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	Quitaúna Landfill Gas Project (QLGP)
Version number of the PDD	03
Completion date of the PDD	31/08/2015
Project participant(s)	Brazil: Quitaúna Serviços Ltda.; 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	118,034

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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At the first crediting period the registered PDD it has been covered the project activity including only LFG collection and flare destruction. The project investment according to the registered PDD would be carried out by the Project Proponent (Quitaúna Serviços Ltda.) and the Guarulhos Municipality (the city where the landfill is located), however Guarulhos Municipality decided to postpone the investment at that time and therefore the registered CDM project has not been implemented.

Since there were significant changes in the management of Guarulhos Municipality, the current decision makers raised interest on the implementation of the registered CDM project and on the renewal of the crediting period.

The configuration of the second crediting period project activity comprises the installation of the capture and flaring systems through the use of landfill gas (LFG)[1] produced in anaerobic conditions into the Quitaúna landfill located in the municipality of Guarulhos in the state of São Paulo, Brazil.

The project activity will result in greenhouse gas (GHG) emission reduction from the Quitaúna landfill through the combustion of CH_4 in flares;

Prior to the implementation of the project activity the scenario for LFG destruction is the partial released to atmosphere through the exiting LFG passive capture system.

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

The estimate of:
- Annual average is 118,034 tCO_2e;
- Total GHG emission reduction is 826,240 tCO_2e.

The project activity includes the construction of an efficient capture, collection and flaring system to burn CH_4 (a greenhouse gas), and this will reduce odours and adverse environmental impacts. However, the final equipment that will be chosen may vary depending on the availability of the equipment on the market at the time of actual implementation.

The LFG capture and collection systems and flaring station will consist on a LFG pipeline grid and a flaring station, equipped with flares, centrifugal blowers, and all other supporting mechanical and electrical subsystems and appurtenances necessary to run the system.

The landfill began the operation in October/2001 and has been receiving solid waste (type Class II-A and Class II-B) representing around 1,000 t/day. The landfill has been receiving waste only from Guarulhos municipality since the operation startup.

Contribution of the Project Activity to Sustainable Development:

Even the project activity not being implemented yet, there is a partnership between the landfill and the Guarulhos municipality in order to develop the environmental educational programs involving the local stakeholders as seen below.

[1] The gas is generated by the decomposition of waste in a solid waste disposal sites (SWDS). LFG is mainly composed of methane, carbon dioxide and small fractions of ammonia and hydrogen sulphide.



In addition, there will be other contributions to the sustainable development when the CDM project is implemented, such as:

a) **Contribution to the environment:**

Methane emissions reduction that would mitigate climate change.

b) **Contribution to the improvement of working conditions and employment creation:**

During the operational phase, which will take place 24 hours/day, 7 days/week, there will be new jobs created locally for duties related to construction, operations and maintenance, landscaping, plumbing, monitoring and security personnel. These people will be fully trained by Quitaúna landfill on their duties and tasks. Local manpower will be used in the project implementation, which entails installation of vertical wells, horizontal collection system and assembly and operation of equipment such as blowers, flares, and group-generators.

c) **Contribution to income generation:**

Local jobs created during its implementation and operation, the project will pay taxes to the municipality.

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.

>>
Guarulhos

A.2.4. Physical/Geographical location

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The project activity will take place in *Aterro Quitaúna*, a Quitaúna Serviços Ltda landfill, in municipality of Guarulhos, in the Metropolitan Region of São Paulo, at Cabuçu District.

The QLGP is located at Sítio das Pedreiras, S/N, Cabuçu District, Guarulhos – SP, Brazil (Latitude 23º24'46.43" S, Longitude 46º33'27.71" W).

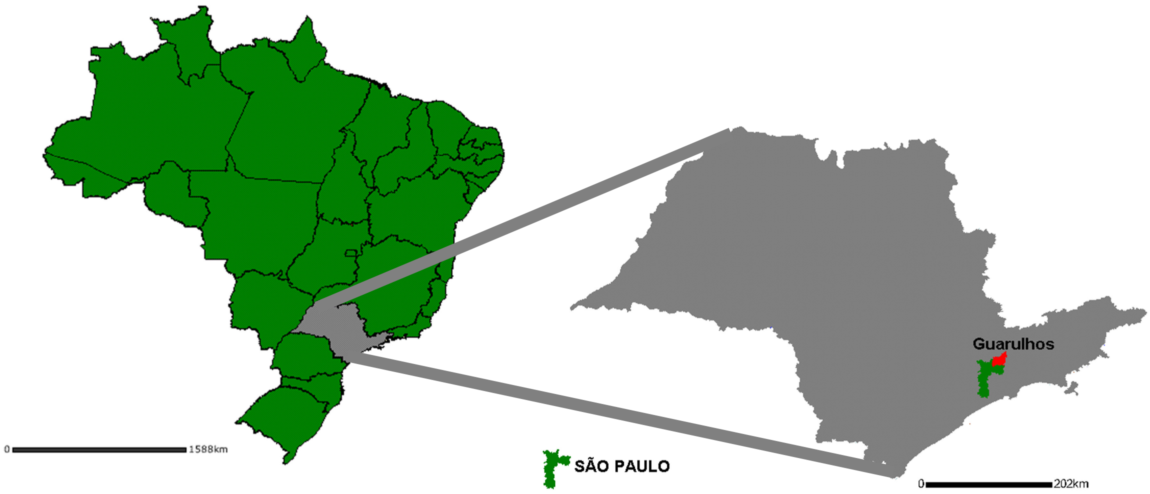

Figure 1. Guarulhos location (Source: IBGE[2] and Google Earth)

[2] Adapted from: http://mapas.ibge.gov.br , accessed on 21/11/2014

Figure 2. Aerial view of Quitaúna Landfill
(Source:Quitaúna)

A.3. Technologies and/or measures

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Quitaúna will use only state-of-art landfill technology in its landfills. 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*). Quitaúna landfill was qualified with an IQR of 9.8[3] (range 0 to 10).

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 will be 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>

[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 26/11/2013

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

Figure 2 – Example of collection system (manifolds)
Source: Cenbio, 2006

Quitaúna landfill intends to install and improve drains directly in the landfill. A covering layer will be installed around the drains to avoid the exhaust gases.

The top of the existing and new vertical drains will be 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 length. In the body of the head, a derivation of HDPE or similar ø 90 mm will be installed and attached to a butterfly valve which is connected to a hose ø 90 mm of HDPE or similar, which is finally connected to the tubing of collection.

Figure 3 - Example of collection system (well head)
Source: Landfill Methane Outreach Program - EPA

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

Removers of condensate will be 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 will be returned to the landfill, through pumps installed at the base of the removers.

All drains will be connected to the adjustment of station located around the landfill, through the collection pipes. The basic functions of the stations will promote the systematic control and monitoring of the characteristics of biogas extracted. Each station will have 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.

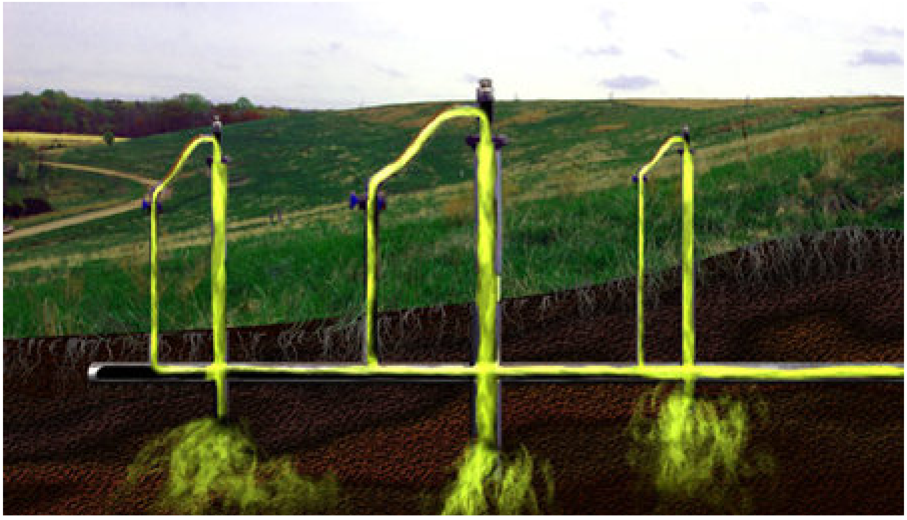


Figure 4 - Illustrative of transport system
Source: Landfill Methane Outreach Program - EPA

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 will depend on flow of the landfill gas. A nominal flow of 2,500 Nm^3/h is considered 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: John Zink

Flare System

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

The dimensioning of the blowers will depend on flow of the landfill gas. A nominal flow of 2,500 Nm^3/h is considered per each blower and the installed capacity around 37 kW for each equipment. 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: Landfill Methane Outreach Program - EPA

Biogas Station

The collection of gas within the landfill will be 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 will depend on the pressure of operation of flares. In addition, the biogas station will have the following:

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

Figure 7 - Example of a biogas station

The biogas station will have, even a system of destruction of methane through flares. This system will be composed initially by 1 enclosure flare 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.

Despite the operational lifetime of the project activity is 21 years, the remaining lifetime of the project activity cannot be determined at this point since no equipment has been commissioned/installed yet.

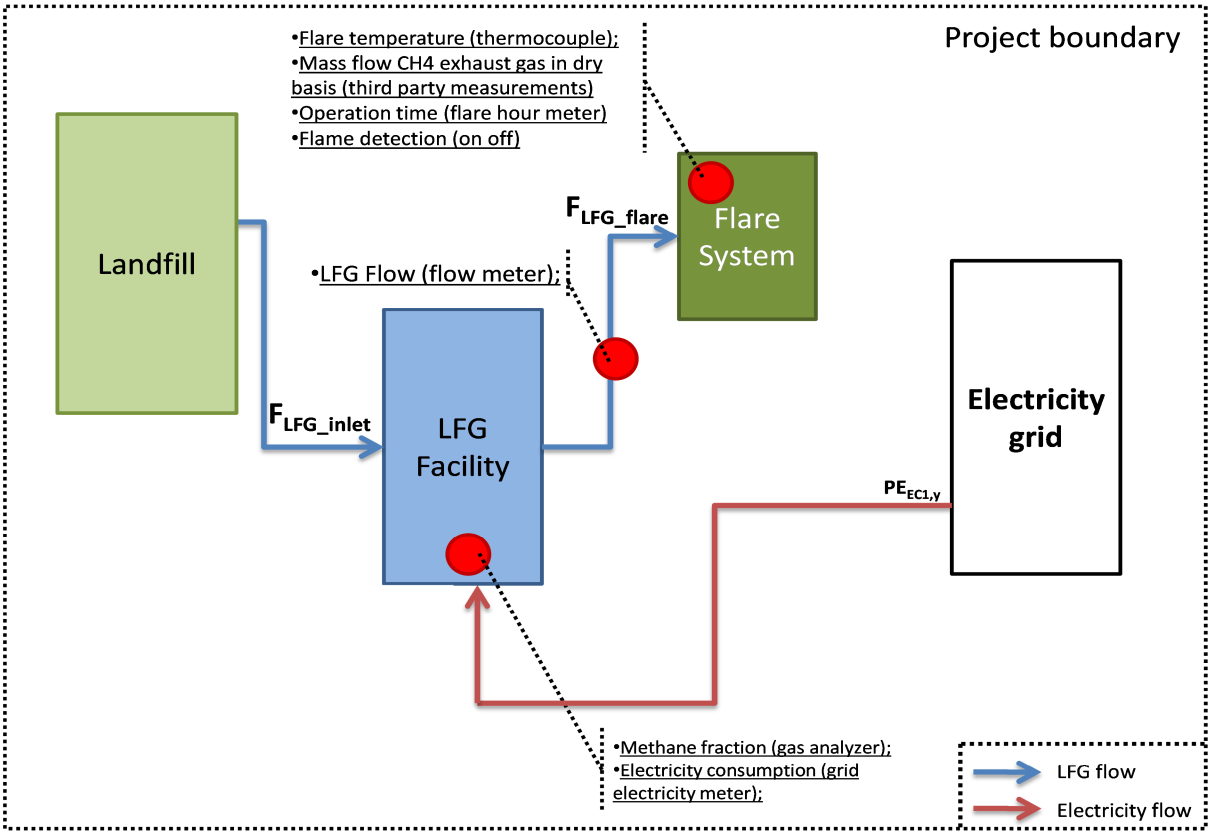
The only equipment in operation under the existing scenario prior to the implementation of the project activity are the vertical drains which venting the LFG through passive LFG capture system. For active capture system, these existing vertical drains will be improved to increase the LFG capture efficiency, according to described above.

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

Technology will have to come from the Europe and mainly from Italia. Hence, technology transfer will occur from countries with strict environmental legislative requirements and environmentally sound technologies.

The technology for biogas collection and flaring can be considered state of art in the Brazilian sanitation context, because all equipment involved has the highest level of development, and the technology used to combust LFG to produce electricity is not a usual business practice in Brazil, as demonstrated in Section B.5.

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



Defined as:

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

Where:

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

And,

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

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

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

- Landfill area: 41,3 ha;
- Total waste amount: 4,500,000 tonnes;
- The disposal waste is type Class II-A and Class II-B[5];
- The landfill lifetime is 18 years (estimated from 2001 to 2018);
- Waterproofing with geomembrane and drainage of leachate;

[4] The information was based on the internal studies provided by Quitaúna 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, 12/06/2013.

- 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)	Quitaúna Serviços Ltda. (private entity) Econergy Brasil Ltda. (private entity)	No

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);
- 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 will be 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 and topographical map 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 iii) Supplying the LFG to consumers through a natural gas distribution network.	**<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 specification report of the landfill gas plant project, indicating the components involved in 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.	**<u>Applicable</u>** There was no recycling of organic waste in the absence of 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; 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.	**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 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 there is no electricity consumption from the diesel generators (electricity consumption from an off-grid fossil fuel fired captive power plant).

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 specification report issued by MULTIAMBIENTE 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 specification report of the landfill gas plant project, indicating the components involved in the landfill gas plant have been made available to 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 LFG analysis report issued by third party company 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 specification report 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 project specification report issued by MULTIAMBIENTE 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.

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.

As the project was not implemented yet, it is not possible to provide an evidence of the electricity consumption.

B.3. Project boundary

The project boundary is limited to the area occupied by the Quitaúna landfill. 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:

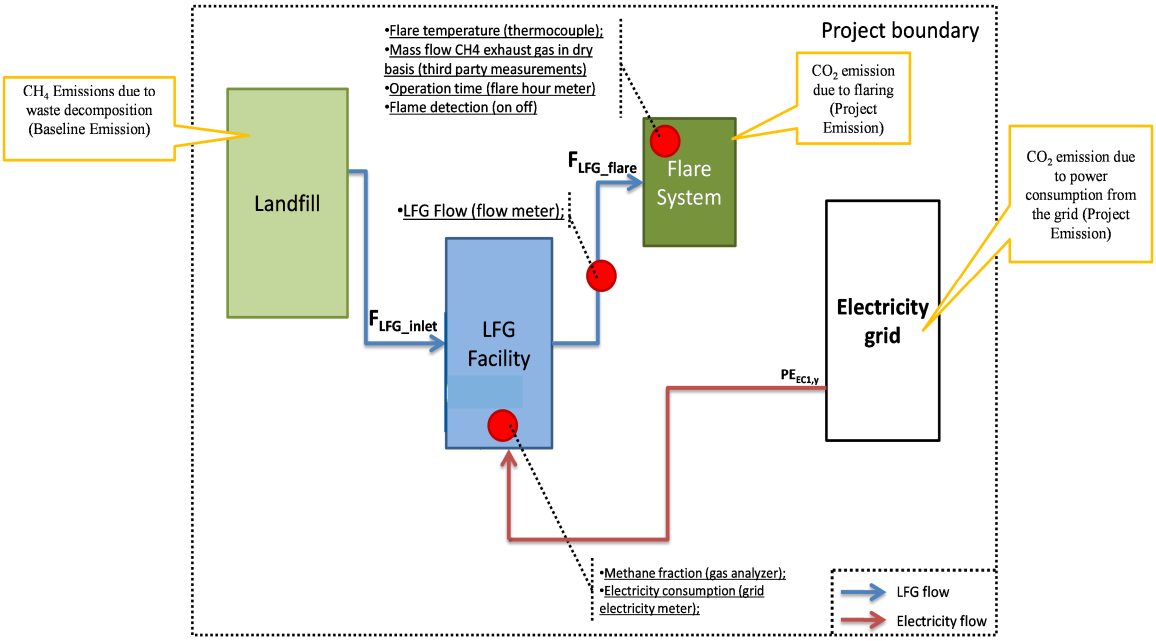

Figure 8 – Flow diagram project boundary

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 Quitaúna Landfill Gas Project in 2007, 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 27/05/2007, 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) [6], 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 4 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 ($EF_{grid,CM,}y$ and $EF_{grid,OM,y}$ are ex-post monitored, $EF_{grid,BM,y}$ defined ex-ante using the 2013 published value by Brazilian DNA and GWP_{CH4}). Further information can be seen in section B.6.

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

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),[7] 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.

[7] 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[8].

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

[8] 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).

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 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)[9] 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.

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

For enclosed flares that are defined as low height flares[10], 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 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:

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

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

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

- (A) Flame enclosure height: 7.7 m;
- (B) Flame enclosure diameter: 2.2 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) = 3.5

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*.

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:

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

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 1 – Parameters[11] 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[12]	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:

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

[11] 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.

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

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 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[13] 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:

[13] According to Operational License: 32005189 valid until 31/03/2015

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

Where:

$F_{CH4,BL,sys,y}$	=	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.[14]

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)

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

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

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

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

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

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

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

The emission factor is calculated as follows:

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

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 which the project activity is displacing grid electricity

The $EF_{grid,OM-DD,2013}$ is displayed on the Brazilian DNA website[15] 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:

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

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

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

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

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

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

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 × 0.25 + 0.2713 × 0.75 = 0.3518 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[16].

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

[16] 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”*

Project emissions

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

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)
PEDT,y	=	Emissions from the distribution of compressed/liquefied LFG using trucks, in year y (t CO2/yr)

There is no consumption of fossil fuels due to the project activity and no distribution of compressed/liquefied LFG using trucks, in year *y* (tCO_2/yr), therefore $PE_{FC,y} = 0$ and $PE_{DT,y} = 0$.

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. 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[17]
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	Quitaúna landfill

[17] 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 10/08/2014 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 10/08/2014.

<table>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th colspan="2">Composition of waste</th></tr>
<tr><td>A) Wood and wood products</td><td>1.70%</td></tr>
<tr><td>B) Pulp, paper and cardboard (other than sludge)</td><td>18.00%</td></tr>
<tr><td>C) Food, food waste, beverages and tobacco (other than sludge)</td><td>53.00%</td></tr>
<tr><td>D) Textiles</td><td>3.70%</td></tr>
<tr><td>E) Garden, yard and park waste</td><td>0.00%</td></tr>
<tr><td>F) Glass, plastic, metal, other inert waste</td><td>23.60%</td></tr>
<tr><td>TOTAL</td><td>100%</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>Quitaúna internal report</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emission</td></tr>
<tr><td>Additional comment</td><td>Used for projection of methane avoidance</td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>$SPEC_{flare}$</td></tr>
<tr><td>Unit</td><td>Temperature - ℃
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>1,250 ºC</td></tr>
<tr><td>Standard flare temperature</td><td>1,100 ºC</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>Minimum retention time</td><td>greater than 0.3 sec</td></tr>
<tr><td>Oxygen in the exhaust gas</td><td>greater than 3%</td></tr>
<tr><td>Methane content</td><td>25 - 60%</td></tr>
<tr><td>Maximum duration in days between maintenance events</td><td>7 days[18]</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>

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

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	-

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 will be installed in the project activity
Source of data	Feasibility study
Value(s) applied	65%
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[19]

[19] Since the average daily temperature in city of Guarulhos is 20.2ºC and monthly average precipitation (MAP) is 1.477 mm, thus Quitaúna landfill is located in a tropical/wet climate. Source: http://www.bdclima.cnpm.embrapa.br/resultados/balanco.php?UF=&COD=326. Accessed on 21/11/2014.

Choice of data or Measurement methods and procedures	According to "Emissions from solid waste disposal sites", the *Application A* was used because the Quitaúna 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	-

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 ℃)</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 and annual precipitation had been provided by Brazilian Agriculture and Farming Research Company (EMBRAPA) [20]. The mean annual temperature (MAT) is 20.20ºC and the mean annual precipitation (MAP) 1,477 mm.</td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>MM_i</td></tr>
<tr><td>Unit</td><td>kg/kmol</td></tr>
<tr><td>Description</td><td>Molecular mass of greenhouse gas i</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>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>

[20] Source: http://www.bdclima.cnpm.embrapa.br/resultados/balanco.php?UF=&COD=326 . Accessed on 26/11/2013.

Data / Parameter	MM_k
Unit	kg/kmol
Description	Molecular mass of gas *k*
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream
Value(s) applied	<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>
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	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

>>

<u>Emission reduction</u>

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 $F_{CH4,PJ,y}$ are:

- Methane content in LFG = 50% (default value[21]);
- LFG collection efficiency = 65%: (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 will capture only a portion of the generated landfill gas. Thus, an estimate of 65% 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.

Table 2 - Ex-ante estimation of FCH4,PJ,y

Year	$F_{CH4,PJ,y}$ (tCH_4/yr)
2014	4,189
2015	7,163
2016	7,324
2017	7,466
2018	7,595
2019	5,931
2020	4,761
2021	1,570

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

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

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

Table 3 - Ex-ante estimation of $F_{CH4,BL,y}$

Year	$F_{CH4,BL,y}$ (tCH_4/yr)
2014	838
2015	1,433
2016	1,465
2017	1,493
2018	1,519
2019	1,186
2020	952
2021	314

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

Year	$BE_{CH4,y}$ (tCO_2/year)
2014	75,397
2015	128,941
2016	131,823
2017	134,395
2018	136,717
2019	106,762
2020	85,692
2021	28,257

The equation of the baseline emission calculation is:

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

The result is:

Table 5 - Baseline emission calculation

Year	$BE_{CH4,y}$ (tCO_2/year)	BE_y (tCO_2/yr)
2014	75,397	75,397
2015	128,941	128,941
2016	131,823	131,823
2017	134,395	134,395
2018	136,717	136,717
2019	106,762	106,762
2020	85,692	85,692
2021	28,257	28,257

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);

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

$PE_{EC1,y}$ - 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 World Bank Databank for the year 2011.[22] Table below summarizes the project emissions resulting from electrical consumption in the plant.

[22] 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 25/11/2013.

Table 6 - Electricity consumption from the grid resulting due to project activity

Year	Electricity consumption from the grid – $EC_{PJ,y}$ (MWh/yr)	$PE_{EC,y}$ (tCO_2/year)
2014	390	160
2015	650	267
2016	650	267
2017	650	267
2018	650	267
2019	650	267
2020	650	267
2021	260	107

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);

Year	BE_y (tCO_2/year)	PE_y (tCO_2/year)	ER_y (tCO_2/year)
2014	75,397	96	75,300
2015	128,941	267	128,674
2016	131,823	267	131,556
2017	134,395	267	134,128
2018	136,717	267	136,449
2019	106,762	267	106,495
2020	85,692	267	85,424
2021	28,257	43	28,214

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[23] (t CO_2e)
2014*	75,397	96	0	75,300
2015	128,941	267	0	128,674
2016	131,823	267	0	131,556
2017	134,395	267	0	134,128
2018	136,717	267	0	136,449
2019	106,762	267	0	106,495
2020	85,692	267	0	85,424
2021*	28,257	43	0	28,214
Total	**827,983**	**1,743**	**0**	**826,240**
Total number of crediting years	**7**			
Annual average over the crediting period	118,283	249	0	118,034

* The starting date of the second crediting period is 27/05/2014
** The end date of the second crediting period is 26/05/2021

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

[23] The emission reductions expected for the second crediting period is are higher than the emission reductions assumed in the first crediting period registered PDD (version 6, dated 20/09/2006). 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.

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	m^3 /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[24]) assuming data from 2011 which is the most recent data available.

[24] http://databank.worldbank.org/ddp/home.do?Step=12&id=4&CNO=2, accessed on 21/11/2014.

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
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>2014</td><td>390</td></tr><tr><td>2015</td><td>650</td></tr><tr><td>2016</td><td>650</td></tr><tr><td>2017</td><td>650</td></tr><tr><td>2018</td><td>650</td></tr><tr><td>2019</td><td>650</td></tr><tr><td>2020</td><td>650</td></tr><tr><td>2021</td><td>260</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: Blower: 74 kW; Computer and computer screen: 0,150 kW Total installed capacity: 74.15 kW Total internal electricity consumption: 650 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".

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 ^{o}C indicates that a significant amount of gases are still being burnt and that the flare is operating. Data will be recorded continuously and values will be averaged hourly or at a shorter time interval. The monitoring port for the monitoring of the temperature of the flare is located at the middle third of the flare[25]. 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

[25] 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
toring 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[26].
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[27].
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 Quitaúna preventive maintenance program which defines the frequency for checking flare equipment situation every week.($SPEC_{,flare}$)

B.7.2. Sampling plan

>>
Not applicable.

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

[27] 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:

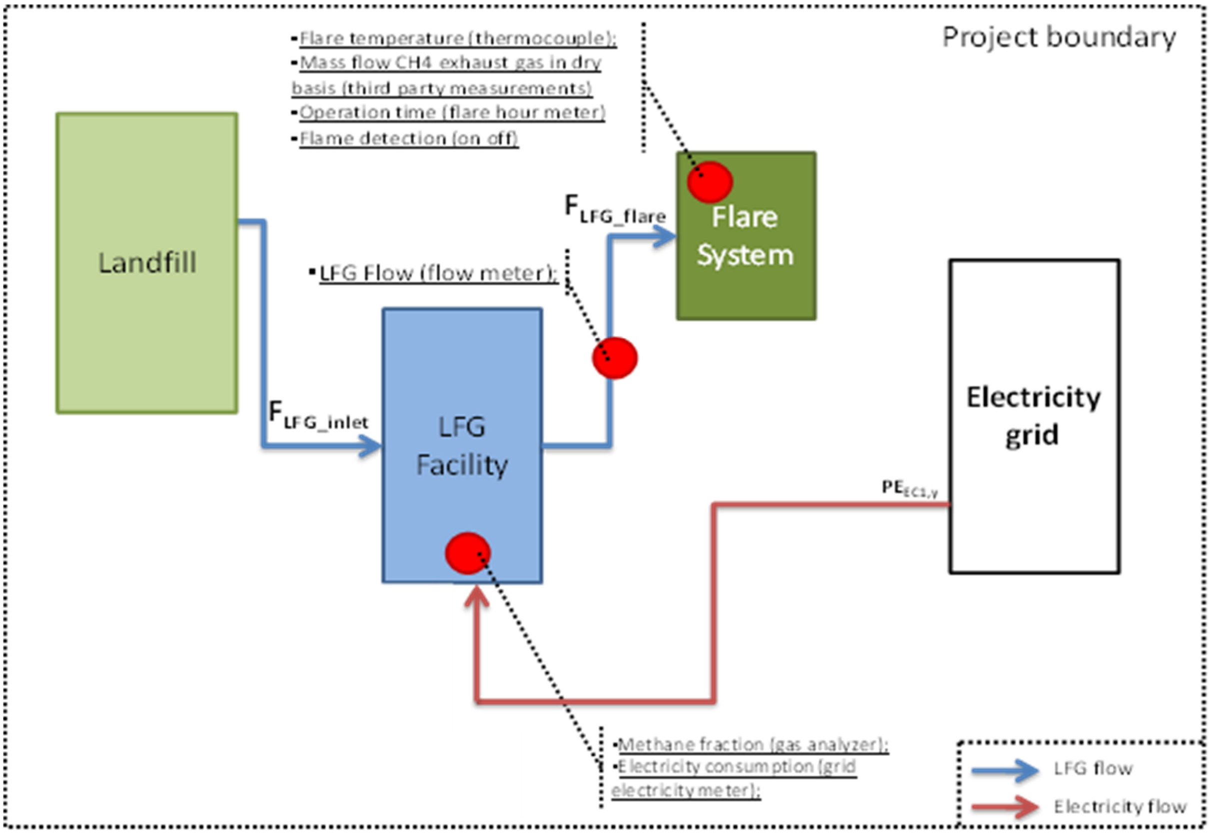

Figure 9 - Monitoring equipment locations

All continuously measured parameters (parameters related to volumetric flow of the gaseous stream, LFG CH_4 concentration, LFG temperature[28], LFG pressure[29], flare temperature, flare operating hours and electricity from the grid 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.

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

[29] 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).

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 Quitaúna Serviços Ltda´s organizational structure is presented in the figure below:

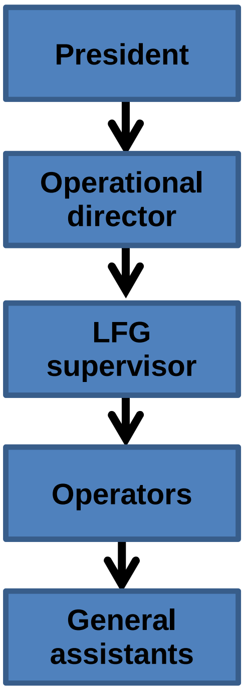

Figure 10 – Quitaúna Serviços Ltda organizational structure

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

- Supervise and verify metering and recording (Quitaúna responsibility): The staff will coordinate internally with other departments to ensure and verify adequate metering and recording of data.
- Collection of additional data (Quitaúna 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 (Quitaúna 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 (Econergy): The staff will prepare the monitoring report for verification.
- Data Archives (Quitaúna / Econergy): 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.

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.

The flow meter provides a normalizer unit which normalizes 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 $v_{i,RG,m}$[30]). The equipment selected for the project activity uses a continuous monitoring system as defined in ACM0001, which measures and aggregates flow data.

By the fact that the parameters related to volumetric flow of the gaseous stream are converted to normal conditions during the monitoring process, this parameter is not be needed except 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

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

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.

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.

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 10/08/2014.

This monitoring report was developed and reviewed by:

Consultancy	Project Proponent (Project Participant)
Econergy Brasil Ltda.	Quitaúna Serviços Ltda.
Francisco Santo francisco.santo@econergy.com.br	Antonio Abdul Nour tonynour@uol.com.br
João Sprovieri joao.sprovieri@econergy.com.br	

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
Project starting date: 01/04/2007[31]

C.1.2. Expected operational lifetime of project activity

>>
21 years and 0 months[32]

[31] According to registered PDD.

[32] Despite the landfill lifetime is 18 years (from 2001 to 2018), the project activity lifetime is 21 years, composed by the first crediting period from 27/05/2007 to 26/05/2014, the second crediting period from 27/05/2014 to 26/05/2021 and the third crediting period from 27/05/2021 to 26/05/2028.

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 the date of UNFCCC approval of the 2nd crediting period.

C.2.3. Length of crediting period

7 years and 0 months.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
The possible environmental impacts have been analyzed by the São Paulo State Environment Agency (*CETESB*). Quitaúna Serviços Ltda has all the pertinent licenses for Quitaúna landfill. The licenses are:

- Phase 1, 2 e 3: n° 15005039 valid until 03/01/2016
- Phase 4 e 5: n° 15006618 valid until 25/09/2018
- Phase 6: n° 15005344 valid until 07/07/2016

There will be no transboundary impacts resulting from QLGP. 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 QLGP. 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

>>
The project activity consulted the stakeholders at the time of the validation under the Brazilian DNA's Rules to obtain the LoA.

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

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

Letters were sent to stakeholders involved and affected by the project activity such as:

- Prefeitura Municipal de Guarulhos – SP / Municipal Administration of Guarulhos - SP
- Secretaria Municipal do Meio-Ambiente / Municipal Environmental Secretariat;

- Câmara dos Vereadores de Guarulhos – SP / Municipal Legislation Chamber of Guarulhos - SP
- Secretaria Estadual do Meio Ambiente / Environmental Secretariat of São Paulo State
- Associação Consciência Ecológica;
- Casa de Cultura Água e Vida;
- Conselho Estadual do Meio-Ambiente / State Environmental Council;
- Departamento de Limpeza Urbana de Guarulhos – DELURB / Guarulhos Department of Urban Waste Collection;
- IBAMA – Instituto Brasileiro do Meio-Ambiente e dos Recursos Naturais Renováveis / Brazilian Institute of Environment and Renewable Natural Resources;
- Ministério Público do Estado de São Paulo / Public Ministry of São Paulo State
- Fórum Brasileiro de ONGs / Brazilian NGO Forum

E.2. Summary of comments received

>>

A comment from FBOMS was received. According with the comment, the entity express gratitude for the correspondence dispatched by Quitapuna. FBOMS also recognizes their role, as one of several institutions listed in the “Resolução n° 1”, created by the Brazilian DNA – Designed National Authority (CIMGC – Comissão Interministerial de Mudança Global do Clima), that must invited 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 provide the improvement of sustainability and the quality of projects collaborating with the implementation of international climate exchange regime. Furthermore, 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 of this sort of projects. Therefore, they emphasize their interest in technical information evaluation, but a lack of a more detailed analysis of the project, does not means their approval of the same.

They also suggest the application of sustainability criteria in order to evaluate the project’s real impact on sustainable development.

E.3. Report on consideration of comments received

>>

Quitaúna appreciated the comment from Fórum Brasileiro de ONGs.A letter was sent from Quitapuna expressing their gratitude for the considerations about the QLGP and the company is available in providing any necessary additional information. Quitaúna informed that they might study the adoption of a sustainability criteria certification, but recognizes that the CDM verification procedures already include the monitoring of such criteria.

SECTION F. Approval and authorization

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In the proposed project, Quitauna Serviços Ltda. and Econergy Brasil Ltda. are the project participants.

Thus, the Party involved is only Brazil.

In accordance with the paragraph 246 in the “Clean Development Mechanism Project Cycle Procedure (version 03.1)”, the project participant has already obtained a letter of approval from the Brazilian DNA, and it is not necessary to obtain a new letter at the renewal of the crediting period.

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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	Quitaúna Serviços Ltda.
Street/P.O. Box	Avenida Rotary, 400
Building	
City	Guarulhos
State/Region	SP
Postcode	07042-000
Country	Brazil
Telephone	+55 (11) 6421.6222
Fax	+55 (11) 6421.3220
E-mail	tonynour@uol.com.br
Website	www.quitauna.com.br
Contact person	Antônio Nour
Title	Director
Salutation	Mr
Last name	Nour
Middle name	
First name	Antônio
Department	Director
Mobile	+ 55 (11) 6421-6222
Direct fax	+55 (11) 6421-3220
Direct tel.	+ 55 (11) 9988-8654
Personal e-mail	tonynour@uol.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	Av. Angélica, 2530, cj. 111
Building	Edifício Reynaldo Raucci
City	São Paulo
State/Region	SP
Postcode	01228-200
Country	Brazil
Telephone	+ 55 (11) 3555-5700
Fax	+ 55 (11) 3555-5735
E-mail	info@econergy.com.br
Website	http://www.econergy.com.br
Contact person	Mr. Flavio Cotrim Pinheiro
Title	Director
Salutation	Mr.
Last name	Pinheiro
Middle name	Cotrim
First name	Flavio
Department	-
Mobile	-
Direct fax	+ 55 (11) 3555-5700
Direct tel.	+ 55 (11) 3555-5735
Personal e-mail	Flavio.pinheiro@econergy.com.br

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:

Econergy Brasil Ltda, São Paulo, Brazil
Telephone: +55 (11) 3555-5700
Contact person: Mr. João Sprovieri (Engineer)
Mr. Francisco Santo (Director)

Email: francisco.santo@econergy.com.br
joao.sprovieri@econergy.com.br

Econergy Brasil Ltda is a Project Participant.

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

1. Key Parameters

Year landfilling operations started	Oct/2001
Projected year for landfill closure - estimated based on current filling rate	2018[33]
GWP for methane (UNFCCC and Kyoto Protocol decisions)	25
Methane concentration in LFG (% by volume) typical assumption for emission reduction calculation[34]	50
LFG collection efficiency (%)	65
Flare efficiencies (%) operational data from flare manufacturer	99%
Electricity consumption from the grid 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
LFG destruction rate in the baseline scenario	20%

[33] The project participant issued an internal declaration, made available to the DOE, affirming that the closure year of the landfill will be 2018.

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

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 7 - Forecast amount of waste disposal in the landfill

Year	Waste disposal (tonnes/yr)
2001	86,747
2002	374,362
2003	314,033
2004	279,466
2005	299,952
2006	365,013
2007	327,835
2008	332,829
2009	343,407
2010	355,295
2011	375,382
2012	384,170
2013	381,539
2014	381,539
2015	381,539
2016	381,539
2017	381,539
2018	381,539

Table 8 - Composition of solid waste disposed in the landfill

Wood and wood products	1.70%
Pulp, paper and cardboard (other than sludge)	18.00%
Food, food waste, beverages and tobacco (other than sludge)	53.00%
Textiles	3.70%
Garden, yard and park waste	0.00%
Glass, plastic, metal, other inert waste	23.60%
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)		
2^{nd} crediting Period		**0.3518**
Build Margin - 2013		0.2713
Margi	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[35]

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)

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 9 - 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[36]	2002	215,770	6,550	1,032	5,061	228,413	94.46%
PNSB 2008[37]	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.

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

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

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

It is important to notice that this study includes the formal[38] and informal[39] 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)[40]:

- 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

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[41] 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[42] published by CETESB in 2013 which considered formal and informal means of solid waste treatment, in the Quitaúna 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 Quitaúna 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

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

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

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

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

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

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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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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