Project design document form
(Version 11.0)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	CTL Landfill Gas Project
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	25
Completion date of the PDD	05/10/2020
Project participants	EcoUrbis Ambiental S/A Norwegian Ministry of Climate and Environment First Climate (Switzerland) AG Allcot AG
Host Party	Brazil
Applied methodologies and standardized baselines	ACM0001: Flaring or use of landfill gas, version 19.0;
Sectoral scopes	Sectoral Scope: 1 -Energy industries (renewable – / non-renewable sources) Sectoral Scope: 13 - waste handling and disposal
Estimated amount of annual average GHG emission reductions	**1,117,018 tCO_2e**

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

The proposed project activity has the objective to capture and to flare/combustion the landfill gas[1] produced in the new[2] landfill called, "*Central de Tratamento de Residuos Leste – CTL*" located in the city of São Paulo (in the state of São Paulo), Brazil.

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

- Burning CH_4 in flares and/or group generators;
- Supply consumers through a dedicated pipeline;
- The amount of electricity generated in the project activity will be part used for self-consumption at CTL landfill facilities and the surplus part will be exported to the Brazilian national grid, avoiding the dispatch of an equal amount of energy produced by fossil-fuelled thermal plants to that grid. The initiative avoids CO_2 emissions and contributes to the regional and national sustainable development.

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

The project activity includes two phases: The first phase (2012) was to capture, flare and supply the landfill gas (LFG) to a costumer through a dedicated pipeline. The second phase (2016 to 2027) is the implementation of a power generation plant that will use LFG to generate electricity. The installed generation capacity will be expected to change during the lifetime of the project.

The first phase of the project was the construction an efficient capture, collection and flaring system to burn CH_4 (a greenhouse gas) as well as supply the landfill gas (LFG) to a costumer through a dedicated pipeline. These actions will reduce odours and adverse environmental impacts.

Ecourbis Ambiental S.A. will inject part of its collected LFG (approximately 78%) to São João Energia thermoelectric plant (SJEA)[3] and FSL/ZEG thermoelectric plant, to be combusted in LFG engine generator sets of high performance standards.

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

[2] Due to the Post Registration Changes, it is important to highlight that at the time of the registration of the original PDD (registered 27th July 2012), CTL Landfill was defined as new in the PDD by the reason of the closure of São João Landfill, located in a neighbouring area where CTL Landfill is currently located and responsible for the waste disposal of solid waste in region East and South of the city of São Paulo.

CTL Landfill began its operation on 24 November 2010 and was designed with a passive LFG collection and open flaring system (at the top of the vertical draining wells) in order to meet with the landfill operation geotechnical, environmental and safety conditions according to the EIA/RIMA aprooved by the Environmental Agency CETESB (Companhia Ambiental do Estado de São Paulo) With the approval of the EIA/RIMA, CTL landfill received, from CETESB, the Operational License no. 30006398, process number 30/00847/08, issued on 23/11/2010 and valid until 23/11/2015. Currently, the landfill count on an updated operational license 30010470 issued on 28/10/2016 and valid until 28/10/2021. Regarding the environmental license from the landfill area expansion, a new Operational License has been issued by CETESB, no 30010065, process number 30/00847/08, issued on 26/02/2016 and valid until 26/02/2021. Thus, besides being defined as new landfill in the PDD, CTL Landfill already had an existing passive LFG capture system at the start of its operation but not an existing active LFG capture system and flaring as the project activity.

During the second phase, the project will install generators that will combust the LFG to produce electricity, using the majority part of the electricity for self-consumption at CTL landfill facilities and the surplus part will be exported to the grid. The flares will be kept in operation due to LFG excess, periods when electricity will not be produced or other operational considerations. The LFG power plant will be expected to install approximately 4.278 MW upon project completion. However, the final equipment that will be chosen (as well as the final installed capacity) may vary depending on the availability of the generator equipment in the market at the time of actual implementation of the second phase.

The LFG capture and collection systems and flaring station are consisted on a LFG pipeline grid and a flaring station, equipped with flares, centrifugal blower(s), and all other supporting mechanical and electrical subsystems and appurtenances necessary to run the system. The supplying of LFG to the consumer is made using a dedicated pipeline connecting CTL LFG plant to SJEA[4] and FSL/ZEG thermoelectric plants, guaranteeing the high efficiency combustion of the LFG for energy purposes and also honouring the LFG purchase agreement signed on 30th September 2013 between Ecourbis Ambiental S/A and São João Energia Ambiental S.A. and the agreement signed on 1st November 2016 between Ecourbis Ambiental S/A and FSL/ZEG Consultoria Empresarial EIRELI. It is important to highlight that in case any of the LFG consumers presents operational problems, the LFG flow to the dedicated pipelines is automatically closed and no LFG venting to atmosphere will occur.

The power generation facility will be comprised of LFG engine generator sets of high performance standards. The engine-generator sets will be the primary equipment to combust the collected LFG once they are installed. A fraction of the collected LFG will be diverted to flares, which will be used to combust any gas in excess of the fuel demand for the engines, as well as a contingency backup.

The landfill began its operation on 24 November 2010, receiving of household waste (Class II-A and II-B). The increased area of the landfill is 704.106 m² incorporated to the existent landfill area of 1.123.590 m². Thus, the total landfill area considering the increased area is 1.827.696 m². There is the possibility of increasing the waste disposal area, however this possibility will be analyzed in the future.

In order to guarantee an efficient LFG capture and maximum quality, compaction and sanitary coverage of waste are carried out daily as well as connection of vertical drains. When operationally feasible, LFG is captured from the drains near to the waste discharge front and the quality of LFG flow is monitored. Also, continuous adjustments are carried out for the collection drains and the field is monitoring by specialized consultants.

EcoUrbis Ambiental S.A.[5] is the company responsible for the implementation and operation of the CTL landfill and also, it is responsible, since October/2004, for collection services and disposal of solid waste in region East and South of the city of São Paulo (covering around 6,000,000 of inhabitants) under a concession for twenty years, renewable for another twenty years.

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[3] According to the Termo of Agreement issued and signed by Ecourbis and SJEA on 31th July 2015, item 1.6. – The CERs from LFG produced at CTL Landfill are exclusive propriety of Ecourbis Ambiental.

[4] According to the Termo of Agreement issued and signed by Ecourbis and SJEA on 31th July 2015, item 1.6. – The CERs from LFG produced at CTL Landfill are exclusive propriety of Ecourbis Ambiental.

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

EcoUrbis Ambiental S.A. also counts on a code of ethics an implemented compliance system and policies such as:

- Anti-Corruption Policy;
- Policy on Gifts and Entertainment;
- Supplier Hiring Policy;
- Donation and Sponsorship Policy;
- Partnership Policy.

For this crediting period, estimates of GHG emission reductions are:

- Annual average GHG emission reduction: 1,117,018 tCO_2e
- Total estimated GHG emission reductions: 7,819,126 tCO_2e

Contribution of the Project Activity to Sustainable Development:

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

Ecourbis has been carrying out a program called “Programa de Educação Ambiental” (in English, Environmental Education Program) which has been put into practice since CTL Landfill planning phase and will be extended for all the operational period. The program actions have already reached more than 45,258 children (since 2008), teachers and local communities around the landfill, highlighting issues related to the municipal solid waste (MSW), from waste generation to final disposal.

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

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

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

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

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

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

A.2. Location of project activity

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Host Party:

Brazil

Region/State/Province etc:

São Paulo State

City/Town/Community etc:

São Paulo City

Physical/Geographical location:

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

Geographical Coordinates: (Latitude: 23° 37’ 52.17” S and Longitude: 46° 25’ 30.29” W)[6]

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

Figure 1 - Geographical position of São Paulo city, inside of São Paulo State

(Source: http://www.ibge.gov.br/cidadesat/default.php)

Figure 2 - Aerial view of CTL Landfill

A.3. Technologies/measures

>>

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

LFG Capture and Collection Systems

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

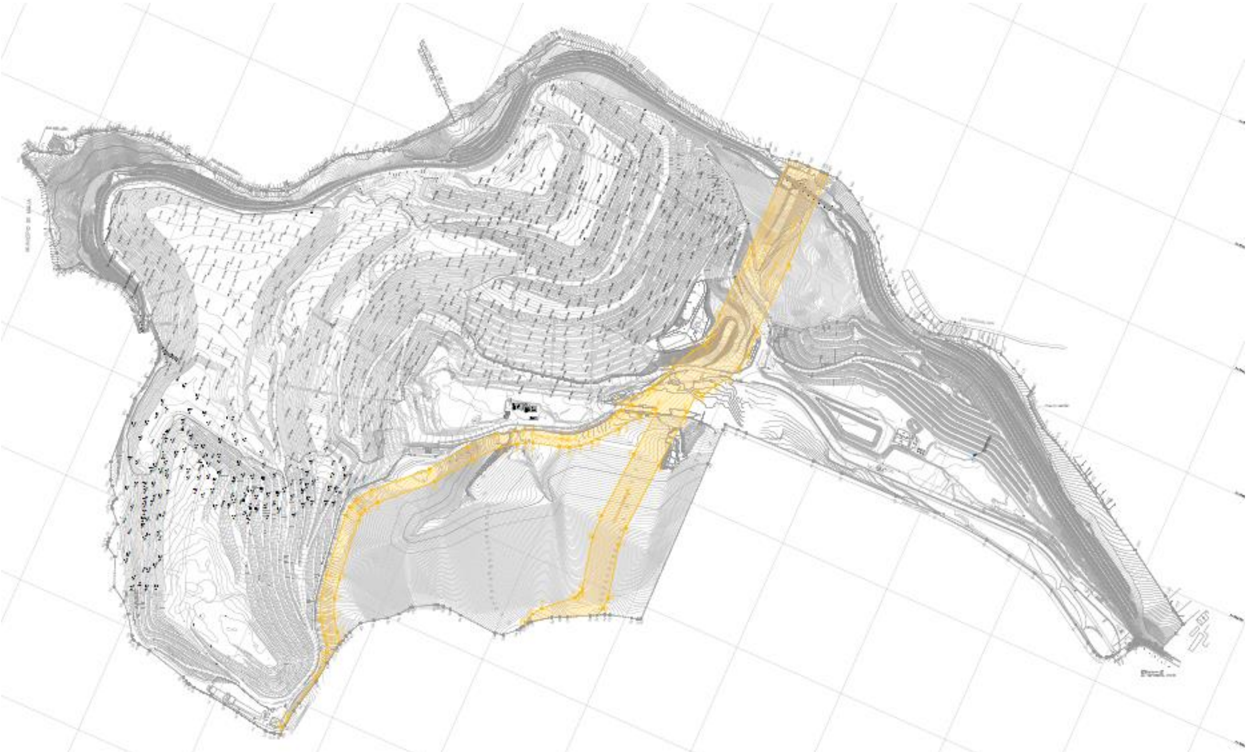

Figure 3 - General view of the LFG Capture and Collection Systems and Flaring Station.

- Capture System (Horizontal Trenches)

The capture system consists on a grid of horizontal trenches made of High Density Polyethylene (HDPE), due to the flexibility and the corrosion resistance. Each trench has an average length of 100 meters and is installed with approximately 15 meters away from each other. The capture system will continue to be installed throughout the lifetime of the CTL. Currently CTL landfill counts with approximately 596 drains, where 284 are connected to the biogas collection network and 181 under active collection, which means counting with adequate LFG quality and flow.

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

Figure 4 - LFG Drainage System.

(Source: EcoUrbis Ambiental S.A.)

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

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

- Vertical Wells/Drains

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

Also, CTL landfill counts with a proper leachate drainage system and periodic monitoring of the generated leachate quality. The leachate is sent for external treatment, and quality is monitored in order to meet the local established standards.

Figure 5 – Leachate drainage system

(Source: EcoUrbis Ambiental S.A.)

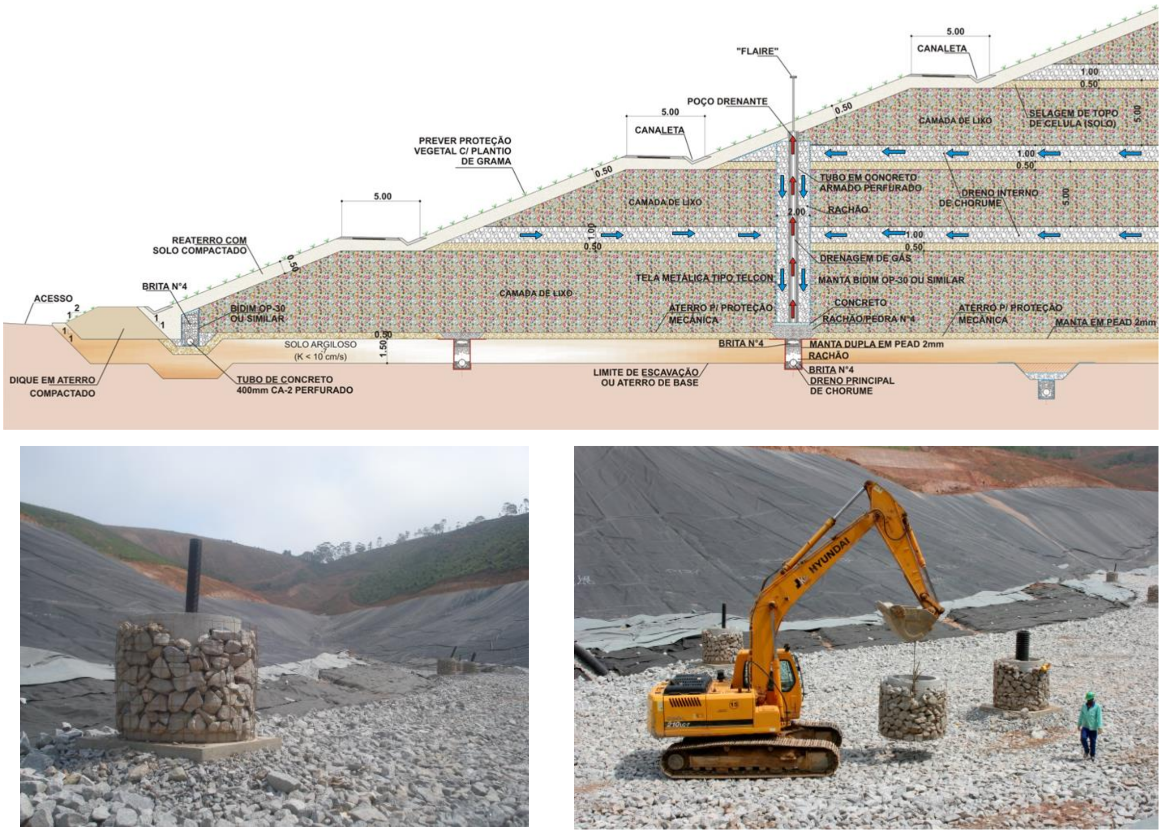

Figure 6 – Design of vertical wells/drains.

(Source: EcoUrbis Ambiental S.A.)

- Collection System (Transmission Pipeline)

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

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

Figure 7 – Connected transmission pipelines

(Source: EcoUrbis Ambiental S.A.)

Flaring Station

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

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

Figure 8 – Flaring station at CTL Landfill Gas Project

(Source: EcoUrbis Ambiental S.A.)

- The Blower System

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

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

Figure 9 – Blower system at CTL Landfill Gas Project

(Source: EcoUrbis Ambiental S.A.)

- The Flare System

The destruction of the methane content in the LFG collected is made via an enclosed flare, in order to assure higher methane destruction (above 98%)[7].

The flare efficiency is monitored according to Option B.1: Biannual measurement of the flare efficiency

The flaring station counts on a system of destruction of methane through flares. This system is composed by 3 enclosure flares and may have additional units installed, according to the LFG generation.

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

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

Figure 10 - Enclosed Flare system at CTL Landfill Gas Project

(Source: EcoUrbis Ambiental S.A.)

Power generation

The power generation system will be comprised of around 4.278 MW. The electricity generated by the Project will be used for self-consumption at CTL Landfill and eventually exported to the electricity grid. The configuration of the equipment will be chosen in accordance with the availability of the generation equipment on the market at the time of actual implementation of the second phase.

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

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

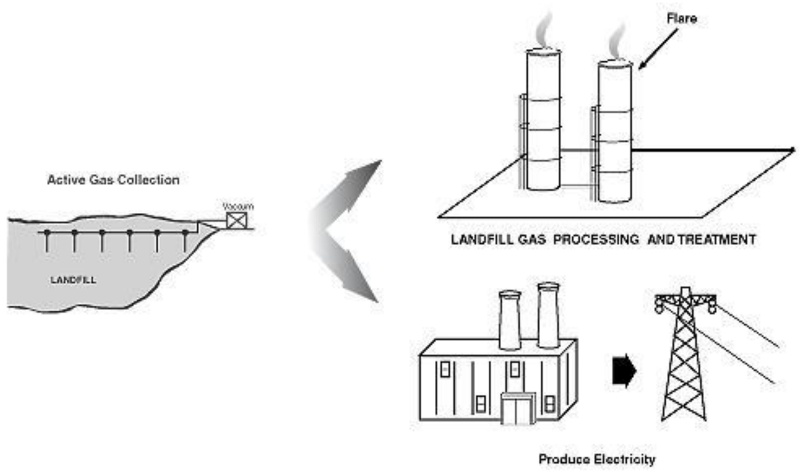

Figure 11 – Power generation diagram

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

Year	Phase	Net capacity (MWe)[1]	Net electricity generated in the plant (MWh)
From 01/04/2020	2	4.278	26,527
2021		4.278	35,369
2022		4.278	35,369
2023		4.278	35,369
2024		4.278	35,369
2025		4.278	35,369
2026		4.278	35,369
Until 31/03/2027		4.278	8,842

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

The lifetime of the equipment is 25 years and it was based on manufacturer's specifications[8].

Monitoring system:

The process is controlled by an electrical control system equipped with a Programmable Logical Controller (PLC). All details related to monitoring of CDM project are provided in section B.7. of this PDD.

[8] The information has been corrected in accordance with manufacturer's specifications and technical literature. Evidences made available to DOE.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	EcoUrbis Ambiental S/A (private entity)	No
Norway	Norwegian Ministry of Climate and Environment	No
Switzerland	First Climate (Switzerland) AG	No
Switzerland	Allcot AG	No

The date of completion the application of the methodology to the project activity study is 15/02/2020.

The person/entity determining the baseline is as follows:
Beng Engenharia Ltda, São Paulo, Brazil

Contact person:
Mr. João Sprovieri (joao.sprovieri@beng.eng.br)
Mr. Francisco Santo (francisco.santo@beng.eng.br)

Beng Engenharia Ltda is not a Project Participant.

A.5. Public funding of project activity

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

A.6. History of project activity

>>
The proposed CDM project activity is not a project activity that has been deregistered, nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA)

A.7. Debundling

>>
Not applicable.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

>>
The following methodologies are applicable to this project activity:

- Large-scale Consolidated Methodology ACM0001: “Flaring or use of landfill gas” (Version 19.0)[9];

[9] https://cdm.unfccc.int/methodologies/DB/JPYB4DYQUXQPZLBDVPHA87479EMY9M

- TOOL02 Methodological tool: “Combined tool to identify the baseline scenario and demonstrate additionality” (Version 07.0)[10];
- TOOL04 Methodological tool: “Emissions from solid waste disposal sites” (Version 08.0)[11];
- TOOL05 Methodological tool: “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (Version 03.0)[12];
- TOOL06 Methodological tool: “Project emissions from flaring” (Version 03.0)[13];
- TOOL08 Methodological tool: “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0)[14];
- TOOL09 Methodological tool: “Determining the baseline efficiency of thermal or electric energy generation systems” (Version 02.0)[15];
- TOOL10 Methodological Tool: “Tool to determine the remaining lifetime of equipment” (Version 01)[16];
- TOOL12 Methodological tool: “Project and leakage emissions from transportation of freight” (Version 01.1.0)[17];
- TOOL07 Methodological tool: “Tool to calculate the emission factor for an electricity system” (Version 07.0)[18];
- TOOL11 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)[19];
- TOOL32 Methodological tool: “Positive lists of technologies” (Version 02.0)[20]

B.2. Applicability of methodologies and standardized baselines

>>

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

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

<u>The methodology ACM0001: “Flaring or use of landfill gas” is applicable to project activities which:</u>

“...

[10] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v7.0.pdf

[11] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v8.0.pdf

[12] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf

[13] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v3.0.pdf

[14] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf

[15] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v2.0.pdf

[16] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-10-v1.pdf

[17] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.1.0.pdf

[18] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

[19] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf

[20] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-32-v2.0.pdf

a) Install a new LFG capture system in a new or existing SWDS where no LFG capture system was installed prior to the implementation of the project activity; or
b) Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that:
   i) The captured LFG was 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 can not 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.
c) Flare the LFG and/or use the captured LFG in any (combination) of the following ways:
   i) Generating electricity;
   ii) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace; and/or
   iii) Supplying the LFG to consumers through a natural gas distribution network;
   iv) Supplying compressed/liquefied LFG to consumers using trucks;
   v) Supplying the LFG to consumers through a dedicated pipeline;
d) Do not reduce the amount of organic waste that would be recycled in the absence of the project activity.

Justification: - Part 1
The methodology **is applicable** because it will be made an investment into an existing LFG capture system to increase the recovery rate (collection efficiency) and change the use of the captured LFG (also electricity generation). The captured LFG was only vented and partially flared in open flares and not used prior to the implementation of the project activity.

In the project activity, the LFG will be flared, will supply consumers through a dedicated pipeline and will generate electricity.

Moreover, the amount of organic waste will be the same in the project activity as well as in the absence of the project activity.

“...
The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is

a) Atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons; 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.

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 a kiln or glass melting furnace;

b) *If the management of the SWDS in the project activity is deliberately changed during the crediting in order to increase methane generation compared to the situation prior to the implementation of the project activity.*

...”

Justification: - Part 2
According to Section B.4 and B.5, the methodology is applicable because:

- The most plausible baseline scenario is release the LFG to atmosphere from the SWDS, and;
- The electricity would be generated in the grid.

Moreover, 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 Correction Factor).

<u>The “Combined tool to identify the baseline scenario and demonstrate additionality” is applicable to project activities where:</u>

“…
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.

Justification:
The tool is **applicable** because 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.

<u>The “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” </u>is **applicable** due to the consumption of fossil fuel by the project activity (with fossil fuel being used for purposes other than for electricity generation). In the particular case of the project activity, Liquefied Petroleum Gas (LPG) has been used to ignite the installed flare (after events of planned or unplanned interruptions of operation of the flare). The applicability condition of the methodological tool is thus met.

<u>The tool “Emissions from solid waste disposal sites” </u>is **applicable** to the project activity because the CDM project activity mitigates methane emissions from a specific existing SWDS (Application A).

The tool to calculate "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" is **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.

As for the monitoring of the amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated:

a) Scenario I: Electricity is supplied to the grid;
b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or
c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.

Justification:
The tool is applicable according to Scenario A and Scenario B stated above since the project activity includes electricity consumption from the grid when electricity generated by the LFG power plant is not operational and electricity consumption from the diesel generators when electricity from the grid is not available.

Also, Scenario I is applicable since the project activity includes electricity generation to the grid.

The tool "Project emissions from flaring" is **applicable** to the project activity 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.

Justification:
Since methane is the component with the highest concentration in the flammable residual gas from waste anaerobic degradation generating LFG and flares used in the project site operate according to the specifications provided by the manufacturer, the tool is available.

The "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" is **applicable** to the project activity because the applicable methodology (ACM0001) demands measuring flow and composition of residual and exhaust gases for the determination of baseline and project emissions.

The "Tool to determine the baseline efficiency of thermal or electric energy generation systems" is **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.

The "Tool to determine the remaining lifetime of equipment" is **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.

The "Project and leakage emissions from transportation of freight" is **not applicable** since the project activity do not involve the transportation of freight.

The "Tool to calculate the emission factor for an electricity system" is **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 and/or leakage emissions from electricity consumption and monitoring of electricity generation" 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.

The "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" is **applicable** to the project activity since it is required to assess the continued validity of the baseline at the renewal of a crediting period.

The "Positive lists of technologies" is **not applicable** to the project activity since the LFG is not exclusively used to generate electricity but also to supply external consumers through a dedicated pipeline.

B.3. Project boundary, sources and greenhouse gases (GHGs)

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	Source	GHG	Included?	Justification/Explanation
Baseline	Emissions from decomposition of waste at the landfill site.	CH_4	Yes	The major source of emissions in the baseline
		N_2O	No	N_2O emissions are small compared to CH_4 emissions from SWDS. This is conservative
		CO_2	No	CO_2 emissions from decomposition of organic waste are not accounted since the CO_2 is also released under the project activity
	Emissions from electricity consumption	CO_2	Yes	Electricity may be consumed from the grid or generated onsite/offsite in the baseline scenario
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
	Emissions from the use of natural gas	CO_2	No	Excluded for simplification. This is conservative
		CH_4	Yes	Emission source when supplying LFG through a dedicated pipeline
		N_2O	No	Excluded for simplification. This is conservative
Project activity	Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO_2	Yes	May be an important emission source.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from electricity consumption due to the project activity	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from flaring	CO_2	No	Emissions are considered negligible
		CH_4	Yes	May be an important emission source
		N_2O	No	Emissions are considered negligible
	Emissions from distribution of LFG to costumers through a dedicated pipelines	CO_2	Yes	May be an important emission source
		CH_4	Yes	May be an important emission source
		N_2O	No	Emissions are considered negligible

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

The project boundary of the project activity shall include the site where the LFG is captured and, as applicable:

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

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

(c) Captive power plant(s) (including emergency diesel generators) or power generation sources connected to the grid, which are supplying electricity in the baseline that is displaced by electricity generated by captured LFG in the project activity; (applicable)

(d) Heat generation equipment or sources which are supplying heat in the baseline that is displaced by heat generated by captured LFG in the project activity; and (not applicable)

(e) The transportation of the compressed/liquefied LFG from the biogas processing facility to consumers. (not applicable but delivered to costumers through a dedicated pipeline applicable)

The flow diagram is presented below:

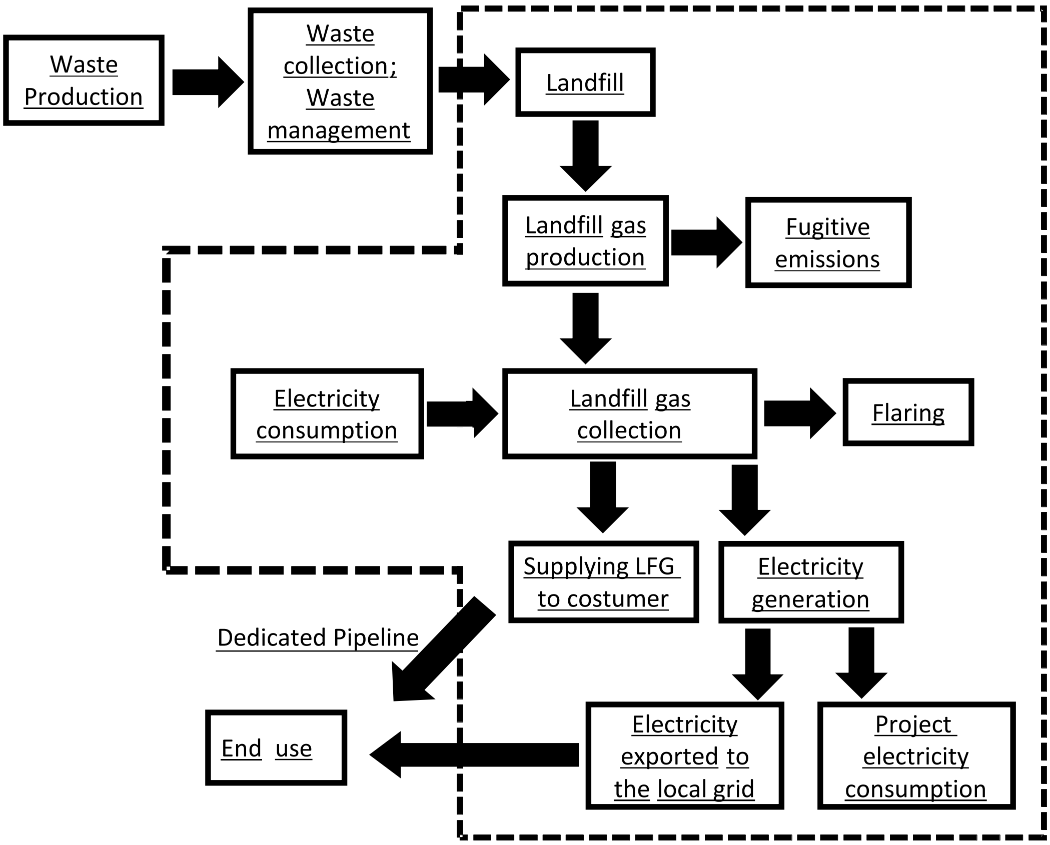

Figure 12 – Flow diagram project boundary

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", 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 the crediting periods have 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 "Procedures for the renewal of the crediting period of a registered CDM project activity" approved by the CDM Executive Board require assessing the impact of new relevant national and/or sectorial policies and circumstances on the baseline.

Prior to the implementation of the project activity the landfill gas was released to atmosphere and electricity was generated in existing and/or new grid-connected power plants, other than the project activity power plant.

Thus the baseline for the 2nd crediting period remains the same as defined in the 1st crediting period and required regulations. The baseline scenario for LFG is assumed to be the atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons. Since LFG is also used in the project activity for generating electricity, the baseline scenario is assumed to be that the electricity would be generated in the grid or in captive fossil fuel fired power plants.

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 project activity in 2004, 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 29/09/2011, 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.

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".

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 use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

This sub-step is not applicable since the baseline scenario of the project activity is the business as usual (BAU) scenario (passive venting system).
In the baseline scenario, electricity is being generated in existing and/or new grid-connected power plants, other than the project activity power plant.
Also, for the supply of LFG through a dedicated pipeline, the baseline is assumed to be the supply with natural gas.

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

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.

Step 2.2: Update the data and parameters

All fixed parameters were updated in accordance with the updated methodology ACM0001, applicable tools and supporting documentation.

- $EF_{grid,BM,y}$ is fixed parameter;
- Update of waste compositon.

All parameters regarding the grid emission factor calculation have been updated for the 2nd crediting period ($EF_{grid,OM,y}$ is ex post monitored, $EF_{grid,BM,y}$ is ex-ante monitored and thus $EF_{grid,CM,y}$ is ex post monitored).

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, flaring and use of LFG);
LFG2	Release of the LFG to atmosphere

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

the EIA (Environmental Impact Assessment) does not cover recycling, treatment or incineration of organic waste, alternatives LFG3, LFG4 and LFG5 should not be considered.

For electricity generation, the realistic and credible alternatives are:

E1	Electricity generation from LFG, undertaken without being registered as CDM project activity;
E3	Electricity generation in existing and/or new grid-connected power plants.

In the absence of project activity, no captive electricity consumption would be necessary. Thus, the alternative scenario E2 should not be considered.

According to the project activity configuration, there will be no heat generation. Therefore, all alternative scenarios addressing these possibilities should not be considered.

Thus, the remaining real alternatives to the project activity are E1 and E3.

Alternative (c): Supply of LFG to a dedicated pipeline.

The combinations of the project activity compose the following scenarios:

Scenarios		Comments
1	LFG1 + E1 + (c)	Possible
2	LFG1 + E3	Possible
3	LFG2 + E1	This alternative is not plausible because to generate electricity in the project activity, it is necessary to implement the capture, flaring and use of LFG.

4	LFG2 + E3	Possible
5	LFG1 + (c)	Possible

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

- Scenario 1 (LFG1 + E1 + (c));
- Scenario 2 (LFG1 + E3);
- Scenario 4 (LFG2 + E3);
- Scenario 5 (LFG1 + (c)).

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),[21] 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. The laws and regulations applicable for the electricity generation component are law 8987/95 and law 9074/95[22].

The scenario 4 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 will monitor all relevant policies and circumstances at the beginning of each crediting period and adjust the baseline accordingly.

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

- Scenario 1 (LFG1 + E1);
- Scenario 2 (LFG1 + E3);
- Scenario 4 (LFG2 + E3);
- Scenario 5 (LFG1 + (c)).

B.5. Demonstration of additionality

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

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

[22] http://www.aneel.gov.br/area.cfm?idArea=43

Table 1 - Implementation timeline of the Project

Key Events	Date
Prior Consideration of the CDM to UNFCCC and Brazilian DNA	06/12/2010
Contract between Designed Operational Entity (DOE) and the PP for the validation process.	20/12/2010
Submit the PDD for Global Stakeholder Consultation (GSC)	08/03/2011
The starting date of the project activity will be the purchase of the main equipment.	29/02/2012
Start-up – Phase I	July/2012
Commercial operation – Phase II*	October/2016

*Estimated

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

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

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

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

The additionality of the project activity will be demonstrated and assessed using the "Combined tool to identify the baseline scenario and demonstrate additionality".

The Step *0*, *1a* and *1b* are described above in section B.4.

Step 2: Barrier analysis

This step serves to identify barriers and to assess which alternative scenarios are prevented by these barriers as per the latest approved version of the "Guidelines for objective demonstration and assessment of barriers". The following Sub-steps are applied:

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

- **<u>Investment barrier:</u>** The implementation of the Scenario 2 (collection and destruction of LFG in enclosed flare + electricity generation in existing and/or new grid-connected power plants) requires a very high amount of investment from such project components:
  - Collection system;
  - Biogas transport pipe system;
  - Blowering System;
  - Flare System;
  - LFG Station (edifications).

In Brazil, flaring LFG in enclosed flare does not generate any revenues and has only expenditures. Therefore, the high investment regarding project components described above is not feasible in the economical point of view.

Outcome of Step 2a: the identified barrier (investment barrier) as described above prevents the scenario 2. However, the identified barrier does not prevent the occurrence of the other scenarios (scenarios 1 and 4).

Step 2b: Eliminate alternative scenarios which are prevented by the identified barriers

As the investment in Scenario 2 does not generate any revenues and has only expenditures for the PP, this scenario is not economical/financial attractive.

- **Outcome of Step 2b:** The three realistic and credible alternative scenarios to the project activity are: Scenario 1 (LFG1 + E1 + c);
- Scenario 4 (LFG2 + E3);
- Scenario 5 (LFG1 + (c)).

Step3. Investment analysis

Sub-step3a. Determine appropriate analysis method

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

Sub-step3b. – Option III. Apply benchmark analysis

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

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

Sub-step 3c. Calculation and comparison of financial indicators

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

Table 2 - Main assumptions - CTL Landfill Gas Project

	CTL Landfill Gas Project			
	Assumptions			
	Parameter	**Value**	**Unit**	Reference
Assumptions	Benchmark	11.75%	%	Guidelines on the assessment of investment analysis - version 04, Group 1 (Brazil).
	Asset's Life time	25	Years	"Tool to determine the remaining lifetime of equipment" - version 1 (Electric Generators, air cooled) and CRA's document (Engineering company) - file: (10290-001 RevD.pdf)
	Installed capacity for each engine	1.426	MW	Electricity for self production Project made by ECOURBIS. File: Relatório - Projeto de Autoprodução de Energia (Agosto-2015).pdf
	Net capacity for each engine	1.426	MW	Electricity for self production Project made by ECOURBIS. File: Relatório - Projeto de Autoprodução de Energia (Agosto-2015).pdf
	Number of generators groups	3	unit	Electricity for self production Project made by ECOURBIS. File: Relatório - Projeto de Autoprodução de Energia (Agosto-2015).pdf
	Total installed capacity	4.278	MW	Calculated taking into consideration: (1) Net capacity for each engine and (2) Number of generators groups, where: Total installed capacity (MW) = (1) x (2)
	Price per MW installed	R$ 5,323,798.04	R$/MWe	Calculated taking into consideration: (1) Total CAPEX in BRL for Generator groups implementation; (2) The installed capacity in MW of each engine and (3) The number of generator groups that will be installed. Thus, the Price per MW installed = (1) / [(3) x (2)]
	Load factor	94.38%	%	Manufacturer's specification. File: (Proposta _O&M - CTL ECOURBIS - Rev00.pdf)
	Hours per year	8,760	h	Number of total hours per year
	Exchange Rate	3.83	R$/USD	"Banco Central do Brasil" (in English, Brazilian Central Bank) on 15/10/2015 (http://www4.bcb.gov.br/pec/conversao/conversao.asp)
	Electricity price	148.39	R$/MWh	The highest value from the only two auctions held in Brazil (Source: Electric Power Commercialization Chamber - CCEE)
	Tax - IRPJ (income tax)	25%	%	Incomex tax (http://www.receita.fazenda.gov.br/legislacao/ins/Ant2001/Ant1997/1995/insrf05195.htm), accessed on 14/01/2011.
	Tax - CSLL (social contribution)	9%	%	Social contribution (http://www.planalto.gov.br/ccivil_03/LEIS/L7689.htm), accessed on 14/01/2011.
	Tax (PIS)	1.65%	%	Contribution to the Social Integration Program and Civil Service Asset Formation Program – PIS/PASEP (http://www.receita.fazenda.gov.br/principal/Ingles/SistemaTributarioBR/Taxes.htm), accessed on 14/01/2011.
	Tax (Cofins)	7.60%	%	COFINS - Contribution to Social Security Financing (http://www.receita.fazenda.gov.br/principal/Ingles/SistemaTributarioBR/Taxes.htm), accessed on 14/01/2011.
	Depreciation	10	years	Secretary of the Federal Revenue of Brazil. Available on http://www.mmcontabilidade.com.br/flash/taxasdepreciacao.htm, accessed on 04/07/2016. Item: 8501 and Art. 69 of the LawI No 3.470, from November 28th, 1958.
	Commercial Lending rate	10.97%	%	http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Produtos/FINEM/energias_alternativas.html, accessed on 19/07/2011.
	Debt term	16	years	http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Produtos/FINEM/energias_alternativas.html, accessed on 30/06/2011
	Electricity sales	R$ 5,248,431.03	R$/year	Calculated
	LFG Sales to SJEA	R$ 3,496,351.00	R$/year	In 2019. Source: "Reveneus SJEA + FSL_ZEG 2019 07 29.xlsx"
	LFG Sales to FSL/ZEG	R$ 8,386,206.00	R$/year	In 2019. Source: "Reveneus SJEA + FSL_ZEG 2019 07 29.xlsx"

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

Alternative Scenario 1

For the **alternative scenario 1** – The project activity (capture of landfill gas, power generation and supply of LFG to a dedicated pipeline) undertaken without being registered as a CDM project activity, the estimated project cash flow is presented below:

Scenario 1 - CTL Landfill Gas Project - Cash Flow

	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Biogas flaring and Electricity generation		**YEARLY INVESTIMENT ANALYSIS**																								
		2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
INCOME x COSTS ANALYSIS																										
Energy savings (MWh/year)		0	0	0	0	11,790	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369	35,369
Savings electricity Price (R$/MWh)		0	0	0	0	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148
Energy savings (kR$)		0	0	0	0	1,749	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248	5,248
Revenue for LFG sales (kR$) - SJEA (Consumer 1)		0	0	4,262	5,892	6,053	4,806	5,006	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496
Revenue for LFG sales (kR$) - FSL/ZEG (Consumer 2)		0	0	0	0	0	0	0	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386
Gross Reveneu (kR$)		0	0	4,262	5,892	7,802	10,055	10,254	17,131	17,131	17,131	17,131	17,131	17,131	17,131	17,131	17,131	17,131	17,131	17,131	17,131	17,131	17,131	17,131	17,131	17,131
Tax (PIS/Cofins)	9.25%	0	0	-394	-545	-722	-930	-949	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585	-1,585
Tax (ICMS)	12.00%	0	0	-511	-707	-726	-577	-601	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420
São Paulo Municipality Costs	5.00%	0	0	-213	-295	-303	-240	-250	-594	-594	-594	-594	-594	-594	-594	-594	-594	-594	-594	-594	-594	-594	-594	-594	-594	-594
Net revenues		0	0	3,143	4,345	6,052	8,307	8,455	14,533	14,533	14,533	14,533	14,533	14,533	14,533	14,533	14,533	14,533	14,533	14,533	14,533	14,533	14,533	14,533	14,533	14,533
O&M Costs - Biogas plant		0	-605	-4,067	-5,048	-4,619	-4,619	-4,619	-4,619	-4,619	-4,619	-4,619	-4,619	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618
O&M Costs - Electricity generation		0	0	0	0	-1,985	-2,621	-2,223	-5,026	-4,808	-3,935	-4,846	-4,965	-4,300	-4,300	-4,300	-4,300	-4,300	-4,300	-4,300	-4,300	-4,300	-4,300	-4,300	-4,300	-4,300
O&M Total Costs		0	-605	-4,067	-5,048	-6,604	-7,240	-6,842	-9,645	-9,427	-8,554	-9,464	-9,584	-7,918	-7,918	-7,918	-7,918	-7,918	-7,918	-7,918	-7,918	-7,918	-7,918	-7,918	-7,918	-7,918
Operational Results - EBITDA		0	-605	-924	-703	-552	1,067	1,612	4,888	5,106	5,979	5,068	4,949	6,614	6,614	6,614	6,614	6,614	6,614	6,614	6,614	6,614	6,614	6,614	6,614	6,614
Depreciation		0	-1,869	-2,929	-4,684	-3,313	-4,593	-5,586	-5,586	-5,586	-5,586	-5,586	-2,273	-2,273	-2,273	-2,273	-993	0	0	0	0	0	0	0	0	0
EBIT		0	-2,473	-3,854	-5,387	-3,866	-3,526	-3,974	-698	-481	392	-518	2,676	4,341	4,341	4,341	5,621	6,614	6,614	6,614	6,614	6,614	6,614	6,614	6,614	6,614
Interests			-2,518	-2,092	-1,454	-815	-319	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				-99	-83	-57	-32	-13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					-116	-96	-67	-37	-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						-1,071	-890	-618	-347	-136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
							-831	-690	-480	-269	-105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total - interests	0	-2,518	-2,192	-1,652	-2,039	-2,138	-1,358	-841	-404	-105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EBT		0	-4,991	-6,045	-7,039	-5,905	-5,664	-5,332	-1,539	-885	287	-518	2,676	4,341	4,341	4,341	5,621	6,614	6,614	6,614	6,614	6,614	6,614	6,614	6,614	6,614
IRPJ/ CSLL taxes (Real Profit Regime)	34%	0	0	0	0	0	0	0	0	0	-98	0	-910	-1,476	-1,476	-1,476	-1,911	-2,249	-2,249	-2,249	-2,249	-2,249	-2,249	-2,249	-2,249	-2,249
Depreciation		0	1,869	2,929	4,684	3,313	4,593	5,586	5,586	5,586	5,586	5,586	2,273	2,273	2,273	2,273	993	0	0	0	0	0	0	0	0	0
Net operational profit		**0**	**-3,123**	**-3,116**	**-2,355**	**-2,592**	**-1,071**	**254**	**4,047**	**4,701**	**5,776**	**5,068**	**4,039**	**5,138**	**5,138**	**5,138**	**4,703**	**4,365**	**4,365**	**4,365**	**4,365**	**4,365**	**4,365**	**4,365**	**4,365**	**4,365**
CapEx																										
CapEx - LFG Station			-17,605	-390	-610	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CapEx - LFG Collection System			-12,498	-642	-728	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CapEx - Electricity Generation			0	0	-45	-12,800	-9,930	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CapEx - Connection and sales to pipeline			0	-158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capex			**-30,103**	**-1,189**	**-1,383**	**-12,800**	**-9,930**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Drawdown of debt - Bank financing			24,252	958	1,115	10,312	8,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Debt repayment			-1,297	-3,883	-5,821	-5,821	-4,524	-2,906						0	0	0	0	0	0	0	0	0	0	0	0	0
				-51	-153	-230	-230	-179	-115					0	0	0	0	0	0	0	0	0	0	0	0	0
					-60	-178	-268	-268	-208	-134				0	0	0	0	0	0	0	0	0	0	0	0	0
						-552	-1,651	-2,475	-2,475	-1,924	-1,236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
							-428	-1,281	-1,920	-1,920	-1,492	-959	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total - Debt repayment	0	-1,297	-3,934	-6,034	-6,781	-7,100	-7,109	-4,718	-3,977	-2,728	-959	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Cash Flow Equity		**0**	**-10,271**	**-7,281**	**-8,658**	**-11,860**	**-10,101**	**-6,855**	**-671**	**724**	**3,048**	**4,109**	**4,039**	**5,138**	**5,138**	**5,138**	**4,703**	**4,365**	**4,365**	**4,365**	**4,365**	**4,365**	**4,365**	**4,365**	**4,365**	**4,365**

Note 1: All numbers are in Brazilian Real (k R$)

Note 2: The O&M costs regarding (1) LFG Station, (3) LFG Collection System and (3) Connection and sales to pipeline are described as the "O&M costs - Biogas Plant" in the line #16 above.

Repayment rate rule per year (%)	-5.35%	-16.01%	-24.00%	-24.00%	-18.65%	-11.98%

Benchmark	11.75%
NPV (25 years)	-25,515.73
IRR (25 years)	1.9%

For the alternative Scenario 1 (electricity generation plant and the landfill gas extraction system), the NPV is kR$ -25,515.73. Consequently, this scenario is not deemed attractive by the project participants.

Alternative Scenario 4

The **alternative scenario 4** (atmospheric release of the landfill gas) is the continuation of the current practice, which is in compliance with all applicable regulations and policies, and was deemed the most plausible alternative to the project activity. As explained above, the **alternative scenario 4** does not generate any revenues, but only expenditures. Therefore, the NPV = 0.

Alternative Scenario 5

For the **alternative scenario 5** – The project activity (capture of landfill gas and supply of LFG to a dedicated pipeline) undertaken without being registered as a CDM project activity, the estimated project cash flow is presented below:

Scenario 5 - CTL Landfill Gas Project - Cash Flow

	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Biogas flaring and Electricity generation		**YEARLY INVESTIMENT ANALYSIS**																								
		2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
INCOME x COSTS ANALYSIS																										
-																										
-																										
Revenue for LFG sales (kR$) - SJEA (Consumer 1)		0	0	4,262	5,892	6,053	4,806	5,006	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496	3,496
Revenue for LFG sales (kR$) - FSL/ZEG (Consumer 2)		0	0	0	0	0	0	0	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386	8,386
Gross Reveneu (kR$)		0	0	4,262	5,892	6,053	4,806	5,006	11,883	11,883	11,883	11,883	11,883	11,883	11,883	11,883	11,883	11,883	11,883	11,883	11,883	11,883	11,883	11,883	11,883	11,883
Tax (PIS/Cofins)	9.25%	0	0	-394	-545	-560	-445	-463	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099	-1,099
Tax (ICMS)	12.00%	0	0	-511	-707	-726	-577	-601	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420	-420
São Paulo Municipality Costs	5.00%	0	0	-213	-295	-303	-240	-250	-175	-175	-175	-175	-175	-175	-175	-175	-175	-175	-175	-175	-175	-175	-175	-175	-175	-175
Net revenues		0	0	3,143	4,345	4,464	3,544	3,692	10,189	10,189	10,189	10,189	10,189	10,189	10,189	10,189	10,189	10,189	10,189	10,189	10,189	10,189	10,189	10,189	10,189	10,189
O&M Costs - Biogas plant		0	-605	-4,067	-5,048	-4,619	-4,619	-4,619	-4,619	-4,619	-4,619	-4,619	-4,619	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618
-																										
O&M Total Costs		0	-605	-4,067	-5,048	-4,619	-4,619	-4,619	-4,619	-4,619	-4,619	-4,619	-4,619	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618	-3,618
Operational Results - EBITDA		0	-605	-924	-703	-155	-1,074	-927	5,570	5,570	5,570	5,570	5,570	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571
Depreciation		0	-1,869	-2,929	-4,684	-2,315	-2,315	-2,315	-2,315	-2,315	-2,315	-2,315	-2,315	-2,315	-2,315	0	0	0	0	0	0	0	0	0	0	0
EBIT		0	-2,473	-3,854	-5,387	-2,470	-3,389	-3,242	3,255	3,255	3,255	3,255	3,255	4,256	4,256	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571
Interests			-2,518	-2,092	-1,454	-815	-319	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				-99	-83	-57	-32	-13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					-112	-93	-65	-36	-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total - interests	0	-2,518	-2,192	-1,648	-966	-416	-49	-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EBT		0	-4,991	-6,045	-7,035	-3,435	-3,805	-3,291	3,241	3,255	3,255	3,255	3,255	4,256	4,256	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571	6,571
IRPJ/ CSLL taxes (Real Profit Regime)	34%	0	0	0	0	0	0	0	-1,102	-1,107	-1,107	-1,107	-1,107	-1,447	-1,447	-2,234	-2,234	-2,234	-2,234	-2,234	-2,234	-2,234	-2,234	-2,234	-2,234	-2,234
Depreciation		0	1,869	2,929	4,684	2,315	2,315	2,315	2,315	2,315	2,315	2,315	2,315	2,315	2,315	0	0	0	0	0	0	0	0	0	0	0
Net operational profit		**0**	**-3,123**	**-3,116**	**-2,351**	**-1,120**	**-1,490**	**-976**	**4,454**	**4,463**	**4,463**	**4,463**	**4,463**	**5,124**	**5,124**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**
CapEx																										
CapEx - LFG Station			-17,605	-390	-610	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CapEx - LFG Collection System			-12,498	-642	-728	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-																										
CapEx - Connection and sales to pipeline			0	-158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capex			**-30,103**	**-1,189**	**-1,339**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Drawdown of debt - Bank financing			24,252	958	1,078	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Debt repayment			-1,297	-3,883	-5,821	-5,821	-4,524	-2,906						0	0	0	0	0	0	0	0	0	0	0	0	0
				-51	-153	-230	-230	-179	-115					0	0	0	0	0	0	0	0	0	0	0	0	0
					-58	-173	-259	-259	-201	-129				0	0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total - Debt repayment	0	-1,297	-3,934	-6,032	-6,223	-5,013	-3,344	-316	-129	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Cash Flow Equity		**0**	**-10,271**	**-7,281**	**-8,643**	**-7,344**	**-6,503**	**-4,320**	**4,138**	**4,334**	**4,463**	**4,463**	**4,463**	**5,124**	**5,124**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**	**4,337**

Note 1: All numbers are in Brazilian Real (k R$)

Note 2: The O&M costs regarding (1) LFG Station, (3) LFG Collection System and (3) Connection and sales to pipeline are described as the "O&M costs - Biogas Plant" in the line #16 above.

Repayment rate rule per year (%)	-5.35%	-16.01%	-24.00%	-24.00%	-18.65%	-11.98%

Benchmark	11.75%

NPV (25 years)	-15,061.64
IRR (25 years)	5.1%

For the alternative Scenario 5 (capture of landfill gas and supply of LFG to a dedicated pipeline), the NPV is kR$ -15,061.64. Consequently, this scenario is not deemed attractive by the project participants.

Sub-step 3d. Sensitivity analysis

The sensitivity analysis was performed varying the electricity tariff (revenues), the capital expenses (CapEx) and operational and maintenance costs (O&M) for the alternative scenarios 1, 4 and 5. All parameters ranging from -10% to +10%, as the result presented below:

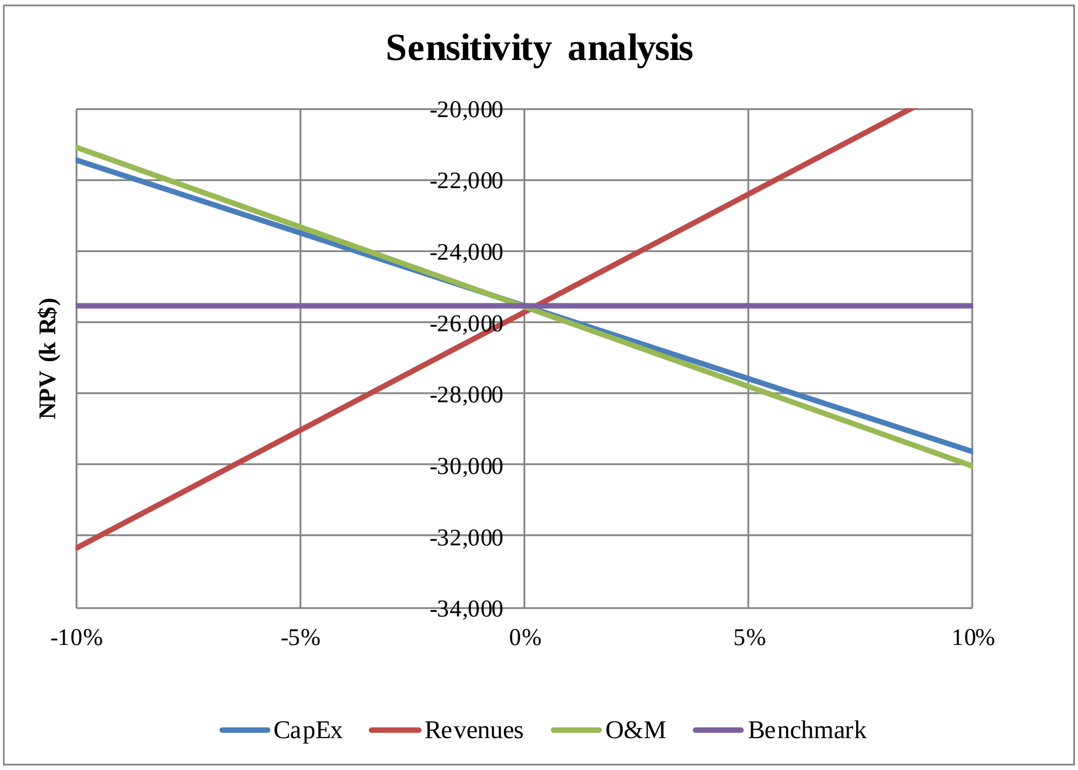
Table 3 - Sensitivity analysis

	Variation	NPV (kR$) Alternative Scenario 1	NPV (kR$) Alternative Scenario 4	NPV (kR$) Alternative Scenario 5
CapEx	-10%	-21,417	0	-12,357
	10%	-29,615	0	-17,767
Revenues	-10%	-32,334	0	-19,279
	10%	-19,068	0	-10,844
O&M	-10%	-21,102	0	-12,496
	10%	-30,056	0	-17,627
Base Case	0.0%	-25,516	0	-15,062

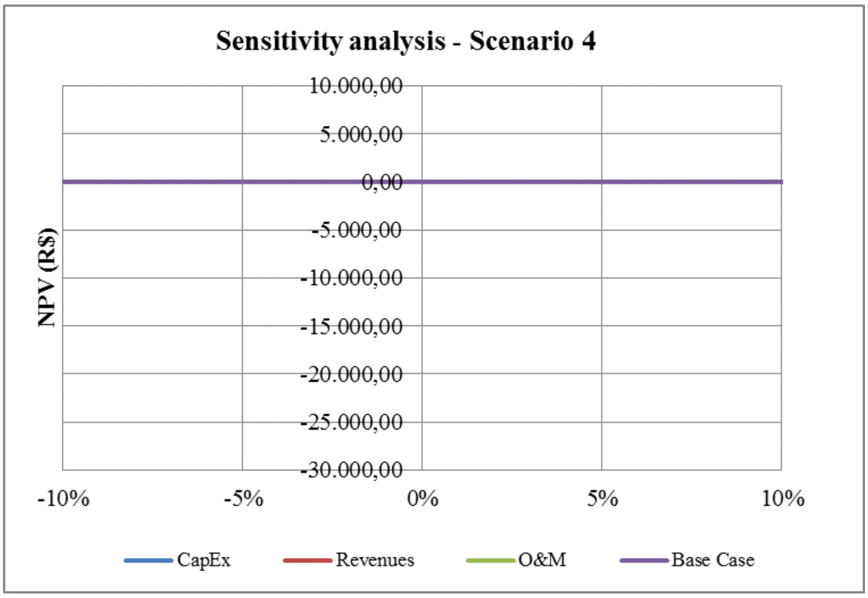
As presented above, the project Net Present Values are always less than or equal to zero in all sensitivity analyses.

The figures below show the sensitivity analysis for the three alternative scenarios (1, 4 and 5).

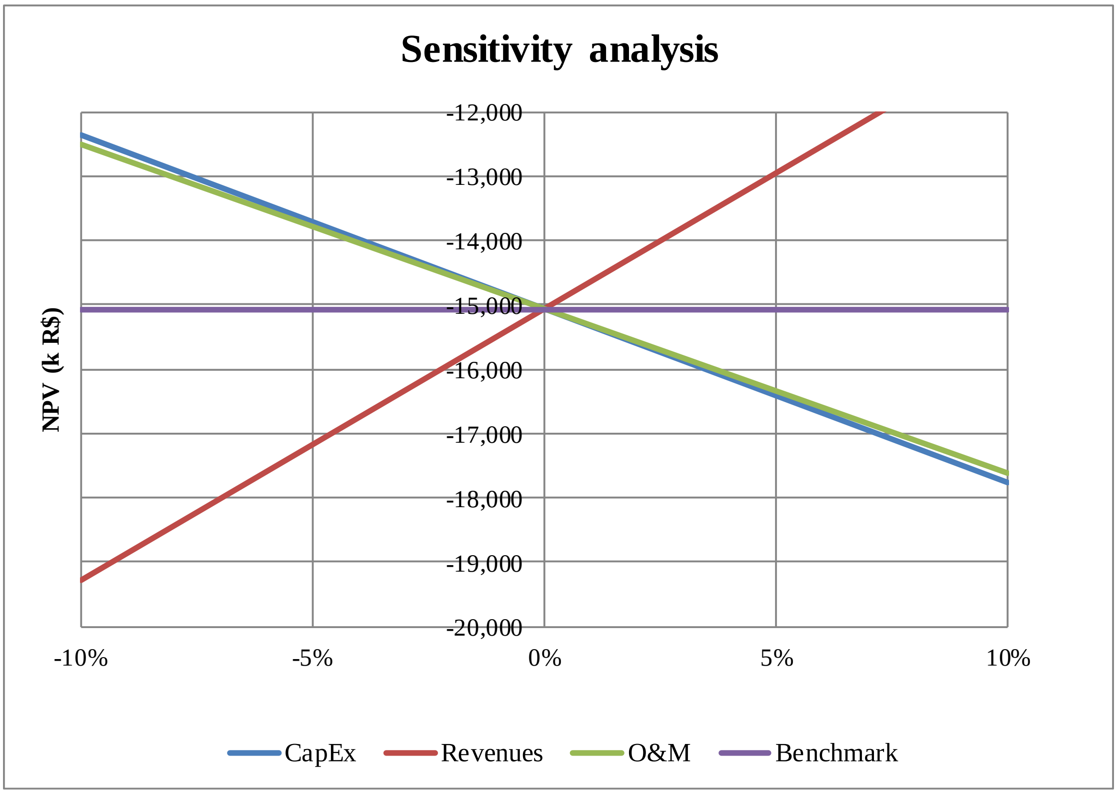
Scenario 1 - Sensitivity analysis



Scenario 4 - Sensitivity analysis



Scenario 5 - Sensitivity analysis



Breakeven point

To ensure the additionality of this project activity, the project proponents varied the three identified parameters (CapEx, Revenues and O&M) until each of them reached the benchmark (i.e. NPV=0). The results are presented below for each alternative (alternative scenarios 1, 4 and 5) and the spreadsheets were provided to the audit team:

Parameter	Breakeven point		
	Alternative Scenario 1	Alternative Scenario 4[23]	Alternative Scenario 5[24]
Capex variation until reach the benchmark (%)	-62.3%	0	-55.7%
Revenue until the benchmark (%)	41.6%	0	35.7%
O&M variation until the benchmark (%)	-61.5%	0	-58.7%

Capital Expenditures (CapEx) – To reach the benchmark, the Capital Expenditures should be reduced in the scenario alternatives 1 and 5, in 62.3% and 55.7%, respectively. This result is extremely unlikely to happen in the future, as this reduction is too large for any kind of project which has a reliable investment estimate (such as CTL Landfill Gas Project) and as usually the CapEx increases during the project implementation.

Revenues – Theses values should be increased in the scenario alternatives 1 and 5, in 41.6%[25] and 35.7% to reach the benchmark, respectively.

In the **alternative scenario 1**, it would mean that the electricity tariff should reach 210.19 R$/MWh or the maximum annual electricity generated reaches 50,100 MWh.

In **alternative scenario 1**, it deems unrealistic as this value is far superior to the average values from the latest electricity sale auctions in Brazil.

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

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

[24] In the alternative scenario 5, there are no breakeven point to the following components: (1) electricity generated and electricity tariff because in this alternative scenario, the LFG is delivered to the dedicated pipeline. Thus, in the alternative scenario 5 it was calculated the breakeven point to LFG sales.

[25] Note: It is important to notice that in scenario 1 for the revenues to reach 41.6% the LFG production should increase 49.00%. For the scenario 5 for the revenues to reach 35.7% the LFG production should increase 51.02%.

Table 4 - Results of the alternatives sources auctions held in Brazil

Date	Name of the Auction	Numbers of the plants	Starting operation	Highest electricity price (R$/MWh)
26/08/2010	2nd New Energy Auction*	89	2013	148.39
18/06/2007	1st New Energy Auction**	18	2010	139.12

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

In the **alternative scenario 5**, as the revenues would only come from the LFG selling, the LFG price by volume should increase 35.7%. The deep increase in the LFG price is unlikely to be reached, turning this alternative unrealistic.

Moreover, the difference between the agreement from consumer 1 and consumer 2 is only 8.96%, much lower than the breakeven point in both scenarios 1 and 5 which are 41.6% and 35.7%, respectively. In other words, even if all LFG were send to the best profitable consumer, the increase of revenues would be not higher than 8.96%.

O&M – Also, to reach the benchmark, the O&M shall be reduced in the scenario alternatives 1 and 5, in -61.5% and 58.7%, respectively. Thus, this scenario is unrealistic.

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

Outcome of Step 3

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

Alternatives	Results
Scenario 4	Best scenario
Scenario 5	Worst scenario
Scenario 1	Very worst scenario

As a result, the sensitivity analysis was conclusive, and the most financially attractive alternative is scenario 4.

Therefore, it seems reasonable to conclude that the alternative scenarios 1 and 5 are unlikely to be the most financially attractive scenario.

Step 4. Common practice analysis

According to “Guidelines on common practice” (EB 63 - Annex 12), the common practice analysis establishes the following items below:

- **Applicable geographical area:** Brazil is the largest country in South America and the world's fifth largest country in the world. Therefore, the entire host country (Brazil) is considered suitable for this analysis;
- **Measure:** The project activity covers methane destruction;
- **Output:** the service delivers by the project is electricity in the grid (MWh);
- **Technology:** the technology used in the project is electricity generation through biogas combustion in group generators.

The common practice analysis consists of the following steps:

Step 1: *Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.*

The installed capacity of the project is 4.278 MW. Then, the output range of the project activity is from 2.1 to 6.4 MW.

Step 2: *In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all}. Registered CDM project activities shall not be included in this step4.*

The list with all plants is in Annex 3, item 4. The total of the plants is 216. Then, N_{all} = 216.

Step 3: Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number N_{diff}.

The technology of the project activity is electricity generation through biogas. All projects in Brazil which generates electricity through biogas are registered CDM Projects and therefore, there is no project with the same technologies as the project activity.

Then, N_{diff} = 216 or $N_{all} = N_{diff}$.

Step 4: Calculate factor F=1-Ndiff/Nall representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity.

$$F = 1 - \left(\frac{N_{diff}}{N_{all}}\right)$$

$$F = 1 - \left(\frac{216}{216}\right)$$

Therefore, F = 0 and $N_{all} - N_{diff} = 0$.

According to Guidelines on common practice: “*the proposed project activity is a “common practice” within a sector in the applicable geographical area if the factor F is greater than 0.2 and Nall-Ndiff is greater than 3”.*

<u>**Outcome of common practice analysis.**</u>

The project activity is not a common practice because the factor F = 0 and the $N_{all} - N_{diff} = 0$.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

>>

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 flares LFG, generate electricity and send LFG to a dedicated pipeline, the $BE_{HG,y}= 0$.

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

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

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

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 and/or dedicated pipeline and/or to the trucks in year y (t CH_4/yr)

As the project flares LFG, generate electricity and send LFG to a dedicated pipeline, the $F_{CH4,HG,y} = 0$. Thus, the equation is:

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

$F_{CH4,EL,y}$, $F_{CH4,HG,y}$ and $F_{CH4,NG,y}$ are determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" and monitoring the working hours of the power plant(s), boiler(s), air heater(s), glass melting furnace(s) and kiln(s), so that no emission reduction are claimed for methane destruction during non-working hours. This is taken into account by monitoring the hours that the equipment utilizing the LFG is operating in year *y* ($Op_{j,h,y}$).

The following requirements apply:

(a) The gaseous stream the tool shall be applied to the LFG delivery pipeline to each item of electricity generation or heat generation equipment *j*, or the natural gas distribution system, or the dedicated pipeline, or the trucks. $F_{CH4,EL,y}$ and $F_{CH4,HG,y}$ are then calculated as the sum of mass flows to each item of electricity generation or heat generation equipment *j*;

(b) CH_4 is the greenhouse gas for which the mass flow should be determined;

(c) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations (3) or (17) in the tool);

(d) The mass flow should be calculated on an hourly basis for each hour *h* in year *y*;

(e) The mass flow calculated for hour *h* is 0 if the equipment is not working in hour *h* ($Op_{j,h}$=not working), the hourly values are then summed to a yearly unit basis.

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 each flare.

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^oC (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^oC (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[26].

Concerning the project activity, the conservative situation will be to assume that the gaseous stream is saturated, then $m_{H2O,t,db}$ is assumed to equal the saturation absolute humidity ($m_{H2O,t,db,sat}$) and calculated using the following equation.

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

Where:

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

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

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

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

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

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

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

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

Where:

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

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

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

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

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

[26] 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).

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”. 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 98% (minimum)[27] of methane destruction efficiency.

To determine the project emissions from flaring gases was used the tool “Project emissions from flaring”. 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.

The option chosen for the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” by the project participant is option A. However, during the project operational monitoring, If not demonstrated that the temperature of the gaseous stream (T_t) is less than 60ºC (dry basis), then the flow measurement should be assumed to be on a wet basis and the option B should be applied instead.

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.

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

The project participant has chosen Option B.

In the present project activity the flare efficiency for minute m ($\eta flare,m$) will be determined by Option B.1 of the methodological tool “Project emissions from flaring”, where the flare efficiency is measured in a biannual basis or, if the biannual measurements are not available, Option A of the methodological tool “Project emissions from flaring” will be used. Both options are described below:

For enclosed flares that are defined as low height flares, 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 A. 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 ($n_{\text{flare,m}}$) is 90% when the following two conditions are met to demonstrate that the flare is operating:

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

(2) The flame is detected in minute m ($Flame_{\text{m}}$).

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

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

(2) The flame is detected in minute *m* ($Flame_{\text{m}}$); and

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

In applying Option B, the project participants chose to determine $n_{flare,calc,m}$ using Option B.1 where the measurement is conducted by an accredited entity on a biannual basis.

Option B.1: Biannual measurement of the flare efficiency

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

$$\eta_{flare,calc,y} = 1 - \frac{1}{n}\sum_{t=1}^{n}\left(\frac{F_{CH4,EG,t}}{F_{CH4,RG,t}}\right) - 0.05$$

Where:

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

measured, each a minimum of one hour and separated by at least six months

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

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 5 – Parameters[28] 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
GWP_{CH4}	Global warming potential of methane valid for the commitment period	25[29]	tCO_2/tCH_4
$\rho_{CH4,n}$	Density of methane at reference conditions	0.716	kg/m^3

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

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

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

Where:

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

[28] As the Option B.1 of the tool “*Project emissions from flaring*” has been adopted to calculate the flare efficiency, the molecular mass parameters are not mentioned.

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

$BE_{CH4,SWDS,y}$ 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. Also, according to ACM0001 methodology, the parameter *X* begins with the year that the SWDS started receiving wastes (2010). For this reason, the parameter f_y and *X* will not be monitored.

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

In the baseline there are no regulatory or contractual requirements, or to address safety and odour concerns to capture and destroy LFG. Thus, the case of the project activity for determining methane captured and destroyed in the baseline is **Case 3** because there is existing LFG capture system (passive system), however there is no requirement to destroy methane. In this case:

$$F_{CH4,BL,y} = F_{CH4,BL,sys,y} = F_{CH4,sent\_flare,y}$$

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)
$F_{CH4,sent\_flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year y (t CH_4/yr)

The amount of methane captured with the existing system will 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% × $F_{CH4,PJ,y}$; or

$F_{CH4,BL,y}$ = 20% × $F_{CH4,PJ,y}$

Step (B): Baseline emissions associated with electricity generation ($BE_{EC,y}$)

$$BE_{EC,y} = \sum_{k} EC_{BL,k,y} \times EF_{EL,k,y} \times (1 + TDL_{k,y})$$

Where:

$BE_{EC,y}$	=	Baseline emissions from electricity generation in year *y* (tCO2/yr)
$EC_{BL,k,y} = EG_{PJ,y}$	=	Net amount of electricity generated using LFG in year y (MWh/yr)
$EF_{EL,k,y}$[30]	=	Emission factor for electricity generation for source *k* in year *y* (tCO2/MWh)
$TDL_{k,y}$	=	Average technical transmission and distribution losses for providing electricity to source *k* in year *y*.

The baseline emissions associated with electricity generation in year y ($BE_{EC,y}$) shall be calculated using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

Step (C): Baseline emissions associated with natural gas use ($BE_{NG,y}$)

$$BE_{NG,y} = 0.0504 \times F_{CH4,NG,y} \times EF_{CO2,NG,y}$$

Where:

$BE_{NG,y}$	=	Baseline emissions associated with natural gas use in year y (tCO2/yr)
$EF_{CO2,NG,y}$	=	Average CO2 emission factor of natural gas in the natural gas network or dedicated pipeline or in the trucks in year y (tCO2e/TJ).
$F_{CH4,NG,y}$	=	Amount of methane in the LFG which is sent to the natural gas distribution network or dedicated pipeline or to the trucks in year y (tCH4/yr)

$EF_{CO2,NG,y}$ is determined using the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion"

Emission Factor calculation

[30] According to the "*Tool to calculate project or leakage CO2 emissions from fossil fuel combustion*", $EF_{EL,k,y} = EF_{grid,CM,y}$

The project emissions derived from fossil fuels used for electricity consumption from grid connected power plants are estimated and guided using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" . The combined margin emission factor was calculated by the "Tool to calculate the emission factor for an electricity system", 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.[31]

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

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

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

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

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

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:

[31] DNA Resolution n.8 was published on 26/05/2008 on http://www.mct.gov.br/index.php/content/view/14797.html, accessed on 10/02/2015.

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

The $EF_{grid,OM,2018}$ is displayed on the Brazilian DNA website, for the year 2018

$EF_{grid,OM,2018}$ = 0.5390 tCO_2/MWh

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

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

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

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

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

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

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

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

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (t CO_2/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit m in year y (t CO_2/MWh)
m	=	Power units included in the build margin

y	=	Most recent historical year for which electricity generation data is available

The $EF_{grid,BM}$ is displayed on the Brazilian DNA website, for the year 2018 which is the most recent available data.

$EF_{grid,BM,2018}$[32] = 0.1370 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:

$$EF_{2018} = (0.5390 \times 0.25) + (0.1370 \times 0.75) = 0.2375\ tCO_2/MWh$$[33]

The build margin CO_2 emission factors will be ex-ante.

The operating margin CO_2 emission factors will be ex-post.

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

Project emissions:

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

Where:

PE_y	=	Project emissions in year *y* ($t\ CO_2/yr$)
$PE_{EC,y}$	=	Emissions from consumption of electricity due to the project activity in year *y* ($t\ CO_2/yr$)
$PE_{FC,y}$	=	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year *y* ($t\ CO_2/yr$)
$PE_{SP,y}$		Emissions from the supply of LFG to consumers through a dedicated pipeline, in year *y* ($t\ CO_2/yr$)

The parameter $PE_{DT,y}$ is not used in the calculation of project emissions since there is no distribution of compressed/liquefied LFG using trucks in the project activity.

<u>Calculation of $PE_{EC,y}$ – project emission from consumption of electricity</u>

[32] According to STEP 5, option 2 of Tool to calculate the emission factor for an electricity system

[33] The source of the data is from Brazilian DNA. The link is http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html, accessed on 23/03/2018.

According to "*Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"*, the project emission from consumption of electricity will be from two sources:

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

Thus,

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

<u>$PE_{EC1,y}$ - Project emission from electricity consumption from the grid</u>

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

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

Thus, the project emission is calculated as following:

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

Where:

$EC_{PJ1,y}$	= quantity of electricity consumed from the grid by the project activity during the year y (MWh);
$EF_{grid,CM,y}$	= the emission factor for the grid in year y (tCO_2/MWh);
TDL_y	= average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

<u>$PE_{EC2,y}$ - Project emission from electricity consumption from an off-grid captive power plant (diesel generator(s))</u>

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

$$PE_{EC2,y} = EC_{PJ2,y} \times EF_{diesel\_generator,y} \times \left(1 + TDL_y\right)$$

Where:

$EC_{PJ2,y}$	= quantity of electricity consumed from diesel generator by the project activity during the year y (MWh);
$EF_{diesel\_generator,y}$	= the emission factor for the diesel generator in year y (tCO_2/MWh);
TDL_y	= average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

<u>Calculation of $PE_{FC,y}$ – project emission from consumption of heat</u>

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

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

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

Where:

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

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

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

Where:

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

<u>Calculation of $PE_{SP,y}$ – from the supply of LFG to consumers through a dedicated pipeline</u>

Project emissions from the supply of LFG to consumers through a dedicated pipeline ($PE_{SP,y}$) is determined by possible leaks during the transportation of LFG to the consumer through a dedicated pipeline, as follows:

$$PE_{SP,y} = 0.0504 \times DEFT_{SP,y} \times F_{CH4,NG,y}$$

Where:

$PE_{SP,y}$	=	Project emissions from the supply of LFG to consumers through a dedicated pipeline, in year y (t CO_2/yr)
$DEFT_{SP,y}$[34]		Default emission factor from the supply of LFG to consumers through a dedicated pipeline (tCO_2/TJ)
$F_{CH4,NGy}$		Amount of methane in the LFG which is sent to the consumer through a dedicated pipeline in year y (tCH_4/yr)

Leakage:

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

Emission Reduction

[34] This default value (0.6×10^{-6}) was based on Tool 15 - Upstream leakage emissions associated with fossil fuel use, Table 4, in item – Transport mode: Pipeline (Natural gas distribution).

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y,$$

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

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

B.6.2. Data and parameters fixed ex ante

(Copy this table for each piece of data or parameter.)

Data / Parameter	$EF_{grid,BM,2018}$
Unit	tCO_2 /MWh
Description	Build margin emission factor of the Brazilian grid
Source of data	Calculations based on parameters described above.
Value(s) applied	0.1370
Choice of data or Measurement methods and procedures	The build margin emission factor has been defined by the Brazilian DNA
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	All data and parameters to determine the grid electricity emission factor, as required by the “Tool to calculate the emission factor for an electricity system”, were included in the monitoring plan. 2018 Build Margin from DNA is the most recent data, thus used in this parameter. For more details, see Annex 3.

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[35]
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	NCV_{CH4}
Unit	TJ/t CH_4
Description	Net calorific value of methane at reference conditions
Source of data	Technical literature
Value(s) applied	0.0504
Choice of data or Measurement methods and procedures	-
Purpose of data	-
Additional comment	-

Data / Parameter	R_u
Unit	$Pa.m^3/kmol.K$
Description	Universal ideal gas constant
Source of data	Methodological tool “Project emissions from flaring”
Value(s) applied	0.008314472
Choice of data or Measurement methods and procedures	Default value used, according to Methodological tool “Project emissions from flaring”, table 1: Constants used in equations
Purpose of data	Calculation of baseline emission
Additional comment	-

Data / Parameter	Waste composition
Unit	%
Description	Waste composition
Source of data	landfill internal studies

[35]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 11/02/2015 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 11/02/2015.

Value(s) applied	<table><tr><th colspan="2">Composition of waste</th></tr><tr><td>A) Wood and wood products</td><td>2.21%</td></tr><tr><td>B) Pulp, paper and cardboard (other than sludge)</td><td>8.90%</td></tr><tr><td>C) Food, food waste, beverages and tobacco (other than sludge)</td><td>47.08%</td></tr><tr><td>D) Textiles</td><td>19.23%</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>22.57%</td></tr><tr><td>TOTAL</td><td>100%</td></tr></table>
Choice of data or Measurement methods and procedures	Internal Report
Purpose of data	Calculation of baseline emission
Additional comment	Used for projection of methane avoidance

Data / Parameter	$SPEC_{flare}$
Unit	Temperature - °C Flow rate - Nm³/h Maintenance schedule - number of days
Description	Manufacturer's flare specifications for temperature, flow rate and maintenance schedule
Source of data	Flare Manufacturer
Choice of data or Measurement methods and procedures	<table><tr><td>Flare model</td><td>3000 HT (ZULE® 13' x 60')</td></tr><tr><td>Minimum flare temperature</td><td>649 ºC</td></tr><tr><td>Maximum flare temperature</td><td>1093 ºC</td></tr><tr><td>Minimum and maximum inlet flow rate</td><td>Minimum flow: 750 Nm³/h --- Maximum flow: 9,600 Nm³/h</td></tr><tr><td>Maximum duration in days between maintenance events</td><td>N/A[36]</td></tr></table>
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	P_{ref}
Unit	Pa
Description	Atmospheric pressure at reference conditions
Source of data	Tool "Project emissions from flaring"

[36] The maximum duration in days between maintenance events by the equipment manufacturer is not available. Thus, the number of maintenance events completed in a determined year has been chosen considering preventive maintenance program which defines the frequency for checking flare equipment situation continuously every day.

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 is be installed in the project activity
Source of data	A Landfill Gat-to-Energy Project Development Handbook. USEPA 1996 Handbook EPA-LFG.
Value(s) applied	85%
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
Choice of data or Measurement methods and procedures	According to “Emissions from solid waste disposal sites”, the *Application A* was used because the 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>-</td></tr>
<tr><td>Description</td><td>Decay rate for waste type j</td></tr>
<tr><td>Source of data</td><td>2006 IPCC Guidelines for National Greenhouse Gas Inventories</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th colspan="2" rowspan="2">Waste type j</th><th>Tropical (MAT > 20 °C)</th></tr>
<tr><th>Wet (MAP > 1,000mm)</th></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.07</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.035</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.17</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.4</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>IPCC default value for anaerobic managed solid waste disposal site is applied.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>Used for projection of methane avoidance. The climate data was provided to Rainfall index database from São Paulo city – Station: E3-243 (http://www.sigrh.sp.gov.br/cgi-bin/bdhm.exe/plu?qwe=qwe). And the temperature data was provided to CIIAGRO (http://www.ciiagro.sp.gov.br/ciiagroonline/Quadros/QTmedPeriodo.asp)</td></tr>
</table>

<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>

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	$DEFT_{SP,y}$
Unit	tCO_2/TJ
Description	Default emission factor from the supply of LFG to consumers through a dedicated pipeline
Source of data	This default value was based on Tool 15 - Upstream leakage emissions associated with fossil fuel use ,Appendix, Table 1, page 19 (Natural gas distribution).
Value(s) applied	2.2
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	Conservatively, it was used the highest value from Table 4 to include as default emission factor.

B.6.3. Ex ante calculation of emission reductions

>>

Emission reduction

Baseline emission calculation

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

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);
- LFG collection efficiency = 85%: (Based on the Handbook from USEPA 1996 EPA-LFG "A Landfill Gat-to-Energy Project Development Handbook" and the active LFG capture system installed in the project activity);
- Density of methane = 0.716 kg/m^3 (as per tool "Project emissions from flaring*").*

The landfill gas collection and utilization system will capture only a portion of the generated landfill gas. Thus, an estimate of 85% 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:

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

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 that will be installed in the project activity
GWP_{CH4}	=	Global warming potential of CH_4 (tCO_2e/tCH_4)

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

Table 6 - Ex-ante estimation of $F_{CH4,PJ,y}$

Year	$F_{CH4,PJ,y}$ (tCH_4/yr)
From 01/04/2020	37,210
2021	52,498
2022	54,860
2023	56,844
2024	58,549
2025	60,042
2026	61,371
Until 31/03/2027	13,615

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

Table 7 - Ex-ante estimation of $F_{CH4,BL,y}$

Year	$F_{CH4,BL,y}$ (tCH_4/yr)
From 01/04/2020	7,442
2021	10,500
2022	10,972
2023	11,369
2024	11,710
2025	12,008
2026	12,274
Until 31/03/2027	2,723

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

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

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

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

Year	$BE_{CH4,y}$ (tCO_2/year)
From 01/04/2020	651,174
2021	918,715
2022	960,052
2023	994,773
2024	1,024,605
2025	1,050,734
2026	1,073,985
Until 31/03/2027	238,264

Step (B): Baseline emissions associated with electricity generation ($BE_{EC,y}$)

The ex-ante calculation is:

$$BE_{EC,y} = EC_{BL,k,y} \times EF_{grid,CM,y} \times (1+TDL_y)$$

As explained above, the $EF_{grid,CM,y}$ = 0.2375 CO_2/MWh

Table 9 - Baseline emissions associated with electricity generation ($BE_{EC,y}$)

Year	$EC_{BL,k,y}$ (MWh/yr)	$BE_{EC,y}$ (tCO_2/yr)
From 01/04/2020	21,494	6,448
2021	30,336	9,100
2022	30,336	9,100
2023	30,336	9,100
2024	30,336	9,100
2025	30,336	9,100
2026	30,336	9,100
Until 31/03/2027	3,809	1,143

Step (C): Baseline emissions associated with natural gas use ($BE_{NG,y}$)

The ex-ante calculation is:

$$BE_{NG,y} = 0.0504 \times F_{CH4,NG,y} \times EF_{CO2,NG,y}$$

Where the $EF_{CO2,NG,y}$ = 58.3 t_{CO2}/TJ and $F_{CH4,NG,y}$ is calculated below. The results are presented below:

Table 10 - Baseline emissions associated with natural gas use (BENG,y)

Year	$F_{CH4,NG}$ (tCH4/yr)	$BE_{NG,y}$ (tCO_2/yr)
From 01/04/2020	26,896	79,030
2021	38,747	113,850
2022	41,109	120,791
2023	43,093	126,620
2024	44,797	131,629
2025	46,291	136,016
2026	47,619	139,920
Until 31/03/2027	10,177	29,904

The equation of the baseline emission calculation is:

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

The result is:

Table 11 - baseline emission calculation

Year	$BE_{CH4,y}$ (tCO_2/year)	$BE_{EC,y}$ (tCO_2/yr)	$BE_{NG,y}$ (tCO_2/yr)	BE_y (tCO_2/yr)
From 01/04/2020	651,174	6,448	79,030	736,652
2021	918,715	9,100	113,850	1,041,665
2022	960,052	9,100	120,791	1,089,943
2023	994,773	9,100	126,620	1,130,494
2024	1,024,605	9,100	131,629	1,165,334
2025	1,050,734	9,100	136,016	1,195,850
2026	1,073,985	9,100	139,920	1,223,006
Until 31/03/2027	238,264	1,143	29,904	269,310

1. Project emission

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

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)

There is no consumption of fossil fuels due to the project activity for purpose other than electricity generation, in year y (tCO2/yr), therefore PEFC,y = 0

Thus,

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

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

The project emission from consumption of electricity is:

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

Where:

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

In the option A1 of the “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”, 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 0.2375 tCO_2/MWh will be used.

Finally the technical transmission and distribution losses ($TDL_{j,y}$) value has been assumed to be 26.3 %, according to National Energy Balance - 2019.[37] Table below summarizes the project emissions resulting from electrical consumption in the plant.

Table 12 - Electricity consumption from the grid resulting due to project activity

Year	**Electricity consumption from the grid** (MWh/year)	**$PE_{el,grid}$ (tCO_2/year)**
From 01/04/2020	0	0
2021	0	0
2022	0	0
2023	0	0
2024	0	0
2025	0	0
2026	0	0
Until 31/03/2027	0	0

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

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

The diesel generator consumption will be around 5,000 MWh/year during phase 1 and for the phase 2 it is no consumption of diesel by the diesel generator since the electricity will be generated through LFG in order to supply the LFG plant internal needs. The emission factor from the diesel generator(s) is 1.3 tCO2/MWh. The following table represents the project emissions from the use of the standby generator, associated with fossil fuel combustion at the project site over the crediting period.

Table 13 - Project emissions from diesel generator

Year	**$PE_{el,diesel}$ (MWh/year)**	**$PE_{el,diesel}$ (tCO_2/year)**
From 01/04/2020	0	0
2021	0	0
2022	0	0
2023	0	0
2024	0	0
2025	0	0
2026	0	0
Until 31/03/2027	0	0

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

[37] National Energy Balance (26.3% for 2019 is the most recent data) Source: https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-479/topico-521/Relato%CC%81rio%20Si%CC%81ntese%20BEN%202020-ab%202019_Final.pdf.:

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

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

$PE_{FC,y} = 0$

Calculation of $PE_{SP,y}$ – Project emissions from the supply of LFG to consumers through a dedicated pipeline

$$PE_{SP,y} = 0.0504 \times DEFT_{SP,y} \times F_{CH4,NG,y}$$

Where:

$PE_{SP,y}$	=	Project emissions from the supply of LFG to consumers due to physical leakage from the dedicated pipeline, in year y (tCO2/yr)
$DEFT_{SP,y}$[38]	=	Default emission factor for the supply of LFG to consumers due to physical leakage through the dedicated pipeline (tCO2e/TJ)
$F_{CH4,NGy}$	=	Amount of methane in the LFG which is sent to the consumer through a dedicated pipeline in year y (tCH_4/yr)

[38] This default value (2.2 tCO2e/TJ) is based on Tool 15 - Upstream leakage emissions associated with fossil fuel use, Appendix, Table 1, page 19 (Natural gas distribution).

Year	FCH4,NG-1,y (tCH4/yr)	FCH4,NG-2,y (tCH4/yr)	PEsp,y (tCO2/year)
From 01/04/2020	16,483	10,414	2,982
2021	21,977	16,770	4,296
2022	21,977	19,132	4,558
2023	21,977	21,116	4,778
2024	21,977	22,820	4,967
2025	21,977	24,313	5,133
2026	21,977	25,642	5,280
Until 31/03/2027	5,494	4,683	1,128

2. <u>Leakage:</u>

No leakage effects need to be accounted under methodology ACM0001.

3. <u>Emission reduction</u>

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	BEy (tCO_2)	PEy (tCO_2)	ERy (tCO_2)
From 01/04/2020	736,652	2,982	733,670
2021	1,041,665	4,296	1,037,368
2022	1,089,943	4,558	1,085,384
2023	1,130,494	4,778	1,125,715
2024	1,165,334	4,967	1,160,366
2025	1,195,850	5,132	1,190,717
2026	1,223,006	5,280	1,217,725
Until 31/03/2027	269,310	1,128	268,181

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 ($t CO_2e$)
From 01/04/2020	736,652	2,982	0	733,670
2021	1,041,665	4,296	0	1,037,368
2022	1,089,943	4,558	0	1,085,384
2023	1,130,494	4,778	0	1,125,715
2024	1,165,334	4,967	0	1,160,366
2025	1,195,850	5,133	0	1,190,717
2026	1,223,006	5,280	0	1,217,725
Until 31/03/2027	269,310	1,128	0	268,181
Total	7,852,254	33,123	0	7,819,126
Total number of crediting years	7			
Annual average over the crediting period	**1,121,751**	**4,732**	**0**	**1,117,018**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Baseline, project and/or leakage emission from electricity consumption and monitoring of electricity generation

Data/Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2 /MWh
Description	CO_2 emission factor of the Brazilian grid electricity during the year y
Source of data	Brazilian DNA
Value(s) applied	0.2375
Measurement methods and procedures	The emission factor is calculated ex-post, as the weighted average of the dispatch data analysis OM (Operating Margin) and the BM (Build margin), as described in B.6.3.
Monitoring frequency	Annual
QA/QC procedures	Apply procedures in the “Tool to calculate the emission factor for an electricity system”
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	All data and parameters to determine the grid electricity emission factor, as required by the “Tool to calculate the emission factor for an electricity system”, were included in the monitoring plan. For more details, see Annex 3.

Data/Parameter	$EF_{grid,OM,y}$
Data unit	tCO_2 /MWh
Description	Operating margin emission factor of the Brazilian grid

Source of data	Calculations based on parameters described above.
Value(s) applied	0.5390
Measurement methods and procedures	The operating margin emission factor is calculated ex-post, 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	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	All data and parameters to determine the grid electricity emission factor, as required by the “Tool to calculate the emission factor for an electricity system”, were included in the monitoring plan. For more details, see Annex 3.

Data/Parameter	TDL_y
Data unit	-
Description	Average technical transmission and distribution losses in the grid in year *y* for the voltage level at which electricity is obtained from the grid at the project site.
Source of data	National Energy Balance
Value(s) applied	23.6%
Measurement methods and procedures	For (a): *TDLj/k/l,y* should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation
Monitoring frequency	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years
QA/QC procedures	-
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	The data was based National Energy Balance .[39]

Data/Parameter	$EC_{PJ1,y} = EG_{EC1,y}$
Data unit	MWh/y
Description	Quantity of electricity consumed from the grid by the project activity during the year y;
Source of data	Measurement from Project participants.

[39] National Energy Balance (26.3% for 2019 is the most recent data) Source: https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-479/topico-521/Relato%CC%81rio%20Si%CC%81ntese%20BEN%202020-ab%202019_Final.pdf

Value(s) applied	<table><tr><th>Year</th><th>$EC_{PJ1,y}$ (MWh/year)</th></tr><tr><td>From 01/04/2020</td><td>0</td></tr><tr><td>2021</td><td>0</td></tr><tr><td>2022</td><td>0</td></tr><tr><td>2023</td><td>0</td></tr><tr><td>2024</td><td>0</td></tr><tr><td>2025</td><td>0</td></tr><tr><td>2026</td><td>0</td></tr><tr><td>Until 31/03/2027</td><td>0</td></tr></table>
Measurement methods and procedures	Continuously measured by electricity meters for the grid electricity consumption as per the “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” and methodology ACM0001.
Monitoring frequency	Continuously
QA/QC procedures	As per the “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	The data will be archived throughout the crediting period and two years thereafter.

Data/Parameter	$EC_{PJ2,y} = EG_{EC2,y}$
Data unit	MWh/y
Description	Quantity of electricity consumed from diesel generator by the project activity during the year y
Source of data	Measurement from Project participants.
Value(s) applied	<table><tr><th>Year</th><th>$PE_{el,diesel}$ (MWh/year)</th></tr><tr><td>From 01/04/2020</td><td>0</td></tr><tr><td>2021</td><td>0</td></tr><tr><td>2022</td><td>0</td></tr><tr><td>2023</td><td>0</td></tr><tr><td>2024</td><td>0</td></tr><tr><td>2025</td><td>0</td></tr><tr><td>2026</td><td>0</td></tr><tr><td>Until 31/03/2027</td><td>0</td></tr></table>
Measurement methods and procedures	Continuously measured by electricity meters for the diesel generators as per “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” and ACM0001 methodology.
Monitoring frequency	Continuously
QA/QC procedures	As per the “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;

Additional comment	The data will be archived throughout the crediting period and two years thereafter.

Tool to calculate project or leakage CO2 emissions from fossil fuel combustion

Data/Parameter	$EF_{CO2,NG,y}$
Data unit	tCO_2 /TJ
Description	Average CO2 emission factor of natural gas in the natural gas network or dedicated pipeline or in the trucks in year y
Source of data	2006 IPCC Guidelines on National GHG Inventories. Value at the upper limit of the uncertainty at a 95% confidence interval.
Value(s) applied	58.3
Measurement methods and procedures	Not applicable since IPCC default value is used.
Monitoring frequency	Any future revisions of the IPCC Guidelines should be taken into account.
QA/QC procedures	Not applicable since IPCC default value is used.
Purpose of data	(b) Calculation of baseline emissions or actual net GHG removals by sinks;
Additional comment	-

Data/Parameter	$FC_{i,j,y}$
Data unit	kg
Description	Quantity of LPG combusted in pilot flames of flares during year y.
Source of data	Invoices of LPG suppliers.
Value(s) applied	0
Measurement methods and procedures	The mass of LPG purchased by the project developer will be stated in the invoices issued by the LPG supplier. Hard copies of the invoices will be kept in files during the crediting period and two years after.
Monitoring frequency	Continuously
QA/QC procedures	Scope of the LPG supplier.
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	Where such data is not available, IPCC data will be used in a conservative manner. The data will be archived throughout the crediting period and two years thereafter.

Data/Parameter	$EF_{CO2,LPG,y}$
Data unit	-
Description	Weighted average CO_2 emission factor of LFG in year y

<table>
<tr><td>Source of data</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>a) Values provided by the fuel supplier in invoices.</td><td>This is the preferred source.</td></tr>
<tr><td>b) Measurements by the project participants.</td><td>If a) is not available.</td></tr>
<tr><td>c) Regional or national default values.</td><td>If a) is not available These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.</td><td>If a) is not available.</td></tr>
</table>
</td></tr>
<tr><td>Value(s) applied</td><td>n/a</td></tr>
<tr><td>Measurement methods and procedures</td><td>For a) and b) Measurements should be undertaken in line with national or international fuel standards.</td></tr>
<tr><td>Monitoring frequency</td><td>-</td></tr>
<tr><td>QA/QC procedures</td><td>For a) and b): The CO_2 emission factor will be obtained for each fuel delivery, from which weighted average annual values should be calculated.
For c): Review appropriateness of the values annually.
For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>Purpose of data</td><td>(b) Calculation of project emissions or actual net GHG removals by sinks;</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

Data/Parameter	$NCV_{fuel,y}$
Data unit	GJ per mass (GJ/ton)
Description	Weighted average net calorific value of fossil fuel i in year y
Source of data	Regional or national default values
Value(s) applied	46.4 for LPG
Measurement methods and procedures	Measurements should be undertaken in line with national or international fuel standards. Monitoring frequency: Review appropriateness of the values annually
Monitoring frequency	Continuously
QA/QC procedures	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.

Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	The value was based on Table VIII.9 of Brazilian Energy Balance -BEN 2019 (most updated base year 2018).

ACM0001: Flaring or use of landfill gas

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

<table>
<tr><td>Data/Parameter</td><td>$EG_{PJ,y} = EC_{BL,k,y}$</td></tr>
<tr><td>Data unit</td><td>MWh</td></tr>
<tr><td>Description</td><td>Amount of electricity generated using LFG by the project activity in year y</td></tr>
<tr><td>Source of data</td><td>Electricity meter</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th>Year</th><th>Net electricity generated in the plant (MWh)</th></tr>
<tr><td>From 01/04/2020</td><td>21.494</td></tr>
<tr><td>2021</td><td>30.336</td></tr>
<tr><td>2022</td><td>30.336</td></tr>
<tr><td>2023</td><td>30.336</td></tr>
<tr><td>2024</td><td>30.336</td></tr>
<tr><td>2025</td><td>30.336</td></tr>
<tr><td>2026</td><td>30.336</td></tr>
<tr><td>Until 31/03/2027</td><td>3.809</td></tr>
</table>
</td></tr>
<tr><td>Measurement methods and procedures</td><td>Monitor net electricity generation by the project activity using LFG</td></tr>
<tr><td>Monitoring frequency</td><td>Continuous</td></tr>
<tr><td>QA/QC procedures</td><td>Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company.</td></tr>
<tr><td>Purpose of data</td><td>(b) Calculation of project emissions or actual net GHG removals by sinks;</td></tr>
</table>

Additional comment	This parameter is required for calculating baseline emissions associated with electricity generation ($BE_{EC,y}$) using the “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”

Data/Parameter	$O_{pj,h}$
Data 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 any one or more of the following three parameters: (a) Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer’s specifications of the burning equipment. Document and justify the location and minimum threshold in the PDD; (b) Flame. Flame detection system is used to ensure that the equipment is in operation; (c) Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnances. This option is not applicable to brick kilns. Opj,h=0 when: (a) One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); (b) Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); (c) No products are generated in the hour h. Otherwise, Opj,h=1
Monitoring frequency	Once per minute
QA/QC procedures	The calibration of this equipment is not applicable since it is a device integrated with the operational software at the landfill gas plant.
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	-

Data/Parameter	$F_{CH4,NGy}$
Data unit	tCH_4/yr
Description	Amount of methane in the LFG which is sent to the costumer through a dedicated pipeline in year *y*
Source of data	-
Value(s) applied	Ex-ante estimative **Year** / **FCH4,NG-1,y (tCH4/yr)** / **FCH4,NG-2,y (tCH4/yr)** From 01/04/2020 / 16,483 / 10,414 2021 / 21,977 / 16,770 2022 / 21,977 / 19,132 2023 / 21,977 / 21,116 2024 / 21,977 / 22,820 2025 / 21,977 / 24,313 2026 / 21,977 / 25,642 Until 31/03/2027 / 5,494 / 4,683
Measurement methods and procedures	Determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream
Monitoring frequency	Continuous and aggregated annually in case of natural gas distribution network and dedicated pipeline. Determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"
QA/QC procedures	-
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks; and (b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	FCH4,NG-1,y and FCH4,NG-2,y refers to methane sent to consumer 1 and 2 respectively.

Nested table (Value(s) applied):

Year	FCH4,NG-1,y (tCH4/yr)	FCH4,NG-2,y (tCH4/yr)
From 01/04/2020	16,483	10,414
2021	21,977	16,770
2022	21,977	19,132
2023	21,977	21,116
2024	21,977	22,820
2025	21,977	24,313
2026	21,977	25,642
Until 31/03/2027	5,494	4,683

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

Data/Parameter	$V_{t,db}$
Data unit	m^3 /h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data	Measurements by Project participants using a flow meter(s)
Value(s) applied	n/a
Measurement methods and procedures	The volumetric flow rate of the residual gas which is sent to each individual flare, LFG engines and dedicated export pipeline in the hour h will be measured by the installed flow meters with 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 60o C (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	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	This parameter will be monitored only in case Option A of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” is applied for the determination of $F_{CH4,flared,y}$, $F_{CH4,EL,y}$ and $F_{CH4,NG,y}$

Data/Parameter	$V_{t,wb}$
Data unit	m^3 /h
Description	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	The volumetric flow rate of the residual gas which is sent to each individual flare, LFG engines and dedicated export pipeline in the hour h will be measured by the installed flow meters with 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 60o C (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	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	This parameter will be monitored only in case Options B or C of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” is applied for the determination of $F_{CH4,flared,y}$, $F_{CH4,EL,y}$ and $F_{CH4,NG,y}$

Data/Parameter	$v_{i,t,db}$
Data unit	m^3 gas i/m^3 dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Source of data	Measurements by Project participants using gas analyser
Value(s) applied	Approximately 50%
Measurement methods and procedures	Continuous gas analyser operating in dry basis. Volumetric flow measurement should always refer to the actual pressure and temperature.
Monitoring frequency	Continuous recorded and hourly aggregated
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.
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	This parameter will be monitored only in case Option A of the tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” is applied for the determination of $F_{CH4,flared,y}$, $F_{CH4,EL,y}$ and $F_{CH4,NG,y}$

Data/Parameter	$v_{i,t,wb}$
Data unit	m^3 gas i/m^3 dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a wet basis
Source of data	Measurements by Project participants using gas analyser
Value(s) applied	Approximately 50%
Measurement methods and procedures	Calculated based on the dry basis analysis plus water concentration measurement or continuous in-situ analysers if not specified in the underlying methodology
Monitoring frequency	Continuous recorded and hourly aggregated
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.
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	This parameter may be monitored only in case Option B of the tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” is applied for the determination of $F_{CH4,flared,y}$, $F_{CH4,EL,y}$ and $F_{CH4,NG,y}$

Data/Parameter	T_t
Data 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	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
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
Data 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	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
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)

Data/Parameter	Status of biogas destruction device
Data unit	-
Description	Operational status of biogas destruction devices
Source of data	Provided by project participants
Value(s) applied	n/a
Measurement methods and procedures	Monitoring and documenting may be undertaken by recording the energy production from methane captured or the operation of the flare by means of a flame detector to demonstrate the actual destruction of methane, unless a different method is specified in the underlying methodology/tool. Emission reductions will not accrue for periods in which the destruction device is not operational.
Monitoring frequency	Continuous
QA/QC procedures	-
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	For Flame detector devices refer to the methodological tool "Project emissions from flaring"

Data/Parameter	$P_{H2O,t,Sat}$
Data 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	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	[1] Fundamentals of Classical Thermodynamics; Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4º Edition 1994, John Wiley & Sons, Inc.

Methodological tool "Project emissions from flaring"

Data/Parameter	$F_{CH4,EG,t}$
Data 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	(b) Calculation of project emissions or actual net GHG removals by sinks;
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	$Flame_m$
Data unit	Flame on or Flame off
Description	Flame detection of flare in the minute m
Source of data	Project Participant
Value(s) applied	-
Measurement methods and procedures	Measurements by project participants using a continuous Ultra Violet flame detector
Monitoring frequency	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off
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[40].
Additional comment	-

Data/Parameter	$Maintenance_y$
Data unit	Calendar dates
Description	Maintenance events completed in year y
Source of data	Project participants
Value(s) applied	-
Measurement methods and procedures	Record the date that maintenance events were completed 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	Daily
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 flame is on[41].
Additional comment	Monitoring of this parameter is required for the case of enclosed flares and the project participant selects Option B to determine flare efficiency. 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 manufacturer ($SPEC_{,flare}$).

Data/Parameter	$T_{EG,m}$
Data unit	º C
Description	Temperature in the exhaust gas of the enclosed flare in minute m
Source of data	Measurements by project participants
Value(s) applied	-

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

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

Measurement methods and procedures	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 649 ºC indicates that a significant amount of gases are still being burnt and that the flare is operating. Data will be recorded continuously and values will be averaged hourly or at a shorter time interval
Monitoring frequency	Once per minute
QA/QC procedures	Thermocouples will be replaced or calibrated every year
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	-

B.7.2. Sampling plan

>>

Not applicable

B.7.3. Other elements of monitoring plan

>>

The monitoring plan will be done according to the methodology ACM0001, the applicable tools, as well as per the paragraph 112 of the CDM project standard. Details are available in section B.7.1 above. The monitoring equipment locations are presented in the picture below:

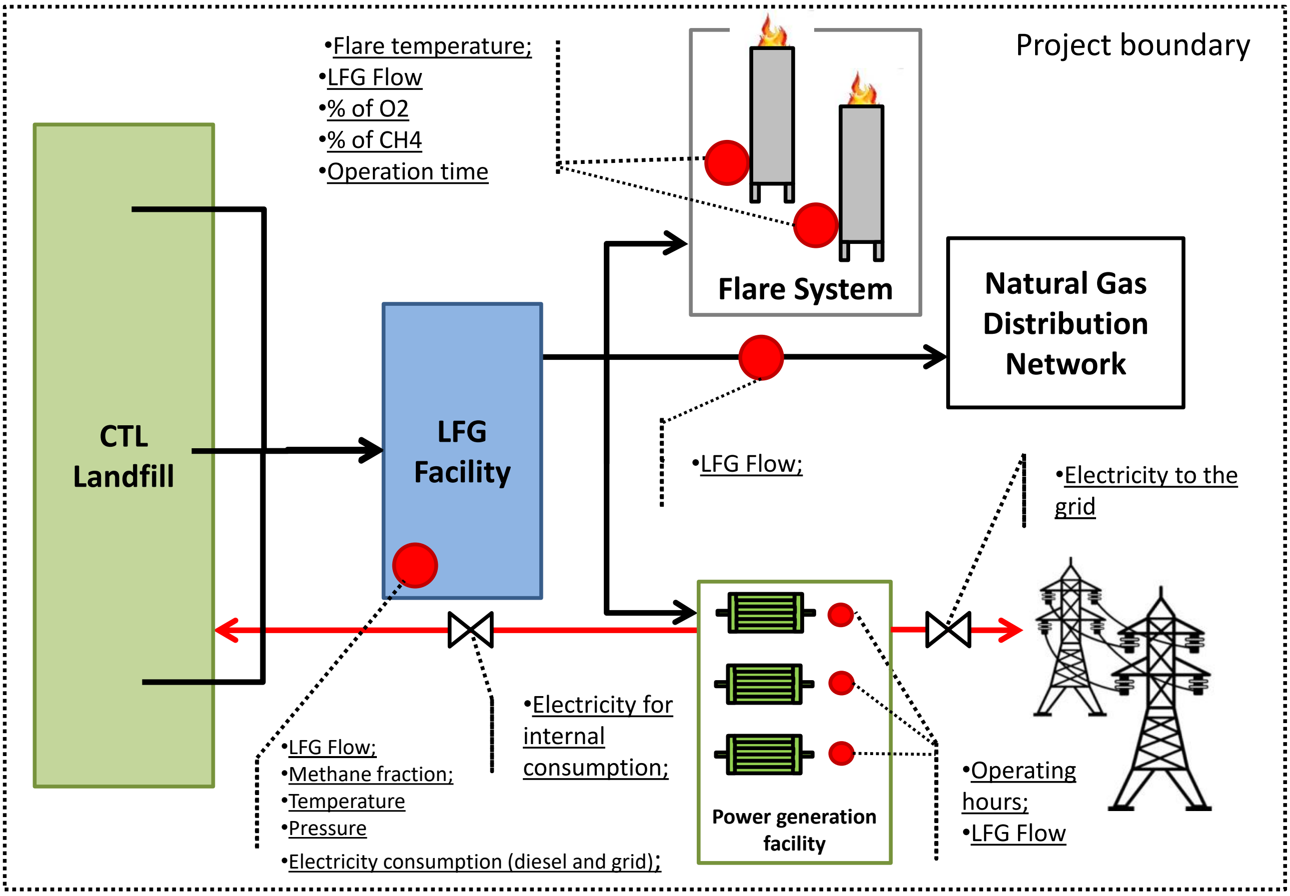


Figure 13 - Monitoring equipments locations

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

1. Introduction and Objectives

The two primary purposes of the monitoring plan are:

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

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

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

2. Training of monitoring personnel

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

3. Monitoring Work Program

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

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

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

3.1. Flow Measurement

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

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

Also, during phase 2 (LFG sent to consumer through dedicated pipeline) implementation, in order to follow ACM0001, other flow meters are also installed in the piping leading to a consumers through dedicated pipeline, being one flow meter for each LFG consumer.

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

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

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

3.2. Gas Quality

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

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

3.3. Uncombusted Methane

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

3.4. Electrical Consumption

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

3.5. Project Electricity Output

The generated electricity used for the landfill internal consumption (i.e. administration offices, truck garage, recycling plant, leachate pumps), excluding the LFG Facility electricity consumption by the project activity[42] is continuously measured by an electricity meter and respective data is electronically recorded.

3.6. LPG purchased

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

3.7. Regulatory Requirements

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

4. Data records and storage

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

4.1. Data Assessment and Reporting

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

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

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

5. Related monitoring and project performance review

EcoUrbis will conduct an additional operational monitoring of the LFG collection system to check the project performance and ensure that the system is being operated both correctly and efficiently. Periodic adjustments to the horizontal trenches and to the extraction wells/drains will be required to optimize the capture and collection systems effectiveness. LFG collection field adjustments will be made based upon a review of the trench and well performance history considered within the

[42] There will not be claimed CERs for LFG Facility electricity consumption because the electricity consumption is a consequence of the CDM Project.

context of the overall LFG collection field operation in order to maximize the collection of methane balanced against minimization of any oxygen in the system that could introduce unsafe operating conditions. Monitoring at each trench and extraction well will consist of the following parameters: valve position, individual well/trench flow, individual well/trench vacuum, and composition of the gas collected, i.e., methane, carbon dioxide, and oxygen, using a portable measuring device.

6. Emergency procedures

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

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

7. Calibration

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

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

The date of completion the application of the methodology to the project activity study is 31/12/2019.

The person/entity determining the baseline is as follows:
Beng Engenharia Ltda, São Paulo, Brazil
Contact person: Mr. João Sprovieri
Mr. Francisco Santo
Email: joao.sprovieri@beng.eng.br
francisco.santo@beng.eng.br

Beng Engenharia Ltda is not a Project Participant.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>
Project starting date: 29/02/2012.[43]

C.2. Expected operational lifetime of project activity

>>

[43] The starting date of the project activity will be the purchase date of the main equipment which will only occur after receiving the LoA.

25 years and 0 months

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
2nd crediting period, renewable (3 x 7 years)

C.3.2. Start date of crediting period

>>
The 2nd crediting period will start on 01/04/2020.

C.3.3. Duration of crediting period

>>
7 years (renewable for two times) and 0 months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

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

A complete Environmental Impact Assess (EIA) was submitted to CETESB (*Companhia Ambiental do Estado de São Paulo*) and this document was concluded that the site selected presents the necessary conditions to the landfill's installation without any significant changes on their actual environmental quality. With the approval of the EIA, CTL landfill received, from CETESB, the Operational License no. 30006398, process number 30/00847/08, issued on 23/11/2010 and valid until 23/11/2015. Regarding waste disposal most recent phases, CTL landfill received, from CETESB, the Operational License no. 30009404, process number 30/00847/08, issued on 21/10/2014 and valid until 21/10/2019. Currently, CTL landfill received, from CETESB, the renewed Operational License no. 30010470, process number 30/00567/16, issued on 28/10/2016 and valid until 28/10/2021.

Regarding the environmental license from the landfill area expansion, a new Operational License has been issued by CETESB, no 30010065, process number 30/00847/08, issued on 26/02/2016 and valid until 26/02/2021.

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

D.2. Environmental impact assessment

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

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>
According to the Resolutions Number 1[44], 4[45] and 7[46] of the Brazilian Designed National Authority (CIMGC – Comissão Interministerial de Mudança Global do Clima / *Interministerial Commission on*

[44] http://www.mct.gov.br/upd_blob/0002/2736.pdf (Art. 3º, II)

Global Climate Change), project participants shall send letters to local stakeholders 15 days before the start of the validation period, in order to receive comments. It includes:

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

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

- *Prefeitura municipal de São Paulo*/ Municipal Administration of *São Paulo*;
- *Câmara dos vereadores de São Paulo* / Legislation Chamber of *São Paulo*;
- *Secretaria Municipal do Verde e do Meio Ambiente* / Municipal Secretary for Green and Environmental São Paulo City;
- *Companhia Ambiental do Estado de São Paulo (CETESB)*/Enviroment Agency of São Paulo State;
- *Secretaria do Meio Ambiente do Estado de São Paulo*/São Paulo State Environmental Secretary.
- *Fórum Brasileiro das Organizações Não Governamentais e Movimentos Sociais para o Meio Ambiente e o Desenvolvimento - FBOMS* / Brazilian Forum of Non-Governmental Organizations and Social Movements for Environment and Development;
- *Ministério Público do Estado de São Paulo* / São Paulo Prosecutor's Office*;*
- *Ministério Público Federal* / Federal Prosecutor's Office.
- Local associations;
  - Associação Nossa Senhora Aparecida;
  - Associação Bruna Rosa;
  - Associação Limoeiro I e II;
  - Cooperativa de Trabalho com Materiais Reaproveitáveis Chico Mendes;
  - Sociedade Amigos do Bairro Vila Leme e Jardim dos Marianos;
  - Zeladoria Ambiental.

E.2. Summary of comments received

>>

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

Stakeholder	Comments
São Paulo Prosecutor's Office	The assessment of the project activity is outside of attribution from São Paulo Prosecutor's Office[47].
Cooperativa de Trabalho com Materiais Reaproveitáveis Chico Mendes	The project activity shows that currently technologies can decrease in large scale impacts from landfills. The advantages of the project activity are: the safety of implanting a gas treatment at the beginning reducing the methane release to atmosphere. Thus, the entity supports this project activity.
Municipal Secretary for Green and Environment São	The stakeholder highlighted that besides destruction methane, the project activity will generate electricity reducing problems related to global warming and contributing to the sustainable development to the

[45] http://www.mct.gov.br/upd_blob/0011/11780.pdf (Artº 5°, unique paragraph)

[46] http://www.mct.gov.br/upd_blob/0023/23744.pdf, accessed on July 21st, 2008.

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

Paulo city;	city.
OFEA	The project activity reduces the methane emission, generated through solid waste decomposition, decreasing the greenhouse effect.

E.3. Consideration of comments received

>>

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

SECTION F. Approval and authorization

>>

In the proposed project, the project participant is presented below:

Host Parties	Project participants
Brazil (host)	Ecourbis Ambiental S.A.

Thus, the Party involved is Brazil.

In accordance with the paragraph 246 in the "Clean Development Mechanism Project Cycle Procedure", the project participant has already obtained a letter of approval from the host parties DNAs.

The registered CDM project activity has been granted with Letter of Acceptance (LoA) by the Designated National Authority (DNA) of the host party Brazil (dated 13/02/2012). Copy of such LoA and related assessment details are made available at the project's page at UNFCCC's CDM website.

Appendix 1. Contact information of project participants

Organization name	EcoUrbis Ambiental S/A
Country	Brazil
Address	Rua João Francisco Delmas, 117 - Campo Limpo
Telephone	+55 (11) 5512-3204
Fax	+55 (11) 5512-3232
E-mail	curien@ecourbis.com.br
Website	http://www.ecourbis.com.br/
Contact person	Cesar Urien

Organization name	Norwegian Ministry of Climate and Environment
Country	Norway
Address	Kongensgate 20 0153 Oslo
Telephone	+47 48045797
Fax	-
E-mail	malin.meyer@kld.dep.no
Website	https://www.regjeringen.no/en/topics/climate-and-environment/climate/innsiktsartikler-klima/norwegian-carbon-credit-procurement-program/id2415405/
Contact person	Malin Meyer

Organization name	First Climate (Switzerland) AG
Country	Switzerland
Address	Brandschenkestrasse 51 – 8002 - Zurich
Telephone	+41 44 2982800
Fax	+41 44 2982899
E-mail	focalpoint@firstclimate.com
Website	https://www.firstclimate.com/en/
Contact person	Michael Brennwald

Organization name	Allcot AG
Country	Switzerland
Address	Steinhauserstrasse 74 - 6300 - Zug
Telephone	+57 32 22098737
Fax	-
E-mail	all@allcot.com
Website	https://www.allcot.com/
Contact person	Alexis Leroy

Appendix 2. Affirmation regarding public funding

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

Appendix 3. Applicability of methodologies and standardized baselines

BASELINE INFORMATION

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

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

1. Key Parameters

Year landfilling operations started operator/historical logs	24/11/2010
Projected year for landfill closure - estimated based on current filling rate	2027
GWP for methane (UNFCCC and Kyoto Protocol decisions)	25
Methane concentration in LFG (% by volume) typical assumption for baseline scenario	50 %
LFG collection efficiency (%)	85%
Flare efficiencies (%) operational data from flare manufacturer	98 %[48]
Electricity consumption from the grid due to the project activity (MWh/year)	0
Electricity consumption from the diesel generator due to the project activity (MWh/year)	0
Unit price of electricity sold to the grid (R$/MWh)	148.39
Combined margin emission factor for electricity displacement (tCO_2/MWh) calculated based on the Tool to calculate the emission factor for an electricity system	0.2375
Installed capacity of Power Plant (MW)	4.278
Load factor	94.38
Operational lifetime of the project activity (years)	25
LFG destruction rate	20%

[48] Although the flare efficiency is 98% according to the flare manufacturer, for the purpose of project emissions from flaring, the efficiency considered is 88%, according to “Project emissions from flaring” as the enclosed flare is defined as low height.

2. Waste disposal

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

Year	Waste disposal (tonnes/yr)
2010	203,077
2011	2,156,647
2012	2,192,637
2013	2,214,918
2014	2,223,482
2015	2,230,501
2016	2,136,686
2017	2,175,898
2018	2,190,874
2019	2,195,838
2020	2,555,000
2021	2,555,000
2022	2,555,000
2023	2,555,000
2024	2,555,000
2025	2,555,000
2026	2,555,000
2027	1,100,000

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 2018 (tCO_2/MWh) [9]		
2nd crediting Period		0.2375
Build Margin - 2018[1]		0.1370
Operating Margin 2018	January	0.5652
	February	0.5559
	March	0.5750
	April	0.5058
	May	0.5461
	June	0.6691
	July	0.5989
	August	0.5948
	September	0.5718
	October	0.5782
	November	0.3654
	December	0.3423
	2018	0.5390

Source: Brazilian DNA

1. According to STEP 5, option 2 of Tool to calculate the emission factor for an electricity system

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 14 - 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[49]	2002	215,770	6,550	1,032	5,061	228,413	94.46%
PNSB 2008[50]	2010	254,087	1,635	67	3,758	259,547	97.90%

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

It is important to notice that this study includes the formal[51] and informal[52] 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 (2014)[53]:

- 0.4% of the total solid waste is headed for composting and;
- Only 0.02% 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

[49] http://biblioteca.ibge.gov.br/visualizacao/livros/liv45.pdf , table 110.

[50] Most recent survey at http://biblioteca.ibge.gov.br/visualizacao/livros/liv45351.pdf , table 93.

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

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

[53] http://www.snis.gov.br/downloads/diagnosticos/rs/2014/DiagRS2014.zip , sheet 11.3

The most recent Greenhouse Gases (GHG) Emissions National Inventory has been published by the Ministry of Technology and Science in 2015. According to page 13[54] of the Waste chapter, the incineration practice in Brazil is not a common practice.

Greenhouse Gases (GHG) Emissions National Inventory 2010 presented in page 252 [55] a statement 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[56] published by CETESB in 2013 which considered formal and informal means of solid waste treatment, in the CTL 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 CTL landfill influence area, 100% of the municipal solid waste are disposed in landfill/open dumps and does not exist organic waste recycling.

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

5. Common practice

It is presented below a table with all plants that deliver the same output, within the applicable output range of the project activity.

Name of the project	Localization	Installed capacity (MW)	Fuel type
Cosipar	Marabá - PA	10.0	Blast furnace gas
Barreiro	Belo Horizonte - MG	12.9	Blast furnace gas
Capuava	Santo André - SP	18.0	Bunker
Gusa Nordeste	Açailândia - MA	10.0	Charcoal
Cruzeiro do Sul	Cruzeiro do Sul - AC	21.7	Diesel
Machadinho do Oeste	Machadinho d´Oeste - RO	13.3	Diesel

54 http://sirene.mcti.gov.br/documents/1686653/1706163/RR_Tratamento+de+Res%C3%ADduos_III+Invent%C3%A1rio.pdf/a4edb776-2971-4b84-8030-153ee290f0cb

55 http://www.mct.gov.br/upd_blob/0213/213909.pdf

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

Caucaia	Caucaia - CE	14.8	Diesel
Baturité	Baturité - CE	11.5	Diesel
Crato	Crato - CE	13.1	Diesel
Aracati	Aracati - CE	11.5	Diesel
Iguatu	Iguatu - CE	14.8	Diesel
Enguia Pecém	São Gonçalo do Amarante - CE	14.8	Diesel
Juazeiro do Norte	Juazeiro do Norte - CE	14.8	Diesel
Marambaia	Teresina - PI	13.1	Diesel
Nazária	Teresina - PI	13.1	Diesel
Campo Maior	Campo Maior - PI	13.1	Diesel
Altos	Altos - PI	13.1	Diesel
Cidade Nova	Manaus - AM	15.6	Diesel
Serra do Navio	Serra do Navio - AP	21.6	Diesel
Alcoa Beneficiamento	Juruti - PA	9.8	Diesel
Nova Buritis	Buritis - RO	14.5	Diesel
Antônio Brennand (Ex-Alto Jauru)	Araputanga - MT	20.0	Hydro
Bonfante	Comendador Levy Gasparian - RJ	19.0	Hydro
Canoa Quebrada	Lucas do Rio Verde - MT	28.0	Hydro
Costa Rica	Costa Rica - MS	16.0	Hydro
Furnas do Segredo	Jaguari - RS	9.8	Hydro
Túlio Cordeiro de Mello (Ex-Granada)	Abre Campo - MG	16.2	Hydro
Monte Serrat	Comendador Levy Gasparian - RJ	25.0	Hydro
Pai Joaquim	Sacramento - MG	23.0	Hydro
Pedrinho I	Boa Ventura de São Roque - PR	16.2	Hydro
Pesqueiro	Jaguariaíva - PR	12.4	Hydro
Pipoca	Caratinga - MG	20.0	Hydro
Angelina (Ex-Portobello - Corredeira do Encano)	Angelina - SC	26.3	Hydro
Rondon	Campos de Júlio - MT	13.0	Hydro
Sítio Grande	São Desidério - BA	25.0	Hydro
São João	Castelo - ES	25.0	Hydro
Braço Norte III	Guarantã do Norte - MT	14.2	Hydro
Ombreiras	Araputanga - MT	26.0	Hydro
Salto Corgão	Nova Lacerda - MT	27.0	Hydro
Indiavaí	Indiavaí - MT	28.0	Hydro
Barra da Paciência	Açucena - MG	23.0	Hydro
Ivan Botelho III (Ex-Triunfo)	Astolfo Dutra - MG	24.4	Hydro
Piranhas	Piranhas - GO	18.0	Hydro
Ivan Botelho I (Ex-Ponte)	Descoberto - MG	24.4	Hydro
Ninho da Águia	Delfim Moreira - MG	10.0	Hydro
Paraíso I	Costa Rica - MS	21.6	Hydro
Funil	Dores de Guanhães - MG	22.5	Hydro
Calheiros	Bom Jesus do Itabapoana - RJ	19.0	Hydro

São Gonçalo (Ex-Santa Bárbara)	São Gonçalo do Rio Abaixo - MG	11.0	Hydro
Ivan Botelho II (Ex-Palestina)	Guarani - MG	12.5	Hydro
Cocais Grande	Antônio Dias - MG	10.0	Hydro
Carangola	Carangola - MG	15.0	Hydro
Corrente Grande	Açucena - MG	14.0	Hydro
Linha Emília	Dois Lajeados - RS	19.5	Hydro
Cotiporã	Cotiporã - RS	19.5	Hydro
Caçador	Nova Bassano - RS	22.5	Hydro
Salto Natal	Campo Mourão - PR	15.1	Hydro
Areia Branca	Caratinga - MG	19.8	Hydro
Cachoeirão	Alvarenga - MG	27.0	Hydro
Ormeo Junqueira Botelho (Ex-Cachoeira Encoberta)	Muriaé - MG	22.7	Hydro
Santa Laura	Faxinal dos Guedes - SC	15.0	Hydro
São Joaquim	Alfredo Chaves - ES	21.0	Hydro
São Simão	Alegre - ES	27.4	Hydro
Santa Edwiges III	Buritinópolis - GO	11.6	Hydro
Santa Edwiges II	Buritinópolis - GO	13.0	Hydro
Riachão (Ex-Santa Edwiges I)	Buritinópolis - GO	11.2	Hydro
Salto	Indiavaí - MT	19.0	Hydro
São Domingos II	São Domingos - GO	24.3	Hydro
Esmeralda	Barracão - RS	22.2	Hydro
São Bernardo	Barracão - RS	15.0	Hydro
Areia	Dianópolis - TO	11.4	Hydro
Água Limpa	Dianópolis - TO	14.0	Hydro
Salto Três de Maio	Altamira - PA	20.0	Hydro
Paiol	Frei Inocêncio - MG	20.0	Hydro
Salto Buriti	Novo Progresso - PA	10.0	Hydro
Jararaca	Nova Roma do Sul - RS	28.0	Hydro
Da Ilha	Antônio Prado - RS	26.0	Hydro
Anhanguera	Guará - SP	22.7	Hydro
Planalto	Aporé - GO	17.0	Hydro
São Francisco	Ouro Verde do Oeste - PR	14.0	Hydro
Alto Irani	Arvoredo - SC	21.0	Hydro
Plano Alto	Faxinal dos Guedes - SC	16.0	Hydro
Arvoredo	Arvoredo - SC	13.0	Hydro
Retiro Velho	Aporé - GO	18.0	Hydro
Braço Norte IV	Guarantã do Norte - MT	14.0	Hydro
Faxinal II	Aripuanã - MT	10.0	Hydro
Novo Horizonte	Bocaiúva do Sul - PR	23.0	Hydro
Alto Benedito Novo I	Benedito Novo - SC	15.0	Hydro
Goiandira	Goiandira - GO	27.0	Hydro
Pirapetinga	Bom Jesus do Itabapoana - RJ	20.0	Hydro
Pedra do Garrafão	Campos dos Goytacazes - RJ	19.0	Hydro
São Tadeu I	Santo Antônio do Leverger - MT	18.0	Hydro

Piedade	Monte Alegre de Minas - MG	21.7	Hydro
Parecis	Campos de Júlio - MT	15.4	Hydro
Sapezal	Campos de Júlio - MT	16.0	Hydro
Mambaí II	Sítio d´Abadia - GO	12.0	Hydro
Cidezal	Campos de Júlio - MT	17.0	Hydro
Primavera	Pimenta Bueno - RO	19.2	Hydro
Engº José Gelásio da Rocha	Pedra Preta - MT	24.4	Hydro
Rondonópolis	Rondonópolis - MT	26.6	Hydro
Flor do Sertão	Flor do Sertão - SC	16.5	Hydro
Sete Quedas Alta	Juscimeira - MT	22.0	Hydro
Marco Baldo	Braga - RS	16.0	Hydro
Ouro	Barracão - RS	16.0	Hydro
Porto das Pedras	Água Clara - MS	28.0	Hydro
Santa Gabriela	Itiquira - MT	24.0	Hydro
Colino 2	Medeiros Neto - BA	16.0	Hydro
Cachoeira da Lixa	Itamaraju - BA	14.8	Hydro
Palanquinho	Caxias do Sul - RS	24.2	Hydro
Criúva	Caxias do Sul - RS	23.9	Hydro
Colino 1	Medeiros Neto - BA	11.0	Hydro
Ponte Alta	São Gabriel do Oeste - MS	13.0	Hydro
Ibirama	Ibirama - SC	21.0	Hydro
Lagoa Grande	Dianópolis - TO	25.6	Hydro
Boa Sorte	Dianópolis - TO	16.0	Hydro
Boa Fé	Nova Bassano - RS	24.0	Hydro
Nova Aurora	Goiandira - GO	21.0	Hydro
Autódromo	Guaporé - RS	24.0	Hydro
Queluz	Lavrinhas - SP	15.0	Hydro
Figueirópolis	Figueirópolis d'Oeste - MT	19.4	Hydro
Rodeio Bonito	Arvoredo - SC	14.7	Hydro
Engenheiro Ernesto Jorge Dreher	Júlio de Castilhos - RS	17.9	Hydro
Engenheiro Henrique Kotzian	Júlio de Castilhos - RS	13.0	Hydro
Graça Brennand (ExTerra Santa)	Barra do Bugres - MT	27.4	Hydro
Cascata Chupinguaia	Chupinguaia - RO	9.6	Hydro
Pampeana	Barra do Bugres - MT	28.0	Hydro
Malagone	Uberlândia - MG	19.0	Hydro
Santa Luzia Alto	Ipuaçu - SC	28.5	Hydro
Moinho	Barracão - RS	13.7	Hydro
Caju	Santa Maria Madalena - RJ	10.0	Hydro
São Sebastião do Alto	Santa Maria Madalena - RJ	13.2	Hydro
Braço	Rio Claro - RJ	11.5	Hydro
Brahma	Rio de Janeiro - RJ	13.1	Natural gas
Metalurgia Caraíba	Dias d'Ávila - BA	18.0	Natural gas
Eucatex	Salto - SP	9.8	Natural gas
Negro de Fumo	Cubatão - SP	24.4	Process gas
São Borja	São Borja - RS	12.5	Rice husk

Barralcool	Barra do Bugres - MT	23.0	Sugar cane bagasse
Iracema	Iracemápolis - SP	14.0	Sugar cane bagasse
MB	Morro Agudo - SP	16.4	Sugar cane bagasse
Viralcool	Pitangueiras - SP	20.0	Sugar cane bagasse
São Martinho	Pradópolis - SP	19.0	Sugar cane bagasse
São Francisco	Sertãozinho - SP	25.2	Sugar cane bagasse
Lucélia	Lucélia - SP	15.7	Sugar cane bagasse
Ruette	Paraíso - SP	28.0	Sugar cane bagasse
Flórida Paulista	Flórida Paulista - SP	15.0	Sugar cane bagasse
São José da Estiva	Novo Horizonte - SP	19.5	Sugar cane bagasse
São Domingos	Catanduva - SP	12.0	Sugar cane bagasse
Moema	Orindiúva - SP	24.0	Sugar cane bagasse
Água Bonita	Tarumã - SP	17.0	Sugar cane bagasse
Cocal	Paraguaçu Paulista - SP	28.2	Sugar cane bagasse
Uruba	Atalaia - AL	10.0	Sugar cane bagasse
Nova América	Tarumã - SP	24.0	Sugar cane bagasse
Coopernavi	Naviraí - MS	12.0	Sugar cane bagasse
Passa Tempo	Rio Brilhante - MS	10.0	Sugar cane bagasse
Vale do Verdão	Turvelândia - GO	23.4	Sugar cane bagasse
Itamarati	Nova Olímpia - MT	28.0	Sugar cane bagasse
Triálcool	Canápolis - MG	15.0	Sugar cane bagasse
Usina da Serra	Ibaté - SP	15.0	Sugar cane bagasse
Santo Antônio	Sertãozinho - SP	23.0	Sugar cane bagasse
UFA	Presidente Prudente - SP	25.2	Sugar cane bagasse
Coruripe Iturama	Iturama - MG	24.0	Sugar cane bagasse
Japungu	Santa Rita - PB	16.8	Sugar cane bagasse
Marituba	Igreja Nova - AL	20.5	Sugar cane bagasse
Cucaú	Rio Formoso - PE	12.6	Sugar cane bagasse
Estivas	Arês - RN	17.0	Sugar cane bagasse
Agrovale	Juazeiro - BA	14.0	Sugar cane bagasse
Jitituba Santo Antônio	São Luís do Quitunde - AL	27.4	Sugar cane bagasse
Sinimbu	Jequiá da Praia - AL	18.0	Sugar cane bagasse
Brasilândia	Brasilândia - MS	10.0	Sugar cane bagasse
Pitangueiras	Pitangueiras - SP	25.0	Sugar cane bagasse
Santa Teresa	Goiana - PE	20.2	Sugar cane bagasse
São José	Igarassu - PE	25.5	Sugar cane bagasse
Santo Ângelo	Pirajuba - MG	11.5	Sugar cane bagasse
Alcon	Conceição da Barra - ES	11.2	Sugar cane bagasse
Coruripe	Coruripe - AL	16.0	Sugar cane bagasse
Eldorado	Rio Brilhante - MS	25.0	Sugar cane bagasse
Cocamar Maringá	Maringá - PR	13.0	Sugar cane bagasse
Ouroeste	Ouroeste - SP	12.0	Sugar cane bagasse
Carneirinho	Carneirinho - MG	24.0	Sugar cane bagasse
Iacanga	Iacanga - SP	19.0	Sugar cane bagasse
São José do Pinheiro	Laranjeiras - SE	14.7	Sugar cane bagasse
Usina Monte Alegre	Monte Belo - MG	18.5	Sugar cane bagasse
Cerradão	Frutal - MG	25.0	Sugar cane bagasse

Pirapama	Vitória de Santo Antão - PE	25.0	Sugar cane bagasse
Total	Bambuí - MG	25.0	Sugar cane bagasse
Monções	Monções - SP	20.0	Sugar cane bagasse
Monteverde	Ponta Porã - MS	20.0	Sugar cane bagasse
Biolins	Lins - SP	28.0	Sugar cane bagasse
São Miguel	São Miguel dos Campos - AL	13.2	Sugar cane bagasse
DVPA	Paracatu - MG	28.0	Sugar cane bagasse
Campo Lindo	Nossa Senhora das Dores - SE	16.0	Sugar cane bagasse
Usina Coruripe Açúcar e Álcool	Iturama - MG	20.0	Sugar cane bagasse
Eólica de Prainha	Aquiraz - CE	10.0	Wind
Parque Eólico de Beberibe	Beberibe - CE	25.6	Wind
Foz do Rio Choró	Beberibe - CE	25.2	Wind
Eólica Canoa Quebrada	Aracati - CE	10.5	Wind
Eólica Paracuru	Paracuru - CE	23.4	Wind
Gargaú	São Francisco de Itabapoana - RJ	28.1	Wind
Pedra do Sal	Parnaíba - PI	18.0	Wind
Taíba Albatroz	São Gonçalo do Amarante - CE	16.5	Wind
Millennium	Mataraca - PB	10.2	Wind
Campo Belo	Água Doce - SC	10.5	Wind
Mangue Seco 3	Guamaré - RN	26.0	Wind
Mangue Seco 2	Guamaré - RN	26.0	Wind
Mangue Seco 1	Guamaré - RN	26.0	Wind
Mangue Seco 5	Guamaré - RN	26.0	Wind
Fazenda Rosário 3	Palmares do Sul - RS	14.0	Wind
Cerro Chato II (Ex Coxilha Negra VI)	Santana do Livramento - RS	26.0	Wind
Praia do Morgado	Acaraú - CE	28.8	Wind
Miguel Forte	União da Vitória - PR	16.0	Wood waste
Piratini	Piratini - RS	10.0	Wood waste
Ecoluz	Guarapuava - PR	12.3	Wood waste
PIE-RP	Ribeirão Preto - SP	27.8	Wood waste
Lages	Lages - SC	28.0	Wood waste
Berneck	Araucária - PR	12.0	Wood waste

Source: Brazilian Electrical Power Agency (ANEEL), accessed on 09/12/2011 (http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp). The Project Proponent sent to DOE a spreadsheet with all details of this analysis.

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

Not applicable

Appendix 5. Further background information on monitoring plan

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

Appendix 6. Summary report of comments received from local stakeholders

Stakeholder	Comments
São Paulo Prosecutor's Office	The assessment of the project activity is outside of attribution from São Paulo Prosecutor's Office[57].
Cooperativa de Trabalho com Materiais Reaproveitáveis Chico Mendes	The project activity shows that currently technologies can decrease in large scale impacts from landfills. The advantages of the project activity are: the safety of implanting a gas treatment at the beginning reducing the methane release to atmosphere. Thus, the entity supports this project activity.
Municipal Secretary for Green and Environment São Paulo city;	The stakeholder highlighted that besides destruction methane, the project activity will generate electricity reducing problems related to global warming and contributing to the sustainable development to the city.
OFEA	The project activity reduces the methane emission, generated through solid waste decomposition, decreasing the greenhouse effect.

Appendix 7. Summary of post-registration changes

A summary of the post registration changes previously approved by the board is presented below:

1) Change of methodology version, ACM0001 v17 with inclusion of "Supply consumers through a dedicated pipeline" as project activity GHG emission reduction way;

2) Change in the description of project activity GHG emission reduction through electricity generation, considering electricity for landfill self-consumption and also electricity export to the grid as follows: "The amount of electricity generated in the project activity will be part used for self-consumption at CTL landfill facilities and the surplus part will be exported to the Brazilian national grid";

3) Change in the landfill area from 1,123,590 m² to 1.827.696 m² due to landfill area expansion.

4) Update in the company shareholders:

From	To
• Construtora Queiroz Galvão S.A.; • Heleno & Fonseca Construtécnica S.A.; • Construtora Marquise S.A.	• Vital Engenharia Ambiental S.A. • Construtora Marquise S.A. • S.A. Paulista Construções e Comércio.

5) Change in the electricity generation plant installed capacity from 19.2 MW to 4.278 MW;

6) Changes in the annual estimation of emission reductions in tonnes of CO2e;

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

7) Change in the flow diagram project boundary, including all project activity GHG emission reduction ways;

8) Change in the implementation timeline of the Project

Key Events	**Original PDD date**	**Amended date**
Commercial operation – Phase II*	October/2013	October/2016

9) Changes in the “Investment Analysis” including the new configuration of the electricity generation components and also the LFG costumer supply through a dedicated pipeline;

10) Update of Waste Composition (%);

11) Update of GWP_{CH4} (tCO_2e/tCH_4) to 25 for the 2nd commitment period according to COP/MOP decisions[58]

12) Update of $BE_{CH4,SWDS,y}$ (tCO_2e/y);

13) Emission reduction calculation update;

14) Changes in EL_{LFG} (MWh);

15) Changes in the “Operational of the energy plant (Hours)”;

16) Changes in $EC_{PJ1,y}$ (MWh/y);

17) Changes in $EC_{PJ2,y}$ (MWh/y);

18) Change in the Figure 13 - Monitoring equipments locations;

19) Update of the Environmental Licences presented in the PDD;

20) Changes in Annex 3 – Baseline Information, key parameters and waste disposal,

21) Changes in determination of flare efficiency option (Option B.1: Biannual measurement of the flare efficiency) according to “Project emissions from flaring version 02.0.0”

22) Inclusion of item 4: Overview of the solid waste management in brazil at the national and regional level in Appendix 3: Applicability of methodology and standardized baseline.

23) A typo mistake correction has been made for the estimated parameters $F_{CH4,NG,y}$ (tCH4) for the entire crediting period. It is important to highlight that the typo corrections in parameter $F_{CH4,NG,y}$ (tCH4), being the only source of income to the project activity, does not affect the previous approved project additionality since the data previously used in the investment analysis were already correct. In other words, there was a typo mistake in the methane flows ($F_{CH4,NG,y}$) however the financial data used in the Investment Analysis was already correct. The typo mistake in the parameter $F_{CH4,NG,y}$, impacted changes in the following parameters: $BE_{NG,y}$, BE_y, $PE_{sp,y}$, P_{Ey}, ER_y. According to “CDM project standard for project activities”, version 01.0, Appendix. Indicative list of post-registration changes that may be suitable for approval under the issuance track, the typo mistake correction is suitable for approval under the issuance track, since:

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

a) The correction to project information do not affect the design of the project activity;

b) No changes occurred to the monitoring of the registered CDM project activity;

c) No changes to the project design occurred, thus, neither adversely impacting applicability of the applied methodologies, nor the applied standardized baselines with which the project activity has been registered, nor the additionality of the project activity, nor the scale of the project activity.

24) Calculation formulae amended for parameter BECH4,y in line with applied methodology (Equation 2 of ACM0001 version 17);

25) Changes of Project Design not affecting the additionality:

a) LFG collection efficiency has been amended from 70% to 85%;

b) The forecast amount of waste disposal has been amended;

- Previous:

Year	Waste disposal (tonnes/yr)
2010	203,077
2011	2,156,647
2012	2,192,637
2013	2,214,918
2014	2,223,482
2015	2,196,501
2016	2,400,000
2017	2,400,000
2018	2,400,000
2019	2,400,000
2020	2,400,000
2021	1,100,000

- Current:

Year	Waste disposal (tonnes/yr)
2010	203,077
2011	2,156,647
2012	2,192,637
2013	2,214,918
2014	2,223,482
2015	2,230,501
2016	2,136,686
2017	2,175,911
2018	2,400,000
2019	2,400,000
2020	2,400,000
2021	2,400,000
2022	2,400,000
2023	2,400,000
2024	2,400,000
2025	2,400,000
2026	2,400,000
2027	1,100,000

c) The composition of waste has been amended.

- Previous:

Composition of waste	
A) Wood and wood products	1.45%
B) Pulp, paper and cardboard (other than sludge)	20.58%
C) Food, food waste, beverages and tobacco (other than sludge)	35.78%
D) Textiles	8.19%
E) Garden, yard and park waste	0.00%
F) Glass, plastic, metal, other inert waste	33.62%
TOTAL	**100%**

- Current:

Composition of waste	
A) Wood and wood products	1.79%
B) Pulp, paper and cardboard (other than sludge)	12.96%
C) Food, food waste, beverages and tobacco (other than sludge)	51.44%
D) Textiles	11.05%
E) Garden, yard and park waste	0.00%
F) Glass, plastic, metal, other inert waste	22.75%
TOTAL	**100%**

All “Project Design Changes” impacts on an increment of amount of ex ante LFG collected. But there is **NO** impact to the additionality resulting from the increment of LFG provided

through a dedicated pipeline to the customer, since the “Amount of methane in the LFG which is sent to the consumer through a dedicated pipeline” is fixed and defined in a LFG Purchasing Agreement (unchanged) so it can´t increment sales of LFG or incomes due to contractual issues. Similarly, the electricity generation plant (not implemented yet by the project owner) will not increase its installed capacity nor the electricity generation output due to the “Project design Changes”. Thus, any increment in the LFG collected will be directed to the flares only, not affecting the additionality. The share of collected LFG injected to the dedicated customer changed from the last version of PDD (before PRC), but the generation of sales revenue remained the same (no cashflow changes).
Changes in the “composition of waste” also did impacted on an increment of amount of LFG collected, but in line with the explanation above, did not generated any additional sales of revenue or impacted the additionality.

According to “CDM project standard for project activities”, version 01.0, Appendix. Indicative list of post-registration changes that may be suitable for approval under the issuance track, the Changes to the project design of a registered CDM project activity that do not adversely impact any of the following:

(i) Changes do not impact the applicability and application of the applied methodology ACM0001 v17 and its applicable tools, nor the applied standardized baseline with which the project activity has been registered;
(ii) Changes do not impact the additionality of the project activity; (explained above)
(iii) Changes do not impact the scale of the project activity.
(iv) No changes occurred to the monitoring of the registered CDM project activity;

Thus, it is understood that the changes is in line with the indicative list of post-registration changes that may be suitable for approval under the issuance track.

26) Changes to the project design, affecting the additionality. The inclusion of a new consumer of LFG using a dedicated pipeline and the redistribution of LFG available and revenues from LFG selling to consumer 1 (SJEA) and new consumer 2 (FSL/ZEG), the following changes has occurred in the PDD:

a. Change in the Estimated amount of annual average GHG emission reductions due to inclusion of new LFG consumer and redistribution of LFG available to consumer 1 (SJEA) and new consumer 2 (FSL/ZEG) and update of the Crediting Period to be in accordance with project activity website (link: https://cdm.unfccc.int/Projects/DB/LRQA_Ltd1332768548.38/view);

b. Changes in the “Investment Analysis” including a new LFG costumer supply through a dedicated pipeline and update of key parameters for the financial analysis, due to the inclusion of a new consumer of LFG using a dedicated pipeline and the redistribution of LFG available and revenues from LFG selling to consumer 1 (SJEA) and new consumer 2 (FSL/ZEG):

    i. Update of Revenue for LFG sales (kR$) - SJEA (Consumer 1);

    ii. Update of Revenue for LFG sales (kR$) - FSL/ZEG (Consumer 2).

c. Correction: Change in the start date of crediting period, as stated in the Project 5947 : CTL Landfill Gas Project UNFCCC website. (Crediting Period: 01 Apr 13 - 31 Mar 20 (Renewable), Changed from: 01 Jul 12 - 30 Jun 19), available in the project activity website (link: https://cdm.unfccc.int/Projects/DB/LRQA_Ltd1332768548.38/view);

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Document information

Version	Date	Description
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision 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; • Make 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).

Version	*Date*	*Description*
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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