kind.

This step is not applied because the proposed project activity is not the First-of-its-kind.

Outcome of Step 0: The proposed project activity is not the First-of-its-kind.

Step 1: Identification of alternative scenarios

This Step serves to identify all alternative scenarios to the proposed CDM project activity(s) which can be the baseline scenario.

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

Step 1a: Define alternative scenarios to the proposed CDM project activity

The identified alternatives for the destruction of LFG in the absence of the project activity are:

LFG1	The project activity implemented without being registered as a CDM project activity (capture and flaring or use of LFG).
LFG2	Release of the LFG to the atmosphere.

In the EIA (Environmental Impact Assessment) there is no reference to any waste treatment activity such as: recycling, treatment or incineration of organic waste. Then, the alternatives LFG3, LFG4 and LFG5 mentioned in the applied methodology should not be considered.

Thus, the remaining real alternatives for the destruction of LFG are LFG1, LFG2.

The combinations of the project activity compose the following scenarios:

Scenarios		Comments
1	LFG1	Possible
2	LFG2	Possible

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

- Scenario 1 (LFG1);
- Scenario 2 (LFG2);

Step 1b: Consistency with mandatory applicable laws and regulations

All alternative scenarios identified in Step *1a* comply with all applicable laws and regulations. Brazil's New National Solid Waste Policy (NSWP),[10] ratified by the President on 02/08/2010 after 19 years under discussion. The NSWP does not request the LFG capture and/or flare and there is not forecast to approve any regulation or policy in the next years with this requirement.

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

The scenario 2 which is a continuation of the current situation of the landfill (baseline scenario) represents the business as usual practice for the project site as well as for most of the landfills in Brazil.

The project participant has monitored all relevant policies and circumstances at the beginning of the second crediting period and updated the baseline, without reassessing the baseline scenario, based on the latest approved version of the methodology ACM0001. In addition, in Appendix 4, item "4 - Overview of the solid waste management in brazil at the national and regional level" was made an evaluation about the waste treatment in national and regional levels and there is no obligation to capture and/or flare and/or use LFG in landfills in Brazil.

Outcome of Step 1b: Two realistic and credible alternative scenarios to the project activity are in compliance with mandatory legislation and regulations. The alternative scenarios remain the same:

- Scenario 1 (LFG1);
- Scenario 2 (LFG2);

B.5. Demonstration of additionality

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The demonstration of additionality is not applicable for the renewal of the crediting period of a registered CDM project activity. The whole assessment and demonstration of additionality for the given registered CDM project activity is included in the latest version of the PDD valid for the 1st 7-year renewable crediting period.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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Baseline emission calculation

The baseline emission was calculated according to the following formula:

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}$$

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2e/yr)
$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (t CO_2e/yr)
$BE_{EC,y}$	=	Baseline emissions associated with electricity generation in year *y* (t CO_2/yr)
$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year *y* (t CO_2/yr)
$BE_{NG,y}$	=	Baseline emissions associated with natural gas use in year *y* (t CO_2/yr)

As the project only flares LFG, the $BE_{HG,y} = 0$ and $BE_{NG,y} = 0$ and $BE_{EC,y} = 0$.

Therefore, $BE_y = BE_{CH4,y}$

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

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

Where:

$BE_{CH4,y}$	=	Baseline emissions of LFG from the SWDS in year *y* (t CO_2e/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)
$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)

$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year *y* (t CH_4/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

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

During the crediting period, the $\mathbf{F_{CH4,PJ,y}}$ will be determined as follows:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y}$$

Where:

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year y (tCH_4/yr)
$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year y (t CH_4/yr)
$F_{CH4,EL,y}$	=	Amount of methane in the LFG which is used for electricity generation in year y (t CH_4/yr)
$F_{CH4,HG,y}$		Amount of methane in the LFG which is used for heat generation in year y (t CH_4/yr)
$F_{CH4,NG,y}$	=	Amount of methane in the LFG which is sent to the natural gas distribution network in year y (t CH_4/yr)

As the project only flares LFG, the $F_{CH4,HG,y}$ = *0 and* $F_{CH4,NG,y}$ = *0 and $F_{CH4,EL,y}$= 0.*Thus, the equation is:

$$F_{CH4,PJ,y} = F_{CH4,flared,y}$$

The amount of methane destroyed by flaring ($F_{CH4,flared,y}$) will be determined as follows:

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

Where:

$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year y (t CH_4/yr)
$F_{CH4,sent\_flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year y (t CH_4/yr)
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year y (t CO_2e/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

$F_{CH4,sent\_flare,y}$ will be determined directly using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, applying the requirements described below. The tool shall be applied to the gaseous stream flowing in the LFG delivery pipeline to the flare(s).

According to “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” the following options will be considered for the present project activity:

- Option A (Volume flow in dry basis and volumetric fraction in dry basis) when the temperature of the gaseous stream is less than 60°C (333.15 K) at the flow measurement point

  And

- Option B (Volume flow in wet basis and volumetric fraction in dry basis) when the temperature of the gaseous stream is higher than 60°C (333.15 K) at the flow measurement point.

Option A

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. The demonstration will be made as following:

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

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

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

With

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t}$$

Where:
$F_{i,t}$ = Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas/h)
$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m^3 dry gas/h)
$v_{i,t,db}$ = 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)
$\rho_{i,t}$ = 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)
R_u = Universal ideal gases constant (8,314 Pa.m^3/kmol.K)
T_t = Temperature of the gaseous stream in time interval *t* (K)

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 option B should be applied instead.

Option B

The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using equations used to Option A. The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis as follows:

$$V_{t,tb} = V_{t,wb}/(1 + v_{H2O,t,db})$$

Where:
$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m^3 dry gas/h)
$V_{t,wb}$ = Volumetric flow of the gaseous stream in time interval *t* on a wet basis (m^3 wet gas/h)
$v_{H2O,t,db}$ = Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m^3 H_2O/m^3 dry gas)

The volumetric fraction of H_2O in time interval *t* on a dry basis ($v_{H2O,t,db}$) is estimated according to following equation.

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

Where:

$v_{H2O,t,db}$ = Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m^3 H_2O/m^3 dry gas)

$m_{H2O,t,db}$ = Absolute humidity in the gaseous stream in time interval *t* on a dry basis (kg H_2O/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 H_2O (kg H_2O/kmol H_2O)

The absolute humidity of the gaseous stream (mH_2O,t,db) will be determined using Option 2 (simplified calculation without measurement of the moisture content):

Option 2: Simplified calculation without measurement of the moisture content

This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation[11].

If it is conservative to assume that the gaseous stream is dry, then $m_{H2O,t,db}$ is assumed to equal 0. If it is conservative to assume that the gaseous stream is saturated, then mH2O,t,db is assumed to equal the saturation absolute humidity ($m_{H2O,t,db,sat}$) and calculated using equation.

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

Where:

$m_{H2O,t,db,sat}$ = Saturation absolute humidity in time interval *t* on a dry basis (kg H_2O/kg dry gas)

$p_{H20,t,Sat}$ = Saturation pressure of H_2O at temperature Tt in time interval t (Pa)

T_t = Temperature of the gaseous stream in time interval *t* (K)

P_t = Absolute pressure of the gaseous stream in time interval *t* (Pa)

MM_{H2O} = Molecular mass of H_2O (kg H_2O/kmol H_2O)

$MM_{t,db}$ = Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas)

Parameter $MM_{t,db}$ is estimated using the following equation.

$$MM_{t,db} = \sum_k (v_{k,t,db} * MM_k)$$

Where:

$MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)

$v_{k,t,db}$ = Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis (m^3 gas k/m^3 dry gas)

MM_k = Molecular mass of gas *k* (kg/kmol)

k = All gases, except H_2O, contained in the gaseous stream (e.g. N_2 and CH_4,). See available simplification below

The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (*k*) in the gaseous stream. However as a simplification, in the case of the project activity, the volumetric fraction of the methane that is a greenhouse gas and considered in the emission reduction calculation in the underlying methodology must be monitored and the

[11] An assumption that the gaseous stream is saturated is conservative for the situation that the mass flow of greenhouse gas *i* is underestimated (applicable for calculating baseline emissions). Conversely, an assumption that the gas stream is dry is conservative for the situation that the greenhouse gas *i* is overestimated (applicable for calculating project emissions).

difference to 100% may be considered as pure nitrogen. The simplification is not acceptable if it is differently specified in the underlying methodology.

$PE_{flare,y}$ shall be determined using the methodological tool "Project emissions from flaring – version 02.0.0". If LFG is flared through more than one flare, then $PE_{flare,y}$ is the sum of the emissions for each flare determined separately.

Enclosed flare(s) have been installed in the project activity to increase the destruction efficiency. Those flares reach 99% (minimum)[12] of methane destruction efficiency.

To determine the project emissions from flaring gases was used the "Project emissions from flaring – version 02.0.0". The project emissions calculation procedure is given in the following steps:

STEP 1: Determination of the methane mass flow of the residual gas;
STEP 2: Determination of the flare efficiency;
STEP 3: Calculation of project emissions from flaring.

Step 1: Determination of the methane mass flow in the residual gas

The "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" shall be used to determine the following parameter:

Parameter	SI Unit	Description
$F_{CH4,m}$	kg	Mass flow of methane in the residual gaseous stream in the minute m

The following requirements apply:

- The gaseous stream tool shall be applied to the residual gas;
- The flow of the gaseous stream shall be measured continuously;
- CH4 is the greenhouse gas i for which the mass flow should be determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool); and
- The time interval t for which mass flow should be calculated is every minute m

$F_{CH4,m}$, which is measured as the mass flow during minute m, shall then be used to determine the mass of methane in kilograms fed to the flare in minute m ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis.

Step 2: Determination of flare efficiency

Enclosed flare
In the case of enclosed flares, project participants may choose between the following two options to determine the flare efficiency for minute *m* ($n_{flare,m}$).

Option A: Apply a default value for flare efficiency

Option B: Measure the flare efficiency.

The project participant has chosen Option B.

For enclosed flares that are defined as low height flares[13], which is the case of the project activity, the flare efficiency in the minute m ($n_{flare,m}$) shall be adjusted, as a conservative approach, by

[12] The document about the specification of the flare efficiencies has been provided to DOE.

[13] The flare executive project provided by the LFG plant manufacturer and made available to the DOE indicates:

subtracting 0.1 from the efficiency as determined in Option B. For example, the default value applied should be 80%, rather than 90%, and if for example the measured value was 99%, then the value to be used shall correspond to 89%.

Option A: Default value

The flare efficiency for the minute *m* ($n_{flare,m}$) is 90% when the following two conditions are met to demonstrate that the flare is operating:

(1) The temperature of the flare ($T_{EG.m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute *m*; and

(2) The flame is detected in minute *m* ($Flame_m$).

Option B: Measured flare efficiency

The flare efficiency in the minute *m* is a measured value ($n_{flare,m} = n_{flare,calc,m}$) when the following three conditions are met to demonstrate that the flare is operating:

(1) The temperature of the flare ($T_{EG.m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute *m*;

(2) The flame is detected in minute *m* ($Flame_m$); and

Otherwise $n_{flare,m}$ is 0%.

In applying Option B, the project participants may choose to determine $n_{flare,calc,m}$ using either Option B.1 or Option B.2. Under Option B.1 the measurement is conducted by an accredited entity on a biannual basis and under Option B.2 the flare efficiency is measured in each minute. For the case of the project activity, the option B.1 has been chosen.

Option B.1: Biannual measurement of the flare efficiency

The calculated flare efficiency $\eta_{flare,calc,m}$ is determined as the average of two measurements of the flare efficiency made in year *y* ($\eta_{flare,calc,y}$), as follows:

$$\eta_{flare,calc,y} = 1 - \frac{1}{2}\sum_{t=1}^{2}\left(\frac{F_{CH4,EG,t}}{F_{CH4,RG,t}}\right)$$

Where:

$\eta_{flare,calc,y}$	=	Flare efficiency in the year y
$F_{CH4,EG,t}$	=	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period t (kg)
$F_{CH4,RG,t}$	=	Mass flow of methane in the residual gas on a dry basis at reference conditions in the time period t (kg)
t		The two time periods in year y during which the flare efficiency is measured, each a minimum of one hour and separated by at least six months

$F_{CH4,EG,t}$ is measured according to an appropriate national or international standard. $F_{CH4,RG,t}$ is calculated according to Step 1, and consists of the sum of methane flow in the minutes *m* that make up the time period *t*.

- (A) Flame enclosure height: 7.7 m;
- (B) Flame enclosure diameter: 1.9 m.

Thus, this is an enclosed flare for which the flame enclosure has a height between 10 and two times the diameter of the enclosure. (A)/(B) = 4.05

Step 3: Calculation of project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions for each minute *m* in year *y*, based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

$$PE_{flare\,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times \left(1 - \eta_{flare\,m}\right) \times 10^{-3}$$

Where:

$PE_{flare,y}$	=	Project emissions from flaring of the residual gas in year *y* (tCO_2e)
GWP_{CH4}	=	Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)
$F_{CH4,RG,m}$	=	Mass flow of methane in the residual gas in the minute *m* (kg)
$\eta_{flare,m}$	=	Flare efficiency in minute m

Table 3 – Parameters[14] used in the Tool "Project emissions from flaring"

Parameter	Description	Value	Unit
P_{ref}	Atmospheric pressure at reference conditions	101,325	Pa
R_u	Universal ideal gas constant	0.008314472	$Pa.m^3/kmol.K$
T_{ref}	Temperature at reference conditions	273.15	K
$v_{O2,air}$	O_2 volumetric fraction of air	0.21	-
GWP_{CH4}	Global warming potential of methane valid for the commitment period	25[15]	tCO_2/tCH_4
$\rho_{CH4,n}$	Density of methane at reference conditions	0.716	kg/m^3
$NA_{i,j}$	Number of atoms of element j in component i, depending on molecular structure	Not default defined	-
VM_{ref}	Volume of one mole of any ideal gas at reference temperature and pressure	22.4	$m^3/kmol$
AM_c	Atomic mass of carbon	12.00	kg/kmol
AM_h	Atomic mass of hydrogen	1.01	kg/kmol
AM_o	Atomic mass of oxygen	16.00	kg/kmol
AM_n	Atomic mass of nitrogen	14.01	kg/kmol
MV_n	Volume of one mole of any ideal gas at reference conditions	22.414	$m^3/Kmol$

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

An *ex ante* estimate of $F_{CH4,PJ,y}$ is required to estimate baseline emission of methane from the SWDS in order to estimate the emission reductions of the proposed project activity in the CDM-PDD. It is determined as follows:

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} / GWP_{CH4}$$

Where:

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (tCH_4/yr)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (tCO_2e/yr)

[14] As the Option B.1 of the "*Project emissions from flaring (Version 02.0.0)*" has been adopted to calculate the flare efficiency, the molecular mass parameters are not mentioned.

[15] Value for the 2nd commitment period updated according to COP/MOP decisions

η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH4}	=	Global warming potential of CH_4 (tCO_2e/tCH_4)

$BE_{CH4,SWDS,y}$ is determined using the methodological tool “Emissions from solid waste disposal sites”. The calculation of $BE_{CH4,SWDS,y}$ according the tool is:

$$BE_{CH4,SWDS,y} = \varphi_y \cdot (1 - f_y) \cdot GWP_{CH4} \cdot (1 - OX) \cdot \frac{16}{12} \cdot F \cdot DOC_{f,y} \cdot MCF_y \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1 - e^{-k_j})$$

Where:

$BE_{CH4,SWDS,y}$	=	Baseline, project or leakage methane emissions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y (t CO_2e / yr)
X	=	Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to year y (x = y).
Y	=	Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)
$DOC_{f,y}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)
$W_{j,x}$	=	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t)
φ_y	=	Model correction factor to account for model uncertainties for year y
f_y	=	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
GWP_{CH4}	=	Global Warming Potential of methane
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction)
MCF_y		Methane correction factor for year *y*
DOC_j	=	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
k_j	=	Decay rate for the waste type *j* (1 / yr)
J	=	Type of residual waste or types of waste in the MSW

According to ACM0001 methodology, the parameter f_y in the methodological tool “Emissions from solid waste disposal sites” shall be assigned a value of 0 (zero) because the amount of LFG that would have been captured and destroyed is already accounted for in equation 2 of this methodology. For this reason, the parameter f_y will not be monitored.

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

In the baseline there is a requirement addressing odour[16] concerns to capture and destroy LFG. Thus, the case of the project activity for determining methane captured and destroyed in the baseline is **Case 4** because there is existing LFG capture system (passive system), and requirement addressing odour concerns to capture and destroy LFG. In this case:

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

Where:

[16] According to Operational Licenses: 18002168 valid until 27/01/2019 and 18001833 valid until 14/04/2017.

$F_{CH4,BL,sys,y}$	=	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 CH_4/yr)
$F_{CH4,BL,R,y}$	=	Amount of methane in the LFG which is flared in the baseline due to a requirement in year y (t CH4/yr)

According to the methodology ACM0001 version 15.0.0, Case 2 for the calculation of $F_{CH4,BL,R,y}$: "*If the requirement does not specify the amount or percentage of LFG that should be destroyed but requires the installation of a capture system, without requiring the captured LFG to be flared then: $F_{CH4,BL,R,y} = 0$*"

The amount of methane captured with the existing system is be monitored along with the amount captured under the project activity and there is no historic data on the amount of methane that was captured in the year prior to the implementation of the project activity. Thus, the situation to determine $F_{CH4,BL,y}$ is:

If 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, then:

$$F_{CH4,BL,sys,y} = 20\% \times F_{CH4,PJ,y};$$

Emission Factor calculation

The project emissions derived from fossil fuels used for electricity consumption from grid connected power plants are estimated and guided using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption. The combined margin emission factor" was calculated by the "Tool to calculate the emission factor for an electricity system" – version 04.0, as follows:

Step 1. Identify the relevant electric power system

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

The Brazilian DNA published an official delineation of the project electricity system in Brazil, considering a national interconnected system.[17]

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

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

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

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

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

[17] DNA Resolution n.8 was published on 26/05/2008 on http://www.mct.gov.br/index.php/content/view/14797.html, accessed on 08/10/2014.

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

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

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

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

The emission factor is calculated as follows:

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

Where:

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

The $EF_{grid,OM-DD,2013}$ is displayed on the Brazilian DNA website[18]of each day and month for the year 2013

The mean average has been calculated using the monthly emission factors for the year 2013. Then,

$EF_{grid,OM-DD,2013} =$ 0.5932 tCO/MWh.

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

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

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

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

[18] Source: http://cdm.unfccc.int/Projects/DB/DNV-CUK1179394615.79/view , accessed on 08/10/2014.

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

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

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

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

The $EF_{grid,BM,2013}$ is displayed on the Brazilian DNA website, for the year 2013

$EF_{grid,BM,2013} =$ 0.2713 tCO_2/MWh

Step 6. Calculate the combined margin emissions factor

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

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

The default weights are as follows: w_{OM} = 0.25 and w_{BM} = 0.75, fixed for the second crediting period. That gives:

$$EF_{2013} = 0.5932 \times 0.25 + 0.2713 \times 0.75 = 0.3518 \text{ tCO2/MWh}$$

The build margin CO_2 emission factor will not be monitored in the 2nd Crediting Period according to "Tool to calculate the emission factor for an electricity system" version 04.0[19].

Therefore, the combined margin CO_2 emission factor will be ex-post.

Project emissions

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

Where:

PE_y	=	Project emissions in year *y* (tCO_2/yr)
$PE_{EC,y}$	=	Emissions from consumption of electricity due to the project activity in year *y* (tCO_2/yr)
$PE_{FC,y}$	=	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year *y* (tCO_2/yr)

[19] According to "Tool to calculate the emission factor for an electricity system" version 04.0, paragraph 68, item (a): *"For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE"*

There is no consumption of fossil fuels due to the project activity for purpose other than electricity generation, in year *y* (tCO_2/yr), therefore $PE_{FC,y} = 0$

Thus,

$$PEy = PE_{EC,y}$$

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

According to *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"*, the project emission from consumption of electricity will be from the following source:

- $PE_{EC,y}$ - Grid (Brazilian interconnected electric system);

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

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

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

Thus, the project emission is calculated as following:

$$PE_{EC,y} = EC_{PJ,y} \times EF_{grid,CM,y} \times \left(1 + TDL_{j,y}\right)$$

Where:

$EC_{PJ,y} = EG_{EC,y}$	Quantity of electricity consumed from the grid by the project activity during the year *y* (MWh);
$EF_{grid,CM,y}$	The emission factor for the grid in year *y* (tCO_2/MWh);
$TDL_{j,y}$	Average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

Calculation of $PE_{FC,y}$ – Project emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation

There is no consumption of fossil fuels due to the project activity, for purpose other than electricity generation. Therefore, $PE_{FC,y} = 0$.

Leakage:

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

Emission Reduction

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

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

B.6.2. Data and parameters fixed ex ante

Data / Parameter	OX_{top_layer}
Unit	Dimensionless
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Consistent with how oxidation is accounted for in the methodological tool “Emissions from solid waste disposal sites”
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	Default value used, according to ACM0001
Purpose of data	Calculation of baseline emission
Additional comment	Applicable to Step A

Data / Parameter	GWP_{CH4}
Unit	t CO_2e/t CH_4
Description	Global warming potential of CH_4
Source of data	IPCC
Value(s) applied	25. Updated for the 2nd commitment period according to COP/MOP decisions[20]
Choice of data or Measurement methods and procedures	Default value used, according to IPCC Fourth Assessment Report: Climate Change 2007, item 2.10.2: Direct Global Warming Potentials, Table 2.14
Purpose of data	Calculation of baseline emission
Additional comment	-

Data / Parameter	Waste composition
Unit	%
Description	Waste composition
Source of data	CGR Piaçaguera
Value(s) applied	(see table below)

Composition of waste

A) Wood and wood products	0.99%
B) Pulp, paper and cardboard (other than sludge)	20.81%
C) Food, food waste, beverages and tobacco (other than sludge)	38.47%
D) Textiles	10.51%
E) Garden, yard and park waste	0.00%
F) Glass, plastic, metal, other inert waste	29.23%
TOTAL	**100%**

[20] IPCC Fourth Assessment Report: Climate Change 2007, item 2.10.2: Direct Global Warming Potentials, Table 2.14, available at: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html , accessed on 08/10/2014 and in accordance with EB69, Annex 3 and decision 4/CMP.7, available at: http://cdm.unfccc.int/Reference/Standards/meth/reg_stan02.pdf , accessed on 08/10/2014.

Choice of data or Measurement methods and procedures	CGR Terrestre internal report. The document has been sent to the DOE during the validation process.
Purpose of data	Calculation of baseline emission
Additional comment	Used for projection of methane avoidance

<table>
<tr><td>Data / Parameter</td><td>$SPEC_{flare}$</td></tr>
<tr><td>Unit</td><td>Temperature - °C
Flow rate - Nm³/h
Maintenance schedule - number of days</td></tr>
<tr><td>Description</td><td>Manufacturer’s flare specifications for temperature, flow rate and maintenance schedule</td></tr>
<tr><td>Source of data</td><td>Flare Manufacturer</td></tr>
<tr><td>Value(s) applied</td><td>Please refer to “Choice of data” below</td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td><table>
<tr><td>Flare model</td><td>2500 HT</td></tr>
<tr><td>Minimum flare temperature</td><td>850ºC</td></tr>
<tr><td>Maximum flare temperature</td><td>1200ºC</td></tr>
<tr><td>Minimum and maximum inlet flow rate</td><td>Minimum flow: 500 Nm³/h
---
Maximum flow: 2,500 Nm³/h</td></tr>
<tr><td>Maximum duration in days between maintenance events</td><td>7 days[22]</td></tr>
</table></td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

Data / Parameter	P_{ref}
Unit	Pa
Description	Atmospheric pressure at reference conditions
Source of data	Tool “Project emissions from flaring”
Value(s) applied	101,325
Choice of data or Measurement methods and procedures	Default value extracted from Tool “Project emissions from flaring”
Purpose of data	Calculation of project emissions
Additional comment	-

[22] The maximum duration in days between maintenance events has been chosen considering Terrestre preventive maintenance program which defines the frequency for checking flare equipment situation every week.

Data / Parameter	T_{ref}
Unit	K
Description	Temperature at reference conditions
Source of data	Tool “Project emissions from flaring”
Value(s) applied	273.15
Choice of data or Measurement methods and procedures	Default value extracted from Tool “Project emissions from flaring”
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	η_{PJ}
Unit	Dimensionless
Description	Efficiency of the LFG capture system that is be installed in the project activity
Source of data	BIOTECNOGAS (flare manufacturer and company which has been responsible for assembly and testing of the equipment at the landfill site)[23]
Value(s) applied	75%
Choice of data or Measurement methods and procedures	Based on the active LFG capture system installed in the project activity.
Purpose of data	Calculation of baseline emission
Additional comment	-

Data / Parameter	$\varphi_{default}$
Unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	Tool “Emissions from solid waste disposal sites”
Value(s) applied	0.75[24]
Choice of data or Measurement methods and procedures	According to “Emissions from solid waste disposal sites”, the *Application A* was used because the CGR Piaçaguera landfill is an existing solid waste disposal site and in the project activity the methane emissions are being mitigated by capturing and flaring the methane (ACM0001).
Purpose of data	Calculation of baseline emission
Additional comment	-

[23] The document “75% Landfill gas capture efficiency BTG.pdf” has been made available to the DOE.

[24] Since the average daily temperature in city of Santos is 23.1ºC and monthly average precipitation (MAP) is 3.396 mm, thus CGR Piaçaguera landfill is located in a tropical/wet climate. Sources: http://www.ciiagro.sp.gov.br/ciiagroonline/Quadros/QTmedPeriodo.asp and http://www.hidrologia.daee.sp.gov.br . Accessed on 08/10/2014.

Data / Parameter	OX
Unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	Default value used according to “Emissions from solid waste disposal sites”
Purpose of data	Calculation of baseline emission
Additional comment	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO_2. The oxidation factor represents the proportion of methane that is oxidized to CO_2.This should be distinguished from the methane correction factor (MCF) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer of SWDS.

Data / Parameter	F
Unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Default value used according to “Emissions from solid waste disposal sites”
Purpose of data	Calculation of baseline emission
Additional comment	Upon biodegradation, organic material is converted to a mixture of methane and carbon dioxide

Data / Parameter	$DOC_{f,default}$
Unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	The default value was used for type Application A). according to “Emissions from solid waste disposal sites”
Purpose of data	Calculation of baseline emission

Additional comment	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.

Data / Parameter	$MCF_{default}$
Unit	-
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	1.0
Choice of data or Measurement methods and procedures	The project activity is an anaerobic managed solid waste disposal site with 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 is include: (i) cover material; (ii) mechanical compacting and (iii) leveling of the waste;
Purpose of data	Calculation of baseline emission
Additional comment	-

Data / Parameter	DOC_j
Unit	-
Description	Fraction of degradable organic carbon in the waste type j (weight fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value(s) applied	(see table below)
Choice of data or Measurement methods and procedures	IPCC default value for municipal solid waste (MSW) disposal site is applied.
Purpose of data	Calculation of baseline emission
Additional comment	-

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

<table>
<tr><td>Data / Parameter</td><td>k_j</td></tr>
<tr><td>Unit</td><td>1/yr</td></tr>
<tr><td>Description</td><td>Decay rate for the waste type j</td></tr>
<tr><td>Source of data</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th colspan="2" rowspan="2">Waste type j</th><th>Tropical (MAT > 20 °C)</th></tr>
<tr><th>Wet (MAP > 1,000mm)</th></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.07</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.035</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.17</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.40</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>IPCC default value for municipal solid waste (MSW) disposal site is applied.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emission</td></tr>
<tr><td>Additional comment</td><td>The information regarding temperature data had been provided by CIIAGRO. Data vintage from 1996 until 2015 (http://www.ciiagro.sp.gov.br/ciiagroonline/Quadros/QTmedPeriodo.asp). Accessed on 10/04/2015.

The information regarding annual precipitation had been provided by Rainfall index database from Santos city – Station: E3-041. Data vintage from 1937 until 2015 (http://www.hidrologia.daee.sp.gov.br/). Accessed on 10/04/2015.

The mean annual temperature (MAT) is 23.1ºC and monthly average precipitation (MAP) is 3.396 mm.</td></tr>
<tr><td></td><td></td></tr>
</table>

Data / Parameter	MM_i
Unit	kg/kmol
Description	Molecular mass of greenhouse gas i
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream

<table>
<tr><td>Value(s) applied</td><td><table><tr><th>Compound</th><th>Structure</th><th>Molecular mass (kg/kmol)</th></tr><tr><td>Methane</td><td>CH_4</td><td>16.04</td></tr></table></td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>According to “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>MM_k</td></tr>
<tr><td>Unit</td><td>kg/kmol</td></tr>
<tr><td>Description</td><td>Molecular mass of gas k</td></tr>
<tr><td>Source of data</td><td>Tool to determine the mass flow of a greenhouse gas in a gaseous stream</td></tr>
<tr><td>Value(s) applied</td><td><table><tr><th>Compound</th><th>Structure</th><th>Molecular mass (kg/kmol)</th></tr><tr><td>Nitrogen</td><td>N_2</td><td>28.01</td></tr></table></td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>According to “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

Data / Parameter	MM_{H2O}
Unit	kg/kmol
Description	Molecular mass of water
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream
Value(s) applied	18.0152
Choice of data or Measurement methods and procedures	According to “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{grid,BM,y}$
Unit	tCO_2 /MWh
Description	Build margin emission factor for the grid in year y
Source of data	Brazilian DNA
Value(s) applied	0.2713 (ex-ante estimate for year 2013)

Choice of data or Measurement methods and procedures	The build margin emission factor has been defined by the Brazilian DNA
Purpose of data	Calculation of project emissions
Additional comment	Brazilian build margin emission factor has been defined by the Brazilian DNA. For more details, see appendix 4.

B.6.3. Ex ante calculation of emission reductions

>>

Emission reduction

Baseline emission calculation

The total of methane generation at the site has been estimated based on the waste tonnage of the landfill using the first order decay model presented in the *"Emissions from solid waste disposal sites"*.

Ex-ante estimation of $F_{CH4,PJ,y}$

The assumptions used to calculate $\mathbf{F_{CH4,PJ,y}}$ are:

- Methane content in LFG = 50% (default value[25]);
- LFG collection efficiency = 75%: (Based on technical specifications from the equipment provider for the active LFG capture system);
- Density of methane = 0.716 kg/m^3 (as per "*Tool to determine project emissions from flaring gases containing methane").*

The landfill gas collection and utilization system captures only a portion of the generated landfill gas. Thus, an estimate of 75% LFG collection was applied to the estimate of LFG produced, under assumption that generated LFG is composed of 50% methane.

The ex ante estimation of the $F_{CH4,PJ,y}$ is presented below:

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} / GWP_{CH4}$$

Where:

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year y (tCH_4/yr)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y (tCO_2e/yr)
η_{PJ}	=	Efficiency of the LFG capture system installed in the project activity
GWP_{CH4}	=	Global warming potential of CH_4 (tCO_2e/tCH_4)

A detailed calculation of the Emission Reductions is provided in a separate spreadsheet.

The table below illustrates the ex-ante estimation of $F_{CH4,PJ,y}$ by the project activity during the crediting period.

[25] According to Methodological Tool "Emissions from solid waste disposal sites" version 06.0.1, page 9, parameter "F".

Table 4 - Ex-ante estimation of FCH4,PJ,y

Year	$F_{CH4,PJ,y}$ (tCH_4/yr)
2015	6,492
2016	8,281
2017	7,094
2018	6,195
2019	5,497
2020	4,939
2021	4,482
2022	1,396

Determination of $F_{CH4,BL,y}$

$F_{CH4,BL,y} = 20\% \times F_{CH4,PJ,y}$

Table 5 - Ex-ante estimation of $F_{CH4,BL,y}$

Year	$F_{CH4,BL,y}$ (tCH_4/yr)
2015	1,298
2016	1,656
2017	1,419
2018	1,239
2019	1,099
2020	988
2021	896
2022	279

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

The equation of the $BE_{CH4,y}$ is:

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

Where the OX_{top_layer} = 0.1 (default value) and $F_{CH4,PJ,y}$ and $F_{CH4,BL,y}$ are calculated above. The results are presented below:

Table 6 - Baseline emissions of methane from the SWDS ($BE_{CH4,y}$)

Year	$BE_{CH4,y}$ (tCO_2/year)
2015	116,853
2016	149,055
2017	127,688
2018	111,514
2019	98,945
2020	88,907
2021	80,676
2022	25,126

The equation of the baseline emission calculation is:

$$BE_y = BE_{CH4,y}$$

The result is:

Table 7 - Baseline emission calculation

Year	$BE_{CH4,y}$ (tCO_2/year)	BE_y (tCO_2/yr)
2015	116,853	116,853
2016	149,055	149,055
2017	127,688	127,688
2018	111,514	111,514
2019	98,945	98,945
2020	88,907	88,907
2021	80,676	80,676
2022	25,126	25,126

Project emissions

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

Where:

PE_y	=	Project emissions in year y (tCO_2/yr)
$PE_{EC,y}$	=	Emissions from consumption of electricity due to the project activity in year y (tCO_2/yr)
$PE_{FC,y}$	=	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year y (tCO_2/yr)

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

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

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

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

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

In the project activity, the annual electricity consumption from the grid is estimated around 811 MWh/year. However, this variable will be monitored during the whole crediting period.

In the option A1 of the "*Tool to calculate baseline, project and/or leakage emissions from electricity consumption*", states that a value of the combined margin emission factor ($EF_{grid,CM,y}$) may be used as the emission factor ($EF_{ELj/k/l,y}$). Therefore, a value of 0.3518 tCO_2/MWh will be used.

Finally the technical transmission and distribution losses ($TDL_{j,y}$) value has been assumed to be 17%, according to Wordbank Databank for the year 2010.[26] Table below summarizes the project emissions resulting from electrical consumption in the plant.

[26] The link was made available to DOE during the validation process (*http://databank.worldbank.org/ddp/home.do?Step=12&id=4&CNO=2*) accessed on 08/10/2014. The most recent value from "electric power transmission and distribution losses" in the World Bank website is 16.5 and it was, conservatively, used the value of 17%.

Table 8 - Electricity consumption from the grid resulting due to project activity

Year	Electricity consumption from the grid - $EC_{PJ1,y}$ (MWh/yr)	$PE_{EC1,y}$ (tCO_2/year)
2015	439	180
2016	668	275
2017	668	275
2018	668	275
2019	668	275
2020	668	275
2021	668	275
2022	228	94

For the second crediting period, it was considered only electricity consumption since 06/05/2015 to 05/05/2022.

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

Since the electricity consumption from diesel generators is very sporadic when compared with the electricity consumption from the grid, the ex-ante estimation was considered to be zero. However, this parameter will be continuously monitored and measured ex-post.

The emission factor from the diesel generator(s) is 1.3 tCO_2/MWh[27]. The following table represents the project emissions from the use of the standby generator over the crediting period. Table below presents the project emissions associated with fossil fuel combustion at the project site.

Table 9 - Project emissions from diesel generators

Year	$PE_{el,diesel}$ - $EC_{PJ2,}$ (MWh/year)	$PE_{EC2,y}$ (tCO_2/year)
2015	0	0
2016	0	0
2017	0	0
2018	0	0
2019	0	0
2020	0	0
2021	0	0
2022	0	0

Leakage:

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

Emission Reduction

Emission reductions are calculated as follows:

[27] According to Methodological Tool “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, option B2, page 8.

$$ER_y = BE_y - PE_y$$

Where:
ER_y = Emission reductions in year y (tCO_2e/yr);
BE_y = Baseline emissions in year y (tCO_2e/yr);
PE_y = Project emissions in year y (tCO_2e/yr);

Year	BE_y (tCO_2/year)	PE_y (tCO_2/year)	ER_y (tCO_2/year)
2015	116,853	180	116,672
2016	149,055	275	148,780
2017	127,688	275	127,413
2018	111,514	275	111,239
2019	98,945	275	98,670
2020	88,907	275	88,633
2021	80,676	275	80,401
2022	25,126	94	25,032

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions[28] (t CO_2e)
…2015*	116,853	180	0	116,672
2016	149,055	275	0	148,780
2017	127,688	275	0	127,413
2018	111,514	275	0	111,239
2019	98,945	275	0	98,670
2020	88,907	275	0	88,633
2021	80,676	275	0	80,401
…2022*	25,126	94	0	25,032
Total	**798,763**	**1,923**	**0**	**796,840**
Total number of crediting years	**7**			
Annual average over the crediting period	**114,109**	**275**	**0**	**113,834**

* The starting date of the second crediting period is 06/05/2015
** The end date of the second crediting period is 05/05/2022

[28] The emission reductions expected for the second crediting period are higher than the emission reductions assumed in the first crediting period registered PDD (version 9, dated 12/02/2007). This difference is due to the methodological approach used in each PDD (GWP 25 for the second crediting period) and also the accumulated amount of waste disposed in the landfill is higher in the second crediting period when compared to the previous one, representing a higher LFG generation capacity.

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Methodology ACM0001, version 15.0.0 - Flaring or use of landfill gas

Data / Parameter	Management of SWDS
Unit	-
Description	Management of SWDS
Source of data	Use different sources of data: • Original design of the landfill; • Technical specifications for the management of the SWDS; • Local or national regulations
Value(s) applied	-
Measurement methods and procedures	Project participants should refer to the original design of the landfill to ensure that any practice to increase methane generation have been occurring prior to the implementation of the project activity. Any change in the management of the SWDS after the implementation of the project activity should be justified by referring to technical or regulatory specifications
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$O_{pj,h}$
Unit	-
Description	Operation of the equipment that consumes the LFG
Source of data	Measurements by Project participant using a device integrated with the operational software at the landfill gas plant.
Value(s) applied	n/a
Measurement methods and procedures	For each equipment unit j using the LFG monitor that the plant is operating in hour h by the monitoring parameter below: • Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer’s specifications of the burning equipment. The flare temperature meter (thermocouple) is located at the middle third of each of the flare at the flare system. The minimum flare temperature which guarantees the operation of the equipment is 850ºC. $O_{pj,h}$=0 when: • One or more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); Otherwise, $O_{pj,h}$=1 The accuracy and uncertainty of the monitoring instrument will be in accordance with manufacturer specifications.
Monitoring frequency	Hourly
QA/QC procedures	Thermocouples will be replaced or calibrated every year

Purpose of data	Calculation of baseline emissions
Additional comment	-

Tool to determine the mass flow of a greenhouse gas in a gaseous stream

Data / Parameter	$V_{t,db}$ / $V_{t,wb}$
Unit	m³ /h
Description	For: • $V_{t,db}$ = Volumetric flow of the gaseous stream in time interval t on a dry basis; • $V_{t,wb}$ = Volumetric flow of the gaseous stream in time interval t on a wet basis;
Source of data	Measurements by Project participants using a flow meter
Value(s) applied	n/a
Measurement methods and procedures	Regarding parameters $V_{t,db}$ and $V_{t,wb}$, the volumetric flow rate of the residual gas refer to actual pressure and temperature in the hour h will be measured by a flow meter with a digital recordable electronic signal, according to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, the measurement option in the project activity will be: • Option (A) dry basis: when the temperature of gaseous stream is lower than 60ºC (333.15 K) at the flow measurement point; • Option (B) wet basis: when the temperature of gaseous stream is higher than 60ºC (333.15 K) at the flow measurement point;
Monitoring frequency	Continuous recorded and hourly aggregated
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. The calibration frequency of this monitoring equipment should be in accordance with manufacturer’s specifications.
Purpose of data	Calculation of baseline emissions
Additional comment	The parameters $V_{t,db}$, $V_{t,wb}$, and $V_{RG,m}$ have been considered in the same monitoring parameter table because all of them refers to volumetric flow rate of the residual gas in the hour h.

Data / Parameter	$v_{i,t,db} = v_{i,RG,m}$
Unit	m^3CH_4/m^3 dry gas
Description	Volumetric fraction of greenhouse gas methane in a hourly time interval *t* on a dry basis
Source of data	Measurements by project participants using a gas analyzer
Value(s) applied	50%
Measurement methods and procedures	Continuous gas analyzer operating in dry-basis. Volumetric flow measurement should always refer to the actual pressure and temperature Data will be monitored continuously and values will be averaged hourly or a shorter time interval. The accuracy and uncertainty of the monitoring instrument will be in accordance with manufacturer specifications.
Monitoring frequency	Continuously (minute basis)

QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) 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 The calibration frequency of this monitoring equipment should be according to the manufacturer's specifications.
Purpose of data	Calculation of baseline emissions
Additional comment	As a simplified approach, project participant will only measure the methane content of the gaseous stream and consider the remaining part as N_2, therefore i = CH_4 This parameter will be monitored using option A (when LFG temperature is lower than 60ºC, it means dry gas) and B (when LFG temperature is higher than 60ºC, it means wet gas)

Data / Parameter	T_t
Unit	K
Description	Temperature of the gaseous stream in time interval t
Source of data	Measurements by Project participant using a temperature meter
Value(s) applied	n/a
Measurement methods and procedures	Thermoresistance with digital recordable electronic signal will be used. The accuracy and uncertainty of the monitoring instrument will be in accordance with manufacturer specifications.
Monitoring frequency	Continuous
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. The calibration frequency of this monitoring equipment should be according to the manufacturer's specifications.
Purpose of data	Calculation of baseline emissions.
Additional comment	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, this parameter must be monitored continuously to assure the applicability condition is met.

Data / Parameter	P_t
Unit	Pa
Description	Pressure of the gaseous stream in time interval t
Source of data	Measurements by Project participant using a pressure meter
Value(s) applied	n/a
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) will be used. Examples include pressure transducers, etc. The accuracy and uncertainty of the monitoring instrument will be in accordance with manufacturer specifications.
Monitoring frequency	Continuous

QA/QC procedures	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. In case the pressure meter is not a capacitive or resistive pressure transducer, the calibration frequency of this monitoring equipment should be according to the manufacturer's specifications.
Purpose of data	Calculation of baseline emissions.
Additional comment	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, this parameter must be monitored continuously to assure the applicability condition is met.

Data / Parameter	$P_{H2O,t,Sat}$
Unit	Pa
Description	Saturation pressure of H_2O at temperature Tt in time interval *t*
Source of data	Provided by project participants
Value(s) applied	n/a
Measurement methods and procedures	This parameter is solely a function of the gaseous stream temperature Tt and can be found at reference [1] for a total pressure equal to 101,325 Pa
Monitoring frequency	-
QA/QC procedures	-
Purpose of data	-
Additional comment	[1] Fundamentals of Classical Thermodynamics; Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4º Edition 1994, John Wiley & Sons, Inc.

Tool to calculate baseline, project and/or leakage emissions from electricity consumption

Data / Parameter	$EF_{grid,CM,y}$
Unit	tCO_2/MWh
Description	Combined margin emission factor for the grid in year y
Source of data	Brazilian DNA
Value(s) applied	0.3518 (ex-ante estimate for year 2013)
Measurement methods and procedures	The emission factor will be calculated ex-post, as the weighted average of the dispatch data analysis OM (Operating Margin) and the BM (Build margin), as described in B.6.3.
Monitoring frequency	Annual
QA/QC procedures	Apply procedures in the "Tool to calculate the emission factor for an electricity system".
Purpose of data	Calculation of project emissions.
Additional comment	Brazilian emission factor has been defined by the Brazilian DNA For more details, see appendix 4.

Data / Parameter	$EF_{grid,OM,y}$
Unit	tCO_2/MWh

Description	Operating margin emission factor for the grid in year y
Source of data	Brazilian DNA
Value(s) applied	0.5932 (ex-ante estimate for year 2013)
Measurement methods and procedures	The operating margin emission factor has been defined by the Brazilian DNA
Monitoring frequency	Annual
QA/QC procedures	Apply procedures in the “Tool to calculate the emission factor for an electricity system”.
Purpose of data	Calculation of project emissions.
Additional comment	Brazilian operating margin emission factor has been defined by the Brazilian DNA For more details, see appendix 4.

Data / Parameter	$TDL_{j,y}$
Unit	-
Description	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data	Regional or national technical literature
Value(s) applied	17% (*ex-ante* estimate for year 2011)
Measurement methods and procedures	The technical distribution losses do not contain grid losses other than technical transmission and distribution.
Monitoring frequency	Annually. In the absence of annual information, It will be used information up to previous 5 years.
QA/QC procedures	-
Purpose of data	Calculation of project emissions.
Additional comment	The technical transmission and distribution losses ($TDL_{j,y}$) value has been assumed to be 17%, according to World Bank database (World data Bank[29]) assuming data from 2011 which is the most recent data available.

Data / Parameter	$EG_{EC,y} = EC_{PJ,y}$
Unit	MWh/y
Description	Quantity of electricity consumed from the grid by the project activity during the year y
Source of data	Electricity meter

[29] http://databank.worldbank.org/ddp/home.do?Step=12&id=4&CNO=2, accessed on 08/10/2014.

Value(s) applied	The ex-ante estimation is: <table><tr><th>Year</th><th>Quantity of electricity consumed from the grid (MWh/year)</th></tr><tr><td>2015</td><td>439</td></tr><tr><td>2016</td><td>668</td></tr><tr><td>2017</td><td>668</td></tr><tr><td>2018</td><td>668</td></tr><tr><td>2019</td><td>668</td></tr><tr><td>2020</td><td>668</td></tr><tr><td>2021</td><td>668</td></tr><tr><td>2022</td><td>228</td></tr></table>
Measurement methods and procedures	The data will be collected continuously using an electricity meter. The data will be archived throughout the crediting period and two years thereafter. The accuracy and uncertainty of the monitoring instrument will be in accordance with manufacturer specifications.
Monitoring frequency	Continuously
QA/QC procedures	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. Periodical calibration as per manufacturer specifications to ensure validity of data measured. The readings will be double checked by the electricity distribution company The calibration frequency of this monitoring equipment should be according to the manufacturer's specifications.
Purpose of data	Calculation of project emissions.
Additional comment	The internal electricity consumption for ex-ante emission reductions calculation was based on the installed capacity of the equipment below: Blowers: (37 x 2) kW Air Conditioning: (0.970 x 2) kW; Computers: (0.15 x 2) kW; Total installed capacity: 76.24 kW Total internal electricity consumption: 76.24 kW x 8760 = 667.9 MWh This parameter is required for calculating project emissions from electricity consumption due to an alternative waste treatment process t ($PE_{EC,y}$) using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

Data / Parameter	$EG_{EC2,y} = EC_{PJ2,y}$
Unit	MWh/y
Description	Quantity of electricity consumed from diesel generators by the project activity during the year y
Source of data	Measured by project participants using electricity meter
Value(s) applied	0 (zero) MWh/y for ex-ante calculation
Measurement methods and procedures	The data will be collected continuously using an electricity meter. The data will be archived throughout the crediting period and two years thereafter. The accuracy and uncertainty of the monitoring instrument will be in accordance with manufacturer specifications.

Monitoring frequency	Continuously
QA/QC procedures	Calibration of instrument as per manufacturer specifications to ensure validity of data measured. The calibration frequency of this monitoring instrument should be according to the manufacturer's specifications.
Purpose of data	Calculation of project emissions.
Additional comment	This parameter is required for calculating project emissions from electricity consumption due to an alternative waste treatment process t ($PE_{EC2,y}$) using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". However, it was considered zero for ex-ante calculation.

Methodological tool "Project emissions from flaring"

Data / Parameter	$F_{CH4,EG,t}$
Unit	kg
Description	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period t
Source of data	Measurements undertaken by a third party accredited entity
Value(s) applied	-
Measurement methods and procedures	Measures of the mass flow of methane in the exhaust gas carried out according to an appropriate international standard (USEPA). The time period t over which the mass flow is measured must be at least one hour. The average flow rate to the flare during the time period t must be greater than the average flow rate observed for the previous six months The accuracy and uncertainty characteristics of the monitoring equipment will be under responsibility of the third party accredited entity.
Monitoring frequency	Biannual
QA/QC procedures	According to the standard applied
Purpose of data	Calculation of project emissions
Additional comment	Monitoring of this parameter is required taking into account the LFG combustion in enclosed flares and also project participants selected Option B.1 to determine flare efficiency

Data / Parameter	$T_{EG,m}$
Unit	º C
Description	Temperature in the exhaust gas of the enclosed flare in minute *m*
Source of data	Measurements by project participants using thermocouple
Value(s) applied	n/a
Measurement methods and procedures	Measure the temperature of the exhaust gas stream in the flare by a Type S thermocouple. A temperature above 850 ºC indicates that a significant amount of gases are still being burnt and that the flare is operating. Data will be recorded continuously and values will be averaged hourly or at a shorter time interval. The monitoring port for the monitoring of the temperature of the flare is located at the middle third of the flare[30]. The accuracy and uncertainty of the monitoring instrument will be in accordance with manufacturer specifications.
Monitoring frequency	Continuously (once per minute)
QA/QC procedures	Thermocouples will be replaced or calibrated every year
Purpose of data	Calculation of project emissions.
Additional comment	Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. These events should be noted in the site records along with any corrective action that was implemented to correct the issue. Monitoring of this parameter is applicable in case of enclosed flares. Measurements are required to determine if manufacturer's flare specifications for operating temperature are met

[30] The Flare Design Project issued by the flare manufacturer, provides information regarding the position of the temperature meter ports in the flare. The document has been made available to the DOE.

Data / Parameter	$Flame_m$
Unit	Flame on or Flame off
Description	Flame detection of flare in the minute m
Source of data	Measurements by project participants
Value(s) applied	n/a
Measurement methods and procedures	Measure using a fixed installation optical flame detector: Ultra violet
Monitoring frequency	Continuously (once per minute)
QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations
Purpose of data	Calculation of baseline and project emissions when the flame is on[31].
Additional comment	Applicable to all flares

Data / Parameter	$Maintenance_y$
Unit	Calendar dates
Description	Maintenance events completed in year y
Source of data	Measurements by project participants
Value(s) applied	n/a
Measurement methods and procedures	Maintenance events dates recorded in year y. Records of maintenance logs must include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced, or needing to be replaced, source of replacement parts, serial numbers and calibration certificates
Monitoring frequency	Annual
QA/QC procedures	Records must be kept in a maintenance log for two years beyond the life of the flare
Purpose of data	Calculation of baseline and project emissions when the maintenance is not being carried out[32].
Additional comment	Monitoring of this parameter is required since the project participant selected Option B to determine flare efficiency and uses enclosed flares. These dates are required so that they can be compared to the maintenance schedule to check that maintenance events were completed within the minimum time between maintenance events specified by the CGR Piaçaguera preventive maintenance program which defines the frequency for checking flare equipment situation every week.($SPEC_{,flare}$)

B.7.2. Sampling plan

>>
Not applicable.

[31] When the flame is off, neither baseline nor project emissions occurs since the LFG is not combusted and instead released to the atmosphere.

[32] When the maintenance is being carried out, neither baseline nor project emissions occur since the LFG is not combusted and released to the atmosphere.

B.7.3. Other elements of monitoring plan

>>

The monitoring plan has been made according to the methodology ACM0001 and the applicable tools. The monitoring equipment locations are presented in the picture below:

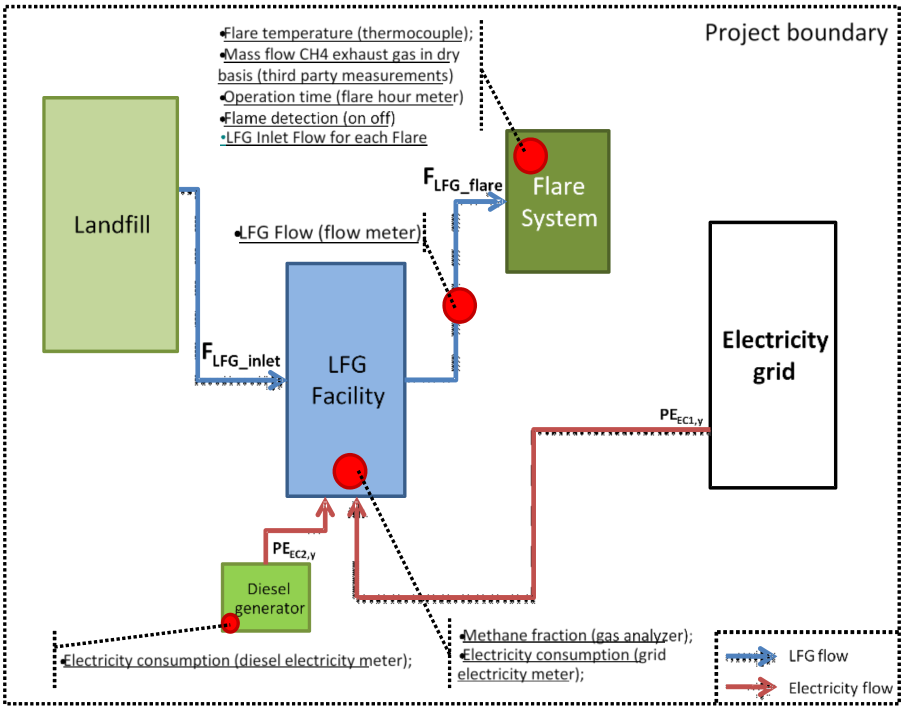

Figure 9 - Monitoring equipment locations

All continuously measured parameters (parameters related to volumetric flow of the gaseous stream, LFG CH_4 concentration, LFG temperature[33], LFG pressure[34], flare temperature, flare operating hours, electricity from the grid and electricity from diesel generators will be recorded electronically via a datalogger, located inside the site boundary which will have the capability to aggregate and print the collected data in the frequencies range specified above. It will be the Site Operator responsibility to provide all requested data logs which will be stored during the reporting period at the Site office. The data logs will be summarized into emission reduction calculations prior to each verification. This task will be completed by Project Participant and reported directly to the DOE. These logs will be available to the DOE when requested in order to prove the operational integrity of the Project.

[33] LFG temperature parameter may not be needed except for the determination of methane density.

[34] LFG pressure parameter may not be needed except for the determination of methane density.

1. Management Structure

The collected operational data will be used to support the periodic verification report requiring CER auditing. The herein discussed monitoring plan has been designed to meet or conservatively exceed the UNFCCC requirements (approved monitoring methodology ACM0001 version 15.0.0).

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

1.1. Responsibility of the personnel involved

The CGR Piaçaguera organizational structure is presented in the figure below:

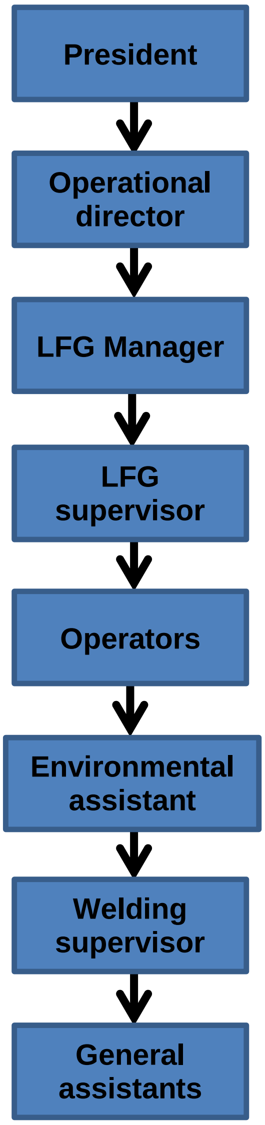

Figure 10 – CGR Piaçaguera organizational structure

The personnel involved with monitoring will be responsible for carrying out the following tasks:

- Supervise and verify metering and recording (CGR PIAÇAGUERA responsibility): The staff will coordinate internally with other departments to ensure and verify adequate metering and recording of data.

- Collection of additional data (CGR PIAÇAGUERA responsibility): The staff will collect any data deemed necessary to calculate and report the emission reductions for each monitoring period, such as daily operational reports of project.
- Calibration (CGR PIAÇAGUERA responsibility): The staff will coordinate internally to ensure that calibration of the metering instruments is carried out in accordance with the equipment manufacturers' specifications. Third parties might be hired to conduct the calibration procedures.
- Preparation of monitoring report (Beng): The staff will prepare the monitoring report for verification.
- Data Archives (CGR PIAÇAGUERA / Beng): The staff will be responsible for keeping all monitoring data, and making it available to the DOE for the verification of the emission reductions.

1.2. Installation of meters

All meters have been installed in order to fulfill the proposed monitoring plan.
All meters will be calibrated by an accredited person or institution.

2. Monitoring Work Program

The LFG monitoring program is designed to collect system operating data required for the safe system operation and for the verification of CERs. This data is collected in real time, and will provide continuous recording which can be easily monitored, reviewed, and verified.

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

- LFG Flow;
- LFG quality;
- Uncombusted methane;
- Electricity consumption;
- Regulatory requirements;
- Data records;
- Data assessment and reporting.

2.1. LFG Flow

The data will be collected continuously using a flow meter located on the main piping measuring the total collected landfill gas. The data will be aggregated monthly and yearly for the flares. The data will be archived for a minimum of two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Each flow meters have a temperature and pressure sensors which are used to normalize the flow rate at standard temperature and pressure.

The data could be measured in dry or wet basis using a flow meter according to the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream". Project Participant must ensure that the same basis (dry or wet) is considered for the measurement of LFG Flow ($V_{t,db}$, $V_{t,wb}$ and $V_{RG,m}$) and the measurement of volumetric fraction of all components in the residual gas ($v_{i,t,db}$ and $v_{i,RG,m}$[35]). The equipment selected for the project activity uses a continuous monitoring system as defined in ACM0001, which measures and aggregates flow data.

[35] Both parameters actually means the same, however defined by two different parameter titles.

By the fact that the parameters related to volumetric flow of the gaseous stream must be converted to normal conditions during the monitoring process, this parameter is needed for the determination of methane density.
More detailed information regarding those data is presented in section B.7.1.

2.2. LFG Quality

The concentration of methane will be measured in the main system piping and will be continuously monitored. The equipment selected for the site aggregates gas composition as per the definition of a continuous monitoring system in ACM0001.

Regular calibrations will be made according to manufacturer specification.

2.3. Uncombusted Methane

The efficiency of the enclosed flare will be measured as per the methodological tool "Project emissions from flaring"

2.4. Electricity consumption

The electricity supplied by the grid to LFG Plant will be continuously measured by electricity meters located in the LFG plant to define energy for self-consumption due to project activity.

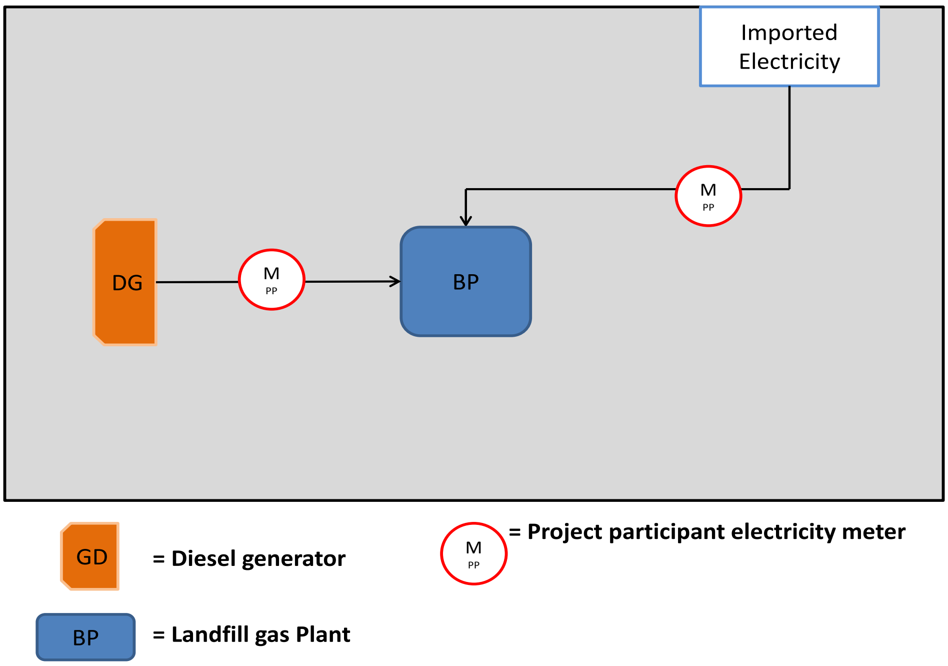

Figure 11 – Electricity Monitoring

Average technical transmission and distribution losses related to electricity consumption from the grid may be updated annually, using recent, accurate and reliable data available in the host country and in the absence of annual information, information up to previous 5 years will be used.

More detailed information regarding these data is presented in section B.7.1.

2.5. Regulatory Requirements

Regulatory requirements relating to LFG projects will be evaluated annually by investigating municipal, state and national regulations regarding the LFG. This will be done through consultation with the appropriate regulatory agencies, on-going discussions with regulators and monitoring of publications delineating upcoming legislative changes governing landfills and LFG.

2.6. Data Records

Data collected from each of the parameter instruments is transmitted directly to an electronic database. Backup of the electronic data will be carried out every week. The monitoring instruments uncertainty levels, methods and the associated accuracy levels are presented in section B.7.1. Data records 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;

2.7. Data Assessment and Reporting

The recorded data will be daily analyzed by the LFG Supervisor. If detected any implausible values regarding monitoring parameter data, it will be reported in a log-book and the LFG Plant Supervisor along with the LFG coordinator will provide corrective actions, according to internal operational procedures.

Daily consolidated data will be sent by the LFG Plant Supervisor to the LFG coordinator through electronic reports. The data of the monitored parameters will be storage using internal system network.

The data will be compiled and assessed to produce the required quantification and validation. The periodic monitoring report will contain the data required for the verification of the CERs. The records of regular maintenance performed will also be a component of the verification reports.

3. Corrective actions

The staff will log all corrective actions and will report these in the monitoring report. In case when the corrective actions are considered necessary, these actions will be implemented according to internal procedures.

4. Procedures for monitoring personnel training

The PP will conduct a training and quality control program to ensure that the good management practices are carried out and implemented by all project operating personnel in terms of record-keeping, equipment calibration, overall maintenance, and procedures for corrective action.

5. Emergency procedures

As a precautionary measure, regularly backups will be carried out to avoid data loss due to power outages. The LFG coordinator will check daily the records. In addition, an emergency plan will be developed including other types of emergencies such as fire and work accidents.

6. Calibration

All the measurement instruments will be subject to regular calibration as per manufacturer's specifications or, in the absence of manufacturer specifications and in the absence of official standards and when applicable, the calibration frequency will be defined by the PP based on good practices in the market. The LFG coordinator will be responsible for checking the equipment's proper working conditions, as well as checking and storing up the calibration certificates and records. The calibration frequencies will be in line with the manufacturer's specifications. Calibration certificates will be kept for all the equipment during the crediting period and two years after. All meters installed ate the LFG plant are calibrated by an accredited person or institution.

B.7.4. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>

The date of completion of study on application of the selected methodologies was 08/10/2014.

This monitoring report was developed and reviewed by:

Consultancy	Project Proponent (Project Participant)
Beng Engenharia	Terrestre Ambiental Ltda.
Francisco Santo francisco.santo@beng.eng.br	Tiago Silva Tiago.silva@estre.com.br
João Sprovieri joao.sprovieri@beng.eng.br	

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

Project starting date: 20/09/2007[36]

C.1.2. Expected operational lifetime of project activity

>>

21 years and 0 months[37]

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

Renewable (second)

C.2.2. Start date of crediting period

>>

The crediting period will start on 06/05/2015, or the date of UNFCCC approval of the 2nd crediting period whichever is later.

C.2.3. Length of crediting period

7 years and 0 months.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

[36] According to registered PDD.

[37] Despite the landfill lifetime is 13 years (from 2003 to 2015), the project activity lifetime is 21 years, composed by the first crediting period from 06/05/08 to 05/05/15, the second crediting period from 06/05/2015 to 05/05/2022 and the third crediting period from 06/05/2022 to 05/05/2029.

The possible environmental impacts have been analyzed by the São Paulo State Environment Agency (*CETESB*). CGR Piaçaguera has all the pertinent licenses for CGR Piaçaguera landfill. The operational licenses are n° 18002168 valid until 27/01/2019 until 18001833 valid until 14/04/2017.

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

D.2. Environmental impact assessment

>>
There are no significant environmental impacts in TALGP. The necessary infra-structure to flare the gas will not likely cause any significant impacts in the site.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>
As required by the Interministerial Commission on Global Climate Change (CIMGC), the Brazilian DNA – Designated National Authority, invitations has been sent for comments to local stakeholders as part of the procedures for analyzing CDM projects and issuing letters of approval. This procedure was followed by Terrestre to take its GHG mitigation initiative to the public. Letters and the Executive Summary of the project were sent to the following local stakeholders:

- Prefeitura Municipal de Santos – SP / *Municipal Administration of Santos – SP;*
- Secretaria Municipal do Meio Ambiente / *Municipal Secretariat of Environment;*
- Câmara dos Vereadores de Santos - SP / *Municipal Legislation Chamber;*
- Secretaria Estadual do Meio Ambiente / *Environmental Secretariat of São Paulo State;*
- CETESB / *State of São Paulo Environmental Agency;*
- Rotary Club de Santos;
- Ministério Público do Estado de São Paulo / *Public Ministry of São Paulo State;*
- Fórum Brasileiro de ONGs (FBOMS) / *Brazilian NGO Forum.*

E.2. Summary of comments received

>>
A comment from Fórum Brasileiro de ONGs was received. According with the comment, the entity expresses gratitude for the correspondence dispatched by Terrestre. FBOMS also recognizes their role, as one of several institutions listed in the "Resolução nº1", created by CIMGC, that must invite for comments. They highlight their support in transparency mechanisms of analysis process and approval of CDM projects. They mention the importance of consulting local stakeholders for comments in order to improve of sustainability and the quality of projects collaborating with the implementation of international climate exchange regime. Futhermore, FBOMS affirms it is waiting for a Brazilian Federal Government manifestation, by means of CIMGC, about how the comments and analysis made by FBOMS integrants for CDM projects are considered into the final decision. Therefore, it emphasizes its interest in technical information evaluation, but a lack of more detailed analysis of the project does not mean their approval of the same.

E.3. Report on consideration of comments received

>>
Terrestre appreciated the comments from FBOMS. A letter was sent from Terrestre expressing its gratitude for the considerations about the TALGP and availability of providing any necessary additional information. Terrestre informed that they might study the adoption of a sustainability criteria certification, but recognizes that the CDM verification procedures already include the assessment of such criteria.

SECTION F. Approval and authorization

>>

In the proposed project, the project participants are presented below:

Host Parties	Project participants
Brazil (host)	Terrestre Ambiental Ltda (private entity)
	Econergy Brasil Ltda (private entity).

Thus, the Party involved is Brazil.

In accordance with the paragraph 246 in the "Clean Development Mechanism Project Cycle Procedure (version 07.0)", the project participant has already obtained a letter of approval from the host parties DNAs, and it is not necessary to obtain a new letter at the renewal of the crediting period.

- - - - -

Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	TERRESTRE AMBIENTAL LTDA.
Street/P.O. Box	Avenida Presidente Juscelino Kubitschek, 7830 Torre IV, 4º andar
Building	-
City	São Paulo
State/Region	São Paulo
Postcode	04543-9000
Country	BRAZIL
Telephone	55-11-3706.8877
Fax	55-11-3078.3355
E-mail	estre@estre.com.br
Website	www.estre.com.br
Contact person	Alex Schlosser
Title	
Salutation	Mr.
Last name	SCHLOSSER
Middle name	-
First name	ALEX
Department	Environmental Management
Mobile	55-11-7713.8562
Direct fax	55-11-3078.3355
Direct tel.	55-11-3706.8877
Personal e-mail	alex@estre.com.br

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Econergy Brasil Ltda.
Street/P.O. Box	Avenida Angélica, 2530 – conjunto 111
Building	Edifício Reynaldo Riucci
City	São Paulo
State/Region	SP
Postcode	01228-200
Country	Brazil
Telephone	+ 55 (11) 3555-5700
Fax	+55 (11) 3555-5735
E-mail	-

Website	http://www.econergy.com.br
Contact person	
Title	Mr./Mrs.
Salutation	
Last name	Diniz Junqueira / Cerchia
Middle name	Schunn / Maria
First name	Marcelo / Francesca
Department	-
Mobile	+55 (11) 8263-3017 / + 55 (11) 8584-2228
Direct fax	Same below
Direct tel.	+ 55 (11) 3555-5725 / + 55 (11) 3555-5729
Personal e-mail	junqueira@econergy.com.br / cerchia@econergy.com.br

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	CM Capital Markets Holding S.A.
Street/P.O. Box	Calle Ochandiano, 2
Building	
City	Madrid
State/Region	
Postcode	28023
Country	Spain
Telephone	+ 34 (91) 509 62 00
Fax	+ 34 (91) 509 6214
E-mail	-
Website	www.capi.es/CapitalMarkets/
Contact person	Mr. Perez Antuña
Title	-
Salutation	-
Last name	-
Middle name	-
First name	-
Department	-
Mobile	
Direct fax	+ 34 (91) 509 62 00
Direct tel.	+ 34 (91) 509 6214
Personal e-mail	-

Appendix 2. Affirmation regarding public funding

Not applicable. There is no public funding involved in the project activity.

Appendix 3. Applicability of methodology and standardized baseline

All the information about the applicability of selected methodology is described in Section B.2 above.

Appendix 4. Further background information on ex ante calculation of emission reductions

The baseline study and monitoring methodology was developed by:

Beng Engenharia, São Paulo, Brazil
www.beng.eng.br
Contact person:
Mr. João Sprovieri (Engineer)
Mr. Francisco Santo (Director)

Email:
joao.sprovieri@beng.eng.br
francisco.santo@beng.eng.com.br

Beng Engenharia is not a Project Participant.

The table below shows the key elements used for estimate the emission reductions.

1. Key Parameters

Year landfilling operations started	2003
Projected year for landfill closure - estimated based on current filling rate	2015[38]
GWP for methane (UNFCCC and Kyoto Protocol decisions)	25
Methane concentration in LFG (% by volume) typical assumption for emission reduction calculation[39]	50
LFG collection efficiency (%)	75
Flare efficiencies (%) operational data from flare manufacturer	99%
Flare efficiencies (%) operational data adjusted according to "Project emissions from flaring" version 02.0.0	89%[40]

[38] The project participant issued an internal declaration, made available to the DOE, affirming that the intended closure year of the landfill will be 2015.

[39] According to Methodological Tool "Emissions from solid waste disposal sites" version 06.0.1, page 9, section "Data and parameters not monitored".

[40] Despite the Flare efficiency parameter is not used to estimate the emission reductions, it has been defined in the table in order to illustrate the flare efficiency methodological discount of 10% in relation to the calculated value (89%).

Electricity consumption from the grid due to the project activity (MWh/year)	667.8
Electricity consumption from the diesel generators due to the project activity (MWh/year)	0
Combined margin emission factor for electricity displacement (tCO_2/MWh) calculated based on the “Tool to calculate the emission factor for an electricity system”.	0.3518
Operational lifetime of the project activity (years)	21[41]
LFG destruction rate in the baseline scenario	20%

2. Waste disposal and composition of the solid waste disposed in the landfill

The forecast amount of waste disposal in project activity is presented below:

Table 10 - Forecast amount of waste disposal in the landfill

Year	Waste disposal (t/yr) [42]
2003	317,135
2004	303,195
2005	397,209
2006	524,511
2007	455,732
2008	463,935
2009	574,149
2010	693,631
2011	658,431
2012	655,198
2013	815,573
2014	863,090
2015	998,276

[41] Despite the landfill lifetime is 13 years (from 2003 to 2015), the project activity lifetime is 21 years, composed by the first crediting period from 06/05/08 to 05/05/15, the second crediting period from 06/05/2015 to 05/05/2022 and the third crediting period from 06/05/2022 to 05/05/2029.

[42] ESTRE Terrestre spreadsheet issued on 08/10/01/2014.

Table 11 - Composition of solid waste disposed in the landfill[43]

Wood and wood products	0.99%
Pulp, paper and cardboard (other than sludge)	20.81%
Food, food waste, beverages and tobacco (other than sludge)	38.47%
Textiles	10.51%
Garden, yard and park waste	0.00%
Glass, plastic, metal, other inert waste	29.23%
TOTAL	**100.0%**

3. Emission factors

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

Combined Margin Emission Factor 2013 (tCO_2/MWh)		
2nd crediting Period		**0.3518**
Build Margin - 2013		0.2713
Operating Margin 2013	January	0.6079
	February	0.5958
	March	0.5896
	April	0.6010
	May	0.5830
	June	0.6080
	July	0.5777
	August	0.5568
	September	0.5910
	October	0.5891
	November	0.6082
	December	0.6102
	2013	0.5932

Source: Brazilian DNA[44]

4. Overview of the solid waste management in brazil at the national and regional level

4.1. National Level

4.1.1. National Basic Sanitation Research (Pesquisa Nacional de Saneamento Básico - PNSB)

[43] CGR Terrestre internal report. The document has been sent to the DOE during the validation process.

[44] Emission factor from Brazilian DNA: http://www.mct.gov.br/index.php/content/view/346664.html#ancora accessed on 08/10/2014

The Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística - IBGE) is a federal agency which carries out several studies at the earth sciences, social statistics, demographics and economic areas to be addressed in the demographic census as well as the determination of the inflation index and basic sanitation conditions investigation for the 5,564 cities of Brazil. The published study concerning the basic sanitation in Brazil is referred as the National Basic Sanitation Research (*Pesquisa Nacional de Saneamento Básico - PNSB*) and it is carried out through a partnership between IBGE and the city, planning, budgeting and management ministries. The table below presents the solid waste destination in Brazil according to the last versions of the PNSB.

Table 12 - Daily amount of domestic/public solid waste collected and/or received (t/day) - PNSB

Source	Published year	Waste disposed in landfills/open dumps	Organic waste composting	Incineration of waste	Others	Total	Amount share of waste disposed in landfills/open dumps
PNSB 2000[45]	2002	215,770	6,550	1,032	5,061	228,413	94.46%
PNSB 2008[46]	2010	254,087	1,635	67	3,758	259,547	97.90%

As a consequence of the Table 1 analysis, the amount of solid waste disposed in landfills/open dumps in Brazil is increasing.

It is important to notice that this study includes the formal[47] and informal[48] means of municipal solid waste treatment.

4.1.2. Municipal Solid Waste Management Diagnostic (Diagnóstico do Manejo de Resíduos Sólidos Urbanos - SNIS)

The Municipal Solid Waste Management Diagnostic (Diagnóstico do Manejo de Resíduos Sólidos Urbanos - SNIS) is a national study showing the solid waste management situation in Brazil. This study is annually carried out by the City Ministries and according to the most recent publication SNIS (2012)[49]:

- 0.11% of the total solid waste is headed for composting and;
- Only 0.03% of the total solid waste is headed for incineration,

It is important to notice that this study includes the formal and informal means of municipal solid waste treatment.

4.1.3. Brazilian Greenhouse Gases (GHG) Emissions Inventory

[45] http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/pnsb/pnsb.pdf, table 110.

[46] http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/pnsb2008/PNSB_2008.pdf, table 93.

[47] Informal means of solid waste treatment: activity in operation and not licensed by an environmental agency, such as open dumps.

[48] Formal means of solid waste treatment: activity in operation and licensed by an environmental agency

[49] http://www.snis.gov.br/PaginaCarrega.php?EWRErterterTERTer=93, sheet 11.3

The most recent Greenhouse Gases (GHG) Emissions National Inventory has been published by the Ministry of Technology and Science in 2010. According to page 14[50] of the Waste chapter, the incineration practice in Brazil is not meaningful.

This information is consistent with the information presented in page 252 of the same document which states that 98% of the municipal solid waste is disposed in landfills/open dumps and only 2% is managed by other methods.

4.2. Local Level

4.2.1. Annual Solid Waste Inventory in São Paulo State

According to Annual Solid Waste Inventory in São Paulo State – Base year 2012[51] published by CETESB in 2013 which considered formal and informal means of solid waste treatment, in the CGR Piaçaguera landfill influence area there is no any organic waste recycling units and 100% of the municipal solid waste are disposed in landfills/open dumps.

From the waste management analysis in Brazil carried out at the national and local levels, it is possible to conclude that:

- The solid waste management trend in Brazil is the municipal solid waste disposal in landfills/open dumps which represents 98% against only 2% of other treatments methods as the incineration and organic waste recycling, etc.
- Inside CGR Piaçaguera landfill influence area, 100% of the municipal solid waste are disposed in landfill/open dumps and does not exist organic waste recycling.

Therefore, it is possible to affirm that based on the information previously presented the implementation of the project activity do not reduce the amount of organic waste that would be recycled in the absence of the project activity considering that landfill installation would happen with the CDM project or without it.

Appendix 5. Further background information on monitoring plan

All the information about the monitoring plan were described in section B.7.1 and B.7.2

Appendix 6. Summary of post registration changes

It was left blank intentionally.

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[50] http://www.mct.gov.br/upd_blob/0213/213909.pdf

[51] Document download on the following link: http://www.cetesb.sp.gov.br/solo/publicacoes-e-relatorios/1-publicacoes-/-relatorios.

Document information

Version	*Date*	*Description*
05.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from *F-CDM-PDD* to *CDM-PDD-FORM;* • Editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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