Project design document form
(Version 12.0)

BASIC INFORMATION	
Title of the project activity	Bandeirantes Landfill Gas to Energy Project (BLFGE)
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	2.4
Completion date of the PDD	16/09/2023
Project participants	Prefeitura Municipal de São Paulo (Municipality of São Paulo) Biogás Energia Ambiental S.A. KfW Fortis Bank N.V./S.A. Mercuria Energy Trading SA ALLCOT AG
Host Party	Brazil
Applied methodologies and standardized baselines	ACM0001 – “Flaring or use of landfill gas” (version 18.0)
Sectoral scopes linked to the applied methodologies	1 – Energy industries (renewable / non-renewable sources) 13 – Waste handling and disposal
Estimated amount of annual average GHG emission reduction	73,517tCO_2e/year

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

Bandeirantes Landfill Gas to Energy Project (BLFGE) is a project designed to explore the landfill gas produced in Bandeirantes landfill, one of the biggest landfills in Brazil. It is located in the metropolitan region of São Paulo, Brazil's biggest city and financial center of the country. With an estimated population of around 11 million citizens, São Paulo generates nearly 20.1 tons of waste daily[1].

The landfill has been designed according to modern practices and was evaluated with 8.8 (from 0 to 10) by the environmental agency of São Paulo (CETESB – Companhia de Tecnologia de Saneamento Ambiental) [2]. However, the designed solution for the landfill gas at the time of the landfill's conception was to collect it through passive venting, occasionally flaring it at the head of the wells, which is not favorable in terms of methane destruction. This is due to the poorly constructive and operational characteristics of the wells, where there is no technique seeking efficiency in the mixture biogas/air and the flaring time.

Aiming to avoid environmental problems related to methane emissions, including global warming, BLFGE created by Biogás Energia Ambiental S.A. – the winner company of a public bid from the municipality of São Paulo. It's goal has been not only to generate renewable energy through 24 engines of 925kW capacity (total installed capacity equals to 22.2MW), but also find an environmental, social and financial solution to avoid landfill greenhouse gases (GHG) release into the atmosphere.

Then, BLFGE uses the gas produced in Bandeirantes landfill for electricity generation dispatch to the Brazilian Interconnected System ("SIN" from the Portuguese *Sistema Interligado Nacional*), occasionally flaring. The project boundary encompasses sites where the LFG is flared or used, *i.e.* the power plant and flares. According to ACM0001, the baseline scenario for LFG destruction is LFG2 (atmospheric release) and for electricity generation is E3 (electricity generation in existing and/or new plants connected to SIN). Detailed description of the baseline scenario is presented in section B4 below. This CDM-PDD refers to the third crediting period of the project and during this 7-year period, the project is expected to reduce 514,620tCO_2e, *i.e*. 73,517tCO_2e/year.

The project started construction in 2003; the flaring system was installed in November 2003 and the first gas engine was installed in December 2003. The project commissioning started on December 23rd 2003, when the final environmental license – working license – was issued. Officially, the project activity started, with the implementation of the degassing station – on January 1st, 2004 – and with the power plant – on February 16th, 2004.

BLFGE provides major contribution towards sustainable development due to:

- Renewable energy generation;
- Methane emission reductions through flaring and generating electricity, avoiding global warming and reducing explosion risks at the landfill site;
- Replicability of technology and know-how in the Host Country, since there are very few projects using biogas in spite of its large potential in Brazil;
- Jobs creation, mainly during implementation and operation phases;
- Increase of local income since revenues from certified emission reductions (CERs) are shared with the Municipality of São Paulo ("PMSP" from the Portuguese Prefeitura Municipal de São Paulo), increasing cash flow towards investments such as rubbish damps recovery, waste management awareness and other environmental benefits.

A.2. Location of project activity

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[1] Data from 2012 year. Information available in Integrated Management Plan of Sao Paulo Municipal Solid Waste (MSW), pages 6-8 Available at: <http://www.prefeitura.sp.gov.br/cidade/secretarias/upload/servicos/arquivos/PGIRS-2014.pdf>

[2] Available at: CETESB - Companhia de Tecnologia de Saneamento Ambiental. *Inventário Estadual de resíduos Sólidos Domiciliares, 2005.*

Bandeirantes landfill is located between km 25 and km 26 at Bandeirantes highway, which connects the city of São Paulo with Campinas Metropolitan Region. The landfill covers an area of approximately 1.35 million m^2, having Perus urban area (a São Paulo district) as North border; São Paulo – Jundiai old road as East border; in South lies the connection between this road and Bandeirantes highway and finally in West there is Bandeirantes highway. The geographic coordinates of project site are as follows:

Latitude: 23° 24' 58.03"S

Longitude: 46°45'46.94''W

Figure 1 – São Paulo location (Source: http://pt.wikipedia.org).

Figure 2 – BLFGE Landfill location (Source: adapted from Google Earth).

A.3. Technologies/measures

Bandeirantes landfill is divided into 5 cells: AS-1, AS-2, AS-3, AS-4 and AS-5. The landfill received waste from 1979 to 2007, when it was closed. More than 37 million tons of waste were disposed in the landfill's area. The collection system encompasses mostly the cells AS-4 and AS-5.

The LFG is extracted from the landfill through the gas wells and is transported to the gas plant by the pipelines for treatment before use as fuel or flaring. During the transportation there might occur the formation of condensates due to temperature gradients requiring drainage of the pipeline to condensate shafts placed along the pipeline. Once in the gas plant, the LFG is cooled again to remove moisture up to a minimum level. The removal of condensates from the LFG flow is a critical step in the gas treatment process should the LFG be used as fuel. LFG condensates contain silica components that can block the gas pipes or damage the gas engines ultimately. Once the condensates are removed, the LFG is heated again by passing through a second heat exchanger, or economizer, to a temperature of around 25 °C, far enough from the dew point of 4 °C to avoid further condensation.

As additional precaution, as per the reasons mentioned in the previous paragraph, a demister was also installed as an extra-guarantee of the LFG quality as fuel for gas engines. The demister is a stainless steel high density filter which separates liquid particles (small amounts of condensate) from the LFG. All liquid removed off the LFG is drained to a condensate shaft.

Blowers are used to provide correct suction pressure into the pipeline system for transportation of the LFG extracted from the landfill up to the gas plant. Flow capacity and pressure are adjusted by electrical motors with frequency control. In addition to that, the blowers are also equipped with necessary safety equipment as well as noise reducing housing.

Sophisticated gas analysing and gas measuring instruments are used on the pressure side of the gas plant to ensure safety, process and operating best controls. Once analysed and properly controlled and measured, the LFG can be used as a fuel for the gas engines which drive electrical generators. Any occasional surplus of the LFG might continue being burned off by the flares. BLFGE has 2 units “High temperature flare HOFGAS – Efficiency 2500” (manufactured by Hofstetter) installed at the site. As presented in the manufacturer’s technical record, the combustion temperature curve varies from 800°C to 1,300°C. Flare dimensions are: 8,126 m height and 2,069m diameter (low height flare).

The main equipment specifications involved in the project activity are presented as follows:

Table 1 – Technical description of project’s equipment.

	Blower*	**Flare**	**El. Generator**	**Diesel Generator**
Manufacturer	Aerzen	Hofstetter	Caterpillar	Cummins Brasil Ltda.
Model	GM 130 L / DN 300	Hofgas Efficiency 2500	G3516A	125DGEB-1297
Quantity	4	2	24	1
Capacity per unit	4,278 Nm^3/h	Min: 500 Nm^3/hr Max: 2,500 Nm^3/h	925kW	125kW
Reference	Manufacturer’s technical data	Manufacturer’s technical data	Equipment tag / site visit	Equipment tag / site visit

*A mini-blower is also installed at the plant with 2,500 Nm^3 capacity.

Figure 3 – Compressors (blue) and dryers (metal)

Figure 4 – Backup diesel generator for emergency purposes

Figure 5 – Enclosed flares for destruction of LFG surplus

Figure 6 – Electricity generators

The whole LFG collecting process and gas plant are controlled by an electrical control system which is provided with a PLC (Programmable Logical Controller) and a SCADA system (visualization of the process on a personal computer), making possible to control and monitor the installation at distance, including through the internet. All the measured process signals are processed by the PLC to feed input signals for the gas-coolers, blowers, flares and gas-engines.

Given the project magnitude in terms of power generation using exclusively LFG as fuel, it would not have happened without technology transfer. The main success for BLFGE implementation is the shareholders of , Biogás Energia Ambiental S.A, which had international experience and, therefore, they contributed for the design of the LFG system and the project implementation and operation. Most of the equipment was imported, such as engines for energy generation, flow meters, gas analyser and flares, as the Brazilian industry was not prepared yet to supply this kind of equipment, at least with the size and characteristics demanded for the BLFGE project. Both project’s implementation and operation have happened under strict environmental regulations, ensuring that technology transference could be made in safe and proper environmental conditions at BLFGE.

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)	Public entity - Prefeitura Municipal de São Paulo (Municipality of São Paulo)	No
Brazil (host)	Private entity - Biogás Energia Ambiental S.A.	No
Germany	Private entity - KfW	No
Switzerland	Private entity - Mercuria Energy Trading SA; ALLCOT AG	No
Netherlands	Private entitiy - Fortis Bank N.V./S.A.	No

A.5. Public funding of project activity

There is no public funding from Parties included in Annex I involved in this project activity.

A.6. History of project activity

BLFGE is registered under CDM on 20/02/2006 and it is currently renewing the crediting period.

The Project Participants confirm that:

(a) The proposed CDM project activity is not included as a component project activity (CPA) in a registered CDM programme of activities (PoA);

(b) The proposed CDM project activity is not a project activity that has been deregistered;

(c) The proposed CDM project activity is not a CPA that has been excluded from a registered CDM PoA;

(d) The proposed CDM project activity is not a registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) exists in the same geographical location as the proposed CDM project activity.

A.7. Debundling

Not applicable. BLFGE is a large scale project type.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

Bandeirantes Landfill Gas to Energy Project applies the ACM0001 methodology – "*Flaring or use of landfill gas*" (version 18.0) and the following methodological tools:

- *TOOL06:* "*Project emissions from flaring"* (version 02.0.0);
- *TOOL05: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0);*
- *TOOL07: "Tool to calculate the emission factor for an electricity system" (version 06.0);*
- *TOOL04:* "*Emissions from solid waste disposal sites"* (version 08.0);

- *TOOL08: "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"* (version 03.0);
- *TOOL11: "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of a crediting period"* (version 03.0.1).

Please note that *"Tool to determine the baseline efficiency of thermal or electric energy generation systems" (TOOL09)*, and the *"Project and leakage emissions from transportation of freight" (TOOL12)* are not applicable to the project activity, since the project does not involve thermal energy generation nor biogas transported by trucks. Therefore, they are not used. The *"Tool to determine the remaining lifetime of equipment" (TOOL10)* and the "*Combined tool to identify the baseline scenario and demonstrate additionality" (TOOL02)* are also not used, since the project equipment does not exist in the baseline scenario (no reform or expansion is involved) and this PDD refers to the third crediting period of the project. Therefore, these tools are not used either. Finally, the *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (TOOL03)* is not used since fossil fuel is not used for other purposes other than electricity generation (fossil fuel is used for electricity generation in cases of emergency). In this case, *TOOL05* shall be used following ACM0001.

B.2. Applicability of methodologies and standardized baselines

The project complies with the applicability conditions described in the methodology ACM0001 as further detailed below.

This methodology is applicable under the following conditions:

(a) Install a new LFG capture system in an existing or new (greenfield) SWDS where no LFG capture system was or would have been 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 cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project system: historical data on the amount of LFG capture and flared is available.

(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.

Previously to the implementation of the project activity, the LFG flow could not be controlled to avoid free GHG emissions to the atmosphere. The main purpose of the project activity is to capture the LFG and to generate electricity. The project activity has also installed enclosed flares for emergency purposes.

Furthermore, the implementation of the proposed CDM project activity does not reduce the amount of organic waste that would be recycled in the absence of the project activity. During the landfill lifetime, there was no recycling system in the region. Currently, the landfill is closed and, since 2007 year, it did not receive waste[3].

[3] Public available information:

http://revistaepoca.globo.com/Sociedade/o-caminho-do-lixo/noticia/2012/01/o-lixo-que-vira-energia-e-credito-de-carbono.html

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.*

(c) *In the case of LFG supplied to the end-user(s) through natural gas distribution network, trucks or the dedicated pipeline, the baseline scenario is assumed to be displacement of natural gas;*

(d) *In the case of LFG from a greenfield SWDS, the identified baseline scenario is atmospheric release of the LFG or capture of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.*

The baseline scenario applied to the project activity is option (a) and (b), since it avoids methane generation and produces renewable electricity. Please refer to Section B.4 for details.

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 the 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.*

The ACM0001 is applicable to the proposed CDM Project Activity since the Bandeirantes Landfill Gas to Energy Project does not use other CDM approved methodology. Furthermore, the management of the landfill in the project activity is not changed in order to increase methane generation compared to the situation prior to the implementation of the project activity (*e.g.* other to meet a technical or regulatory requirement). There is neither the addition of liquids to the SWDS and pre-treating waste to seed it with bacteria for the purpose of increasing the anaerobic degradation environment of the SWDS nor changing the shape of the SWDS to increase the Methane Correction Factor.

In addition to ACM0001 applicability conditions, the ones listed in the tools applied must also be assessed. Regarding the *"Tool to determine the mass flow of a greenhouse gas in a gaseous stream"*, the flow and composition of residual or flared gases or exhaust gases are measured for the determination of baseline or project emissions. Therefore, this tool is applicable.

The methodological tool *¨Emissions from solid waste disposal sites"* is applicable as it is used under Application A: *¨The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. "ACM0001: Flaring or use of landfill gas"). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex- ante estimation of emissions in the CDM-PDD. The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS).*

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http://g1.globo.com/sao-paulo/sao-paulo-mais-limpa/noticia/2012/04/aterros-desativados-recebem-monitoramento-ambiental-em-sp.html

http://www.loga.com.br/content.asp?CP=LG&PG=LG_L03

http://www.apoioambiental.com.br/noticia.aspx?id=NzE=

The *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption and monitoring or electricity generation"* is applicable since the project activity dispatches electricity to the grid (baseline emissions) and there is fossil fuel consumption for electricity generation in case of emergency (project emissions). Further, the *"Tool to calculate the emission factor for an electricity system"* is applicable since, as further described below in section B.6.1., off-grid power plants are not considered. Hence, the requirements of Appendix 2 of the tool, referring to the applicability conditions that shall be met when this kind of plants are considered, are not applicable. Besides, the Brazilian Electricity System is neither partially nor totally located in any Annex-I country.

The methodological tool *"Project emissions from flaring"* is applicable to the flaring of flammable greenhouse gases where:

- *Methane is the component with the highest concentration in the flammable residual gas;*
- *The source of the residual gas is coal mine or gas from biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).*

The flammable residual gas is LFG (gas from biogenic source), which is composed by CH_4, H_2S, CO_2 and N_2, among other components. By default, the methodology adopts that the default fraction of methane in the LFG is 50%. Therefore, it can be assumed that methane is the component with the highest concentration in the LFG. In this sense, both applicability conditions of the tool are met.

The methodological tool "*Assessment of the validity of the original/current baseline and update of the baseline at the renewal of a crediting period"* is used, since this CDM-PDD refers to the third crediting period of the project.

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

<table>
<tr><th colspan="2">Source</th><th>GHG</th><th>Included?</th><th>Justification/Explanation</th></tr>
<tr><td rowspan="12">Baseline</td><td rowspan="3">Emissions from decomposition of waste at the SWDS site</td><td>CH_4</td><td>Yes</td><td>The major source of emissions in the baseline</td></tr>
<tr><td>N_2O</td><td>No</td><td>N_2O emissions are small compared to CH_4 emissions from SWDS. This is conservative</td></tr>
<tr><td>CO_2</td><td>No</td><td>CO_2 emissions from decomposition of organic waste are not accounted since the CO_2 is also released under the project activity</td></tr>
<tr><td rowspan="3">Emissions from electricity generation</td><td>CO_2</td><td>Yes</td><td>Major emission source since power generation is included in the project activity</td></tr>
<tr><td>CH_4</td><td>No</td><td>Excluded for simplification. This is conservative</td></tr>
<tr><td>N_2O</td><td>No</td><td>Excluded for simplification. This is conservative</td></tr>
<tr><td rowspan="3">Emissions from heat generation</td><td>CO_2</td><td>No</td><td>Excluded since heat generation is not included in the project activity</td></tr>
<tr><td>CH_4</td><td>No</td><td>Excluded for simplification. This is conservative</td></tr>
<tr><td>N_2O</td><td>No</td><td>Excluded for simplification. This is conservative</td></tr>
<tr><td rowspan="3">Emissions from the use of natural gas</td><td>CO_2</td><td>No</td><td>Excluded for simplification. This is conservative</td></tr>
<tr><td>CH_4</td><td>No</td><td>Excluded since supply of LFG through a natural gas distribution network is not included in the project activity</td></tr>
<tr><td>N_2O</td><td>No</td><td>Excluded for simplification. This is conservative</td></tr>
</table>

Source	GHG	Included?	Justification/Explanation
Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO_2	No	Not applicable to the proposed CDM Project Activity.
	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 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 distribution of LFG using trucks	CO_2	No	Not applicable to the proposed CDM Project Activity.
	CH_4	No	Not applicable to the proposed CDM Project Activity.
	N_2O	No	Not applicable to the proposed CDM Project Activity.

According to the ACM0001 methodology the project boundary includes *the site where the LFG is captured* (Bandeirantes Landfill) *and*:

(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);*

(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;*

(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;*

(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*

(e) *The transportation of the compressed/liquefied LFG from the biogas processing facility to consumers.*

In the case of the proposed CDM Project Activity, the sites where the LFG is flared/used consists of the collection system, electricity generation plant and gas station facilities (including flaring) – item (a) above.

Regarding item (b), all the power generation sources connected to SIN is included in the project boundary, since electricity is dispatched into and also consumed from the from the grid. On May 26th, 2008, the Brazilian Designated Authority published Resolution #8[4] defining the Brazilian Interconnected Grid as a single system covering all five geographical regions of the country (North, Northeast, South, Southeast and Midwest). Hence, this is the configuration of the national grid that is to be considered.

Items (c) and (d) are not applicable to the project activity. The figure below is a representation of the project boundary.

[4] Comissão Interministerial de Mudança Global do Clima (CIMGC). Available at: <http://www.mct.gov.br/upd_blob/0024/24719.pdf>.

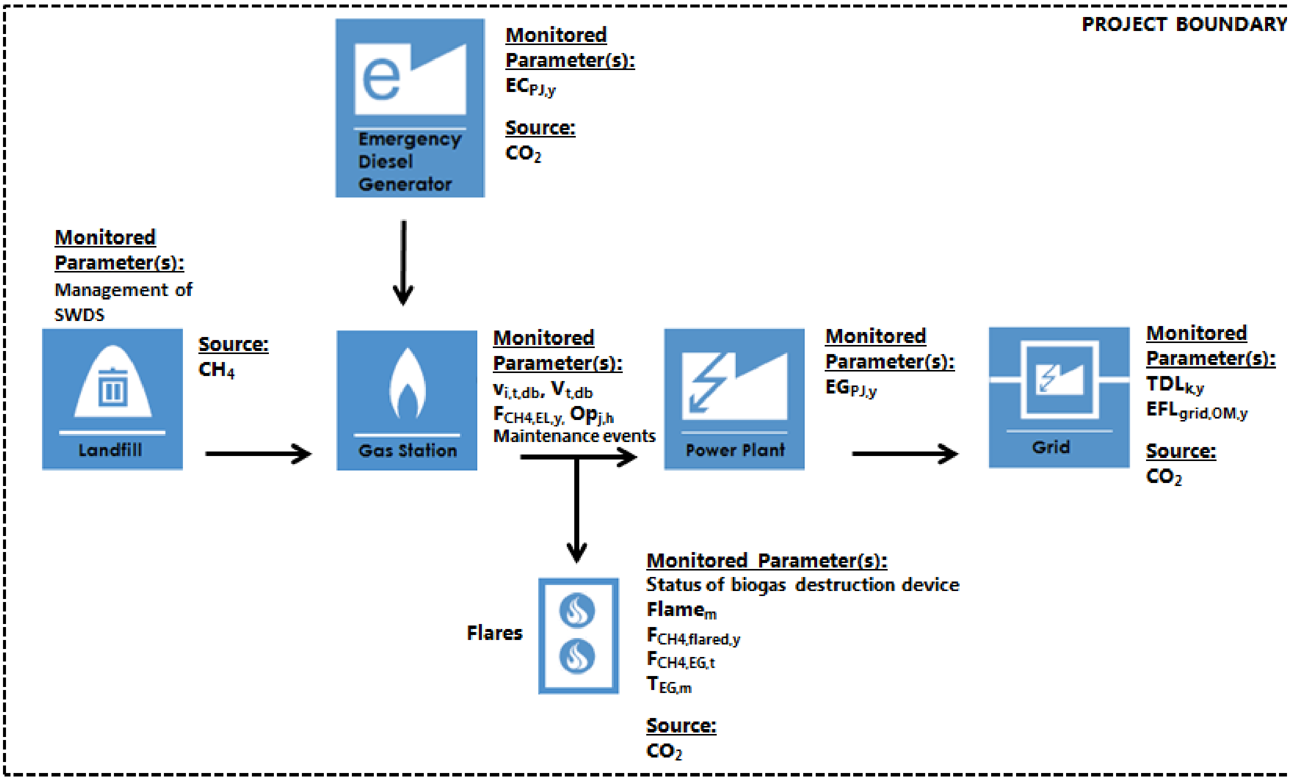

Figure 7 – Simplified diagram of the Project Boundary[5]

B.4. Establishment and description of baseline scenario

According to the CDM Project Standard for Project Activities (version 1.0):

"To demonstrate the validity of the original baseline or its update, project participants are not required to re-assess the baseline scenario. Instead, project participants shall assess the GHG emission reductions that would have resulted from that scenario.

The project participants shall assess and incorporate the impact of national and/or sectoral policies and circumstances, existing at the time of requesting the renewal of the crediting period, on the current baseline GHG emissions, without reassessing the baseline scenario".

Following the methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period", the following steps were taken:

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

According to the updated version of ACM0001, the following baseline alternatives shall be considered while identifying the baseline scenario: (i) destruction of LFG, (ii) electricity generation and (iii) heat generation:

- *Destruction of LFG*

  LFG1: *The project activity implemented without being registered as a CDM project activity (i.e. capture and flaring or use of LFG);*

  LFG2: *Atmospheric release of the LFG or capture of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons;*

[5] Some of the icons used to illustrate the project boundary were adapted from the CDM Methodology Booklet available at http://cdm.unfccc.int/methodologies/documentation/meth_booklet.pdf

LFG3: *Atmospheric release of the LFG or capture of LFG in an unmanaged SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons;*

LFG4: *LFG generation is partially avoided because part of the organic fraction of the solid waste is recycled and not disposed in the SWDS;*

LFG5: *LFG generation is partially avoided because part of the organic fraction of the solid waste is treated aerobically and not disposed in the SWDS;*

LFG6: *LFG generation is partially avoided because part of the organic fraction of the solid waste is incinerated and not disposed in the SWDS.*

- *Electricity generation*

  E1: *Electricity generation from LFG, undertaken without being registered as CDM project activity;*

  E2: *Electricity generation in existing or new renewable or fossil fuel based captive power plant(s);*

  E3: *Electricity generation in existing and/or new grid-connected power plants;*

- *Heat generation*

  H1: *Heat generation from LFG undertaken without being registered as CDM project activity;*

  H2: *Heat generation in existing or new fossil fuel fired cogeneration plant(s);*

  H3: *Heat generation in existing or new renewable based cogeneration plant(s);*

  H4: *Heat generation in existing or new fossil fuel based boiler(s), air heater(s), glass melting furnace(s) or kiln(s);*

  H5: *Heat generation in existing or new renewable energy based boiler(s), air heater(s), glass melting furnace(s) or kiln(s);*

  H6: *Any other source, such as district heat; and*

  H7: *Other heat generation technologies (e.g. heat pumps or solar energy);*

Before the implementation of the project activity, LFG was collected through passive venting and occasionally flaring. As there was no requirement for methane destruction, no technology was employed up to December 2003, when the project activity started construction. Regarding electricity generation, in the absence of the project, it would be generated by the existing power plants connected to the grid. Heat generation is not applicable to the project activity context. Therefore, the baseline scenario identified for LFG destruction and electricity generation is **LFG2** and **E3**, respectively.

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

In Brazil, before the project implementation and nowadays, there were/are no policies regarding mandatory LFG capture and destruction requirements neither local environmental regulations nor policies which promote the energetic use of LFG.

In the beginning of 2010, the National Solid Waste Policy ("PNRS" from the Portuguese *Política Nacional de Resíduos Sólidos*), under discussion since 2000, was approved[6]. One of the scopes of this policy is to enforce the adequate environmental final destination of the solid waste. However, the Policy does not foreseen either the obligation of landfill gas destruction or the promotion of the landfill gas use such as those for the production of renewable energy and processing of organic waste.

[6] Law # 12,305/2010. Available at: http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm

Concerning energetic use of the landfill gas, the project is in line with the Brazilian government initiatives to increase the renewable energy share in the electric matrix. Through Law # 10,438/2002[7], the Brazilian government created PROINFA (Program for Alternative Energy Sources) for promoting the renewable electricity generation by celebrating long-term power purchase agreements (20-year period) at a guaranteed price of at least 80% of the average energy supply tariff charged to ultimate consumers. However, the public call for the first phase of the program occurred in 2004, which no biogas projects participated. Currently, there is no indication by the Brazilian government when the second phase of the program will occur or if it will occur indeed. More recently, the government has been trying to promote micro-scale renewable electricity generation, which consumers can generate its own electricity and dispatch electricity surplus to the grid[8]. However, these initiatives are applied to household consumers.

Based on information above, the baseline scenario for the project did not change at the time of this renewal of the crediting period **LFG2** and **E3** are still applicable. No new relevant national and/or sectoral policies and/or circumstances regarding the waste management sector occurred in comparison to the time of the submission of the project activity for validation, which could impact the compliance of the current baseline scenario. Therefore, the baseline scenario is still the same.

Step 1.2. Assess the impact of circumstances

As discussed above, there are no new relevant national and/or sectoral policies and/or circumstances in the waste management sector applicable to the Project Activity, in comparison to the time of the submission of the project activity for validation, which could impact the validity of the current baseline for the next crediting period. Therefore, the current baseline scenario does not need to be updated for this crediting period.

Step 1.3. Assess whether the continuation of the use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested

The project activity consists of the implementation of a forced extraction system to collect the landfill, which is used to generate electricity, where neither a similar system nor electricity was generated prior to its implementation. In the absence of the proposed CDM Project Activity, the project participants would not have constructed the project's infrastructure. Therefore, the landfill gas would continue to be emitted to the atmosphere and electricity would have been generated by other power plants connected to the grid.

In this context, this sub-step is not applicable since the identified baseline scenario at the validation of the project activity did not correspond to the continuation of use of the current equipment(s) without any investment and, the projects proponents or third party (or parties) would undertake an investment later due, for example, to the end of the technical lifetime of the equipment(s) before the end of the crediting period or the availability of a new technology.

In light of the definition above, independently of the penetration rate of different technologies, it is concluded that the baseline scenario remains valid and applicable for the third crediting period.

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

According to the methodological tool "*Assessment of the validity of the original/current baseline and update of the baseline at the renewal of a crediting period*", updates should be undertaken in the following cases:

— Where IPCC default values are used, the values should be updated if any new default values have been adopted and published by the IPCC, for example, in guidelines for national GHG inventories, IPCC assessment report or special reports by the IPCC;

— Where emission factors, values or emission benchmarks are used and determined only once for the crediting period, they should be updated, except if the emission factors, values or emission benchmarks are based on the historical situation at the site of the project activity prior to the implementation of the

[7] Available at: <http://www.planalto.gov.br/ccivil_03/leis/2002/L10438.htm>

[8] ANEEL Resolution # 482 issued on 17-April-2012. Available at: <http://www2.aneel.gov.br/cedoc/ren2012482.pdf>

project and cannot be updated because the historical situation does not exist anymore as a result of the CDM project activity.

The version of ACM0001 drastically changed during the project crediting periods:

— 1st crediting period: ACM0001 version 2;
— 2nd crediting period: ACM0001 version 11;
— 3rd crediting period: ACM0001 version 18.

The methodological tools referred in ACM0001 and used to calculate baseline and project emissions were also updated. Therefore, all algorithms and data were revised in this CDM-PDD accordingly. Detailed description of methods used to calculate ex-ante emission reductions is presented in section B.6.

Additionally, the methane Global Warming Potential (GWP) has been updated for the second commitment period. As per section 6.3 of the "CDM Project Standard for Project Activities" (version 1.0), since the proposed project activity is requesting the renewal of the crediting period after 1 January 2013, the GWPs valid for the second commitment period shall be used for ex-ante calculation of emission reductions or removals.

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

Step 2.1. Update the current baseline

The baseline emissions for the third 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 and has not impacted the project. Detailed description on how baseline emissions were determined for this third crediting period is presented in section B.6.

Step 2.2. Update the data and parameters

All parameters regarding the baseline emissions calculation have been updated for the third crediting period. Further information can be seen in section B.6.

B.5. Demonstration of additionality

Not applicable for projects requesting the renewal of the crediting period. Please refer to section B.4. above for details.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

Baseline Emissions

Baseline emissions for the proposed project activity are determined according to the following equation:

$$BEy = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y} \quad \textbf{Equation 1}$$

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)
$BE_{HG4,y}$	=	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)

Baseline emissions associated with heat generation in year y ($BE_{HG,y}$) and natural gas use in year y ($BE_{NG,y}$) are not applicable to the proposed project activity.

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

Baseline emissions of methane from the SWDS are determined, based on the amount of methane that is captured under the project activity and the amount that would be captured and destroyed in the baseline (such as due to regulations). In addition, the effect of methane oxidation that is present in the baseline and absent in the project is taken into account[9].

$$BE_{CH4,y} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH4,BL,y}\right) \times GWP_{CH4}$$ **Equation 2**

Where,

$BE_{CH4,y}$	=	Baseline emissions of methane 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)

Ex post determination of $F_{CH4,PJ,y}$

During the crediting period, $F_{CH4,PJ,y}$ is to be determined as the sum of the quantities of methane flared and forwarded to the electricity generation plant, considering the following equation:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y}$$ **Equation 3**

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 (tCH_4/yr)
$F_{CH4,EL,y}$	=	Amount of methane in the LFG which is used for electricity generation in year y (tCH_4/yr)
$F_{CH4,HG,y}$	=	Amount of methane in the LFG which is used for heat generation in year y (tCH_4/yr)
$F_{CH4,NG,y}$	=	Amount of methane in the LFG which is sent to the natural gas distribution network in year y (tCH_4/yr)

In the case of the project activity, $F_{CH4,HG,y}$ and $F_{CH4,NG,y}$ are zero since the proposed project activity neither produces heat nor distributes natural gas through a network. Therefore, $F_{CH4,PJ,y}$ is the sum of $F_{CH4,flared,y}$ *and* $F_{CH4,EL,y}$. $F_{CH4,flared,y}$ is measured by F100 flare (FIR200 flow-meter) and F200 flare (FIR700 flow-meter). $F_{CH4,EL,y}$ is measured by the FIR300, FIR400, FIR500 and FIR600 flow meters.

[9] $OX_{top-layer}$ is the fraction of the methane in the LFG that would oxidize in the top layer of the SWDS in the absence of the project activity. Under the project activity, this effect is reduced as a part of the LFG is captured and does not pass through the top layer of the SWDS. This oxidation effect is also accounted for in the methodological tool “Emissions from solid waste disposal sites”. In addition to this effect, the installation of a LFG capture system under the project activity may result in the suction of additional air into the SWDS. In some cases, such as with a high suction pressure, the air may decrease the amount of methane that is generated under the project activity. However, in most circumstances where the LFG is captured and used this effect was considered to be very small, as the operators of the SWDS have in most cases an incentive to main a high methane concentration in the LFG. For this reason, this effect is neglected as a conservative assumption.

According to ACM0001, $F_{CH4,EL,y}$ shall be determined using *TOOL08* 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 (Opj,h,y).

Furthermore, the following requirements apply:

— As per the gaseous stream tool, if the LFG is used for multiple purposes (e.g. flaring or energy generation), and all methane destruction devices are verified to be operational (e.g. by means of flame detectors records, energy generated), a single flow meter may be used to record the flow into multiple destruction devices. The destruction efficiency of the least efficient among the destruction devices shall be used as the destruction efficiency for all destruction devices monitored by this flow meter. If there are any periods for which one or more destruction devices are not operational, paragraph 5 (a) and (b) of the Appendix of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" tool shall be followed;
  CH_4 is the greenhouse gases for which the mass flow should be determined;

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

— The flow of the gaseous stream should calculated on an hourly basis for each hour *h* in year *y*;

— The mass flow calculated for hour h is 0 if the equipment is not working in hour h (Opj,h=not working), the hourly values are then summed to a yearly unit basis.

For calculating $F_{CH4,EL,y}$, **Option A** of the Tool has been selected (*i.e.*, volume flow measured in dry basis and volumetric fraction measured in dry basis). The demonstration that the gaseous stream is dry follows alternative *b)* of the tool is used since it is forecasted that the temperature of the gaseous stream (T_t) is less than 60^{o}C (333.15 K) at the flow measurement point.

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

$$F_{i,t} = V_{t,db} \times v_{i,t,db} \times \rho_{i,t}$$ **Equation 4**

With

$$\rho_{i,t} = (P_t \times MM_i) / (R_u \times T_t)$$ **Equation 5**

Where,

$F_{i,t}$	=	Mass flow of CH_4 in the gaseous stream (gas sent to electricity generation facility) 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) – of the gas sent to electricity generation facility;
$v_{i,t,db}$	=	Volumetric fraction of CH_4 in the gaseous stream in time interval *t* on a dry basis (m^3 gas *i*/m3 dry gas);
$\rho_{i,n}$	=	Density of CH_4 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);
T_t	=	Temperature of the gaseous stream in time interval t (K);
MM_i	=	Molecular mass of CH_4 (kg/kmol);
R_u	=	Universal ideal gases constant (Pa.m^3/kmol.K).

The flow meters installed convert automatically the volumetric flow of the gaseous stream from actual conditions to normal conditions of temperature and pressure.

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

$F_{CH4,flared,y}$ is determined as the difference between the amount of methane supplied to the flares and any methane emissions from the flares, as follows:

$$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}}$$ **Equation 6**

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)

$F_{CH4,sent\_flare,y}$ is determined directly using *TOOL08* and will be performed separately for each flare, which the sum will be used for the emission reductions calculation.

Similarly to the option used to determine $F_{CH4,sent\_flare,y}$, $F_{CH4,EL,y}$ will be calculated using **Option A** of the Tool (*i.e.*, volume flow measured in dry basis and volumetric fraction measured in dry basis). Hence, the mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using Equation 4 and Equation 5 presented above.

Project Emissions from flaring:

Project emissions are related to the amount of methane not destroyed in the flares and will be calculated following the procedures of *TOOL06* as follows. As LFG is flared through more than one flare, $PE_{flare,y}$ is the sum of the emissions for each flare.

STEP 1: Determination of the methane mass flow of the residual gas;

The mass flow of methane in the residual gaseous stream in the minute *m* ($F_{CH4,m}$) will be determined using the procedures set out by *TOOL08* and 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;
- CH_4 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. Please note that this parameter corresponds to $F_{CH4,sent\_flare,y}$. Therefore, the same methodological approaches apply to both parameters (Option A of the tool). During the site visit, data was collected in a 5-minute interval, but currently, the system was updated to consider 1-minute interval as required by the tool.

The tool also requires that low height flares shall be adjusted, as a conservative approach, by subtracting 0.1 from the efficiency. According to definitions from the tool, a low height flare is an enclosed flare for which the flame enclosure has a height between 10 and two times the diameter of the enclosure.

Since the project flares have 2,069m diameter and 8,126 m height, its height is between the indicated range (2 x 2,069m = 4,138m and 10 x 2,069 = 20,690m). Therefore, the project flares are classified as low height flares and efficiency to be used is 80%, *i.e.* 90% by default minus 10% discount for low height flares.

STEP 2: Determination of flare efficiency

The project has installed enclosed flares and Option A will be used to determine efficiency as follows:

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

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

Otherwise $\eta_{flare,m}$ is 0%.

<u>STEP 3</u>: Calculation of project emissions from flaring

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

$$PE_{flare,y} = GWP_{CH_4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \cdot \left(1 - \eta_{flare,m}\right) \times 10^{-3} \quad \textbf{Equation 7}$$

Where,

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

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

It is determined as follows:

$$F_{CH4,PJ,y} = \eta_{PJ} \cdot BE_{CH4,SWDS,y} / GWP_{CH4} \quad \textbf{Equation 8}$$

Where,

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* ($t\ CH_4/yr$)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($t\ CO_2e/yr$)
η_{PJ}	=	Efficiency of the LFG capture system that is installed in the project activity, this is considered as 50% considering the default value provide in the methodology.
GWP_{CH4}	=	Global warming potential of CH_4 ($t\ CO_2e/t\ CH_4$)

$BE_{CH4,SWDS,y}$ is determined using the methodological tool *"Emissions from solid waste disposal sites"*. The following guidance should be taken into account when applying the tool:

- f_y in the tool shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for in $\boldsymbol{F_{CH4,BL,y}}$;
- In the tool, x begins with the year that the SWDS started receiving wastes (e.g. the first year of SWDS operation); and
- Sampling to determine the fractions of different waste types is not necessary because the waste composition can be obtained from previous studies (obtained from data from ECOURBIS – landfill operator).

Application A of the Tool is used (*i.e.*, the project activity mitigates methane emissions from a specific existing SWDS-solid waste disposal site). A yearly selection has been chosen as the Bandeirantes landfill started receiving wastes in 1979.

The amount of methane that would in the absence of the project activity be generated from disposal of waste at the solid waste disposal site ($BE_{CH4,SWDS,y}$) is calculated with a multi-phase model. The calculation is based on a first order decay (FOD) model.

$$BE_{CH_4,SWDS,y} = \varphi y \times (1-f_y) * GWP_{CH_4} * (1-OX) * \frac{16}{12} * F * DOC_{f,y} * MCFy * \sum_{x=1}^{y}\sum_{j} W_{j,x} * DOC_j \times e^{-k_j(y-x)} * \left(1-e^{-k_j}\right) \qquad \textbf{Equation 9}$$

Where,

$BE_{CH4,SWSD,y}$	=	Baseline methane emissions occurring in year y generated from waste disposal at the solid waste disposal site (SWDS) during a period ending in year y (tCO_2e/y)
φ	=	Model correction factor to account for model uncertainties (default value of 0.75), Option 1 in the Tool has been selected, value as per Table 3 of the Tool (Application A and humid wet conditions).
f	=	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. As this is already accounted for in $\boldsymbol{F_{CH4,BL,y}}$, "f" in the Tool shall be assigned a value of 0.
GWP_{CH4}	=	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste) (default Tool value 0.1)
F	=	Fraction of methane in the SWDS gas (volume fraction) (0.5)
$DOC_{f,y}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWSD for year y (weight fraction). Default value of 0.5 used as per page 65 of the Tool.
MCF_y	=	Methane correction factor for year y (1)
$W_{j,x}$	=	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year *x* (t)
DOC	=	Fraction of degradable organic carbon (by weight fraction) in the waste type *j*
k_j	=	Decay rate for the waste type *j (1/yr)*
j	=	Type of residual waste or types of waste in the MSW
x	=	Years in the time period in which waste is disposed at the SWSD, extending from the first year in the time period (x=1) to year (x = y)
y	=	Year for which methane emissions are calculated (considering a consecutive period of 12 months)

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

NBR 13896/97, consisting of the technical standard published by ABNT (Brazilian Association of Technical Standards - *Associação Brasileira de Normas Técnicas*), sets out the requirements for the development of the design, implementation and operation of landfills aiming at minimizing gaseous emissions and promoting its capture and correct management. However, its use is not mandatory and the norm neither specifies the amount of methane to be destroyed nor the system that shall be put in place. In addition, there is no federal/state/local law requiring the destruction of the methane.

Previously to the implementation of the proposed CDM Project Activity there was a passive system and methane was burned in an uncontrolled manner. Hence, in the case of the Bandeirantes Landfill Project *Case 3* is applicable (*i.e.* there is no technical requirement to destroy methane and there was an existing LFG capture and destruction system).

In accordance with the ACM0001 methodology, *Case 3* is applicable to the project. Since there is no monitored or historical data on the amount of methane that was captured in the year prior to the implementation of the project, the following equation applies:

$$F_{CH4,BL,sys,y} = 0.2 \times F_{CH4,PJ,y}$$ **Equation 10**

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

The baseline emissions associated with electricity generation in year *y* ($BE_{EC,y}$) shall be calculated using *TOOL05*. When applying the tool:

- The electricity sources *k* in the tool correspond to the sources of electricity generated identified in the selection of the most plausible baseline scenario; and
- $EC_{BL,k,y}$ in the tool is equivalent to the net amount of electricity generated using LFG in year *y* ($EG_{PJ,y}$).

Taking into account the approach provided by the tool, baseline emissions are then calculated using the generic approach based on the quantity of electricity dispatched into the National Grid, an emission factor for electricity generation and a factor to account for transmission losses, as follows

$$BE_{EC,y} = \sum EC_{BL,k,y} \times EF_{EL,,k,y} \times \left(1 + TDL_{k,y}\right)$$ **Equation 11**

Where,

$EC_{BL,k,y}$	=	Net amount of electricity generated using LFG in year *y* (MWh/yr)
$EF_{EL,k,y}$	=	Emission factor for electricity generation for source *k* in year *y* (tCO_2/MWh)
$TDL_{k,y}$	=	Average technical transmission and distribution losses for providing electricity to source *k* in year *y*
k	=	Sources of electricity generated in the baseline

The Emission Factor is calculated according *TOOLO07.* The Tool considers the determination of the emission factor for the grid to which the project activity is connected as the core data to be determined in the baseline scenario. Thus, $EF_{EL,k,,y} = EF_{grid,CM,y}$.

The Emission Factor is calculated as the *Combined Margin (CM)*, comprised by two components: the *Built Margin (BM)* and the *Operation Margin (OM)*. The BM evaluates the contribution of the power plants which would have been built if the project plant would not have been implemented. The OM evaluates the contribution of the power plants which would have been dispatched in the absence of the project activity.

TOOL07 presents the following steps to calculate the Emission Factor:

- **STEP 1** - Identify the relevant electricity systems

According to the tool, "*If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used. If such delineations are not available, project participants should define the project electricity system and any connected electricity system and justify and document their assumptions in the CDM-PDD*".

The Brazilian DNA published Resolution #8, issued on 26th May, 2008, defines the Brazilian Interconnected Grid as a single system that covers all the five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest). Hence this figure is used to calculate the baseline emission factor of the grid.

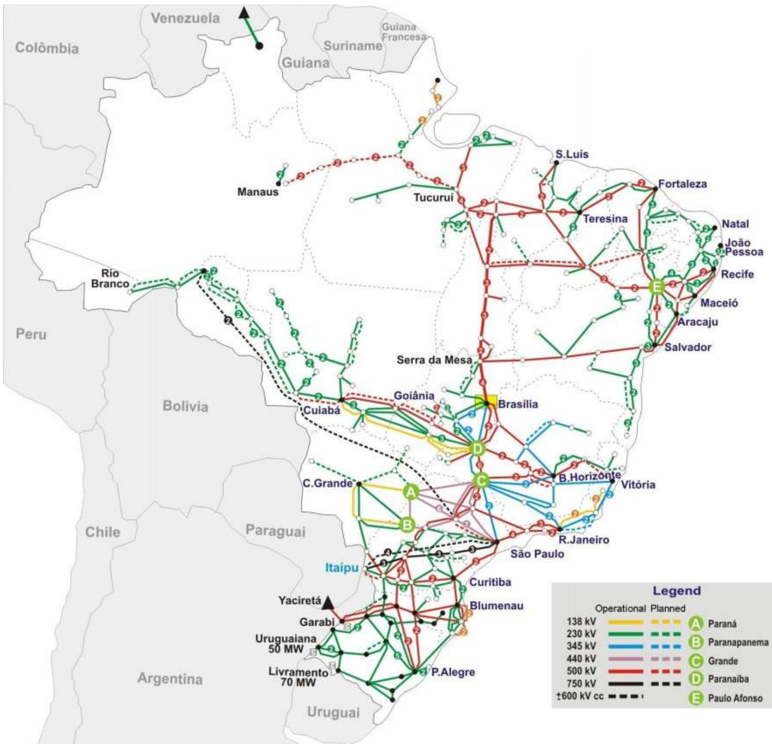

Figure 8 – Brazilian Interconnected System

Source: ONS. “Mapas do SIN”. Information available at: <http://www.ons.org.br/>.

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

  Option I of the tool is chosen, which includes only grid power plants in the operating margin and build margin emission factor.

- **STEP 3 -** Select a method to determine 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 simple operating margin can only be used where low-cost/must-run resources[10] constitute less than 50% of total grid generation in: 1) average of 5 most recent years, or 2) based on long-term normalities for hydroelectricity production. **Figure 1**Figure 9 shows the share of hydroelectricity in the total electricity production for the Brazilian Interconnected System. The results show the non-applicability of the simple operating margin to the proposed CDM Project Activity.

[10] Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

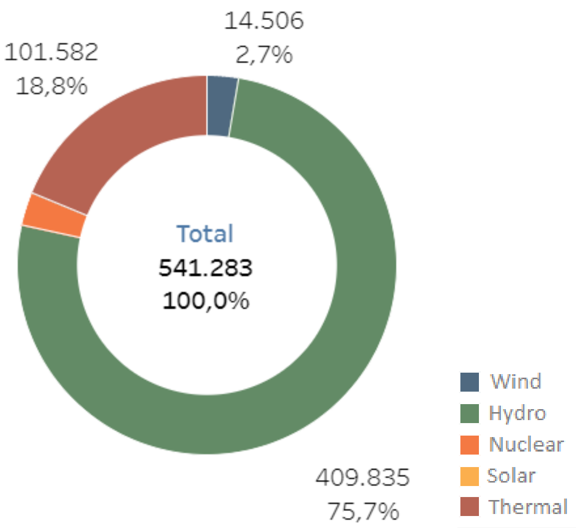

Figure 9 – Electricity generation in the Brazilian interconnected system by source, 2012 to 2016 (GWh)

Source: *ONS: Histórico da Operação. Available at* <http://www.ons.org.br/Paginas/resultados-da-operacao/historico-da-operacao/geracao_energia.aspx>.

The fourth alternative, an average operating margin, is an oversimplification and does not reflect in any way the impact of the project activity on the operating margin. The use of the dispatch data analysis method requires hourly monitoring of electricity and, in order to reduce data demand, the simple adjusted operating margin was chosen to determine the grid emission factor for the BLFGE, option b) of the tool.

The Brazilian DNA made available the operating margin emission factor calculated following the "Tool to calculate the emission factor for an electricity system", approved by the CDM Executive Board. Since the 2nd crediting period considers an *ex-post* data vintage, the option (b) was used in this 3rd crediting period based on *ex-post* data vintage. Therefore, this parameter will be annually updated applying the numbers provided by the Brazilian DNA.

- **STEP 4** - Calculate the operating margin emission factor according to the selected method

  The simple adjusted OM shall be calculated based on the following equation:

$$EF_{grid,OM-adj,y} = (1-\lambda_y) \cdot \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y \cdot \frac{\sum_k EG_{k,y} \times EF_{EL,k,y}}{\sum_k EG_{k,y}} \qquad \textbf{Equation 12}$$

Where,

$EF_{grid,OM-adj,y}$	=	Simple adjusted operating margin CO_2 emission factor in year *y* (tCO_2/MWh);
λ_y	=	Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year *y;*
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh);
$EG_{k,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *k* in year *y* (MWh);
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh);
$EF_{EL,k,y}$	=	CO_2 emission factor of power unit *k* in year *y* (tCO_2/MWh);
m	=	All grid power units serving the grid in year *y* except low-cost/must-run power units;

k	=	All low-cost/must run grid power units serving the grid in year *y;*
y	=	The relevant year as per the data vintage chosen in Step 3.

The $EF_{grid,OM-adj,y}$ parameter is calculated and annually updated by the Brazilian DNA. The resulted values will be used in project verification.

- **STEP 5** - Calculate the build margin (BM) emission factor

The sample group of power units *m* used to calculate the build margin was determined following the procedure provided by the tool and BM emission factor shall be calculated based on the equation below:

$$EF_{grid,BM,y} = \frac{\sum mEG_{m,y} \times EF_{EL,m,y}}{\sum mEG_{m,y}}$$ **Equation 13**

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (tCO_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 (tCO_2/MWh)
m	=	Power units included in the build margin
y	=	Most recent historical year for which electricity generation data is available

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 shall 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 emissions 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 chosen by the Project Participants is option 2, *i.e.* the *ex-post* data vintage based on the build margin emission factor made available by the Brazilian DNA. Therefore, the CO_2 BM EF considered in the 2nd crediting period PDD will be used in the 3rd crediting period of the project.

- **STEP 6** – Calculate the combined margin (CM) emissions factor

The calculation of the combined margin (CM) emission factor is based on one of the following methods:

(a) Weighted average CM; or
(b) Simplified CM.

Since power grid is not located in LDC/SIDs/URC and the weighted average CM method (option A) is the preferred option, this method was considered. The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM}$$ **Equation 14**

Where,

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (tCO_2/MWh);
$EF_{grid,OM,y}$	=	Operating margin CO_2 emission factor in year y (tCO_2/MWh);
w_{OM}	=	Weighting of operating margin emissions factor (%);
w_{BM}	=	Weighting of build margin emissions factor (%).

According with the Tool, values adopted for w_{OM} and w_{BM} were equal to 0.25 and 0.75, respectively, for the 3rd crediting period. As mentioned above, the *ex-post* approach is used.

Steps (C) and (D) of ACM0001 methodology are not applicable since there won't be either heat generation or natural gas distribution through a network in the project activity.

Project Emissions

Project emissions are calculated as follows:

$$\mathrm{PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} + PE_{SP,y}}$$ **Equation 15**

Where,

$PE_{EC,y}$	=	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);
$PE_{DT,y}$	=	Emissions from the distribution of compressed/liquefied LFG using trucks, 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)

$PE_{FC,y}$, $PE_{DT,y}$ *and* $PE_{SP,y}$ *are not applicable to the proposed project activity.* During the crediting period, electricity from the diesel generator may be consumed for the operation of the active LFG collection and destruction systems whenever the electricity generation facility stops and for emergency purposes. Therefore, $PE_{EC,y}$ is applicable to the project and will be calculated as follows.

Emissions from consumption of electricity due to the project activity ($PE_{EC,y}$)

Project emissions from electricity consumption ($PE_{EC,y}$) will be calculated following the procedures set out by *TOOL05*. Project emissions from consumption of electricity from the diesel generator are calculated based on the electricity consumed by the project activity and, in the case of the project activity, a conservative default value for the emission factor (1.3tCO_2/MWh), adjusted for transmission losses as follows:

$$\mathrm{PE_{EC,grid,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times \left(1 + TDL_{j,y}\right)}$$ **Equation 16**

Where,

$PE_{EC,grid,y}$	=	Project emissions from electricity consumption from the grid by the project activity during the year *y* (tCO_2/year);
$EC_{PJ,y}$	=	Quantity of electricity consumed by the project electricity consumption source *j* in year *y* (MWh)
$EF_{EL,j,,y}$	=	Emission factor for electricity generation for source *j* in year (tCO_2/MWh)

$TDL_{j,y}$ = Average technical transmission and distribution losses for providing electricity to source *j* in year *y*

J = Sources of electricity consumption in the project

Electricity sources *j* corresponds to all the sources of electricity consumed for the operation of the LFG capture system and transportation of the LFG to the flares. Since the diesel generator is located inside BLFGE, there are no transmission losses and, therefore, $TDL_{j,y}$ is zero, unlike baseline emissions which TDL is based on the power utility losses. For the *ex-ante* estimation of electricity consumed, amount of electricity consumed from the diesel generator during the last monitored period is considered.

Leakage

According with ACM0001 there is no need to account for leakage.

Emission reductions

Emission reductions will be calculated using the formula below:

$$ER_y = BE_y - PE_y$$

Equation 17

Where,

ER_y = Emission reductions during the year *y* (tCO_2e)

BE_y = Baseline emissions in year *y* (tCO_2e)

PE_y = Project emissions in year *y* (tCO_2e)

B.6.2. Data and parameters fixed ex ante

"ACM0001 Methodology"

Data/Parameter	OX_{top_layer}
Data unit	*Dimensionless*
Description	*Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline*
Source of data	*Consistent with how oxidation is accounted for in TOOL04*
Value(s) applied	*0.1*
Choice of data or measurement methods and procedures	*As per the applicable tool*
Purpose of data	*Calculation of baseline emissions*
Additional comment	-

Data/Parameter	$F_{CH4,BL,y}$
Data unit	t CH_4/yr
Description	Amount of methane in the LFG that would be flared in the baseline in year *y*
Source of data	Information of the host country's regulatory requirements relating to LFG, contractual requirements, or requirements to address safety and odour concerns as well as records of the project site previously to the implementation of the proposed CDM Project Activity
Value(s) applied	706 (average during the crediting period)
Choice of data or measurement methods and procedures	There was no regulatory and/or contractual requirement to destroy methane and a there was a LFG capture and destruction system installed prior to the implementation of the project activity.
Purpose of data	Calculation of baseline emissions
Additional comment	In the case of the proposed project activity Case 3 is applicable. For details please refer to section B.6.1. above.

Data/Parameter	GWP_{CH4}
Data unit	tCO_2e/tCH_4
Description	Global Warming Potential of CH_4
Source of data	IPCC
Value(s) applied	25 for the second commitment period. Shall be updated according to any future COP/MOP decisions.
Choice of data or measurement methods and procedures	As per the applicable methodology
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	η_{PJ}
Data unit	Dimensionless
Description	Efficiency of the LFG capture system installed in the project activity
Source of data	-
Value(s) applied	50%
Choice of data or measurement methods and procedures	Default value provided by the applicable methodology
Purpose of data	Calculation of baseline emissions
Additional comment	Applicable to Step A.1.1

TOOL04: "Emissions from solid waste disposal sites"

Data/Parameter	$\varphi_{default}$
Data unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	-
Value(s) applied	0.75
Choice of data or measurement methods and procedures	As per *TOOL04*. This parameter is used to determine the baseline emissions following the procedures related to *Application A*. Further, the project is located at São Paulo state (southeast region of Brazil) which possesses tropical weather conditions[11]: MAT > 20ºC MAP > 1,000mm
Purpose of data	Calculation of baseline emissions
Additional comment	As per Option 1 of the tool.

Data/Parameter	f_y
Data unit	-
Description	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*
Source of data	ACM0001
Value(s) applied	0
Choice of data or measurement methods and procedures	In accordance with the ACM0001 methodology this value is to be assigned since the amount of LFG that would have been captured and destroyed is already accounted for in Equation 2. As per *TOOL04*, for application A, this parameter is determined once for the crediting period ($f_y = f$).
Purpose of data	Calculation of baseline emissions
Additional comment	-

[11] The climatic conditions were taken from CEPAGRI – *Centro de Pesquisas Meteorológicas e Climáticas Aplicadas a Agricultura* -, available at http://www.cpa.unicamp.br/outras-informacoes/clima_muni_565.html.

Data/Parameter	***OX***
Data unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	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
Choice of data or measurement methods and procedures	As per *TOOL04*
Purpose of data	Calculation of baseline emissions
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. For ex-ante calculations this effect was accounted when determining emission reductions as per ACM0001 formulae. Please refer to AM_CLA_0259. Although clarification refers to ACM0001 (version 15.0) and *TOOL04* (version 6.0.1), it is also applied to the project since equations do not change in the updated version of methodology and tool.

Data/Parameter	***F***
Data 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	As per *TOOL04*
Purpose of data	Calculation of baseline emissions
Additional comment	Upon biodegradation, organic material is converted to a mixture of methane and carbon dioxide.

Data/Parameter	$DOC_{f,default}$
Data unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories”
Value(s) applied	0.5
Choice of data or measurement methods and procedures	The proposed project activity corresponds to *Application A* described in *TOOL04*. Therefore, in accordance with the requirements set out by tool, the default value was chosen.
Purpose of data	Calculation of baseline emissions
Additional comment	This factor reflects the fact that some of the degradable organic carbon does not degrade, or degrades very slowly, in the SWDS.

Data/Parameter	$MCF_{default}$
Data unit	-
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	1
Choice of data or measurement methods and procedures	The proposed project activity matches *Application A* described in *TOOL04*. The Bandeirantes Landfill meets the criteria of managed SWDS. Hence, the value corresponding to **anaerobic managed solid waste disposal sites** is chosen.
Purpose of data	Calculation of baseline emissions
Additional comment	The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

<table>
<tr><td>Data/Parameter</td><td>DOC_j</td></tr>
<tr><td>Data unit</td><td>-</td></tr>
<tr><td>Description</td><td>Fraction of degradable organic carbon in the waste type j (weight fraction)</td></tr>
<tr><td>Source of data</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th>DOC_j
(% wet waste)</th><th>Waste type j</th></tr>
<tr><td>43%</td><td>Wood and wood products</td></tr>
<tr><td>40%</td><td>Pulp, paper and cardboard</td></tr>
<tr><td>15%</td><td>Food, food waste, beverages and tobacco</td></tr>
<tr><td>24%</td><td>Textiles</td></tr>
<tr><td>20%</td><td>Garden, yard and park waste</td></tr>
<tr><td>0%</td><td>Glass, plastic, metal, other inert waste</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>Values for MSW, as per Table 6 of TOOL04.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

<table>
<tr><td>Data/Parameter</td><td>k_j</td></tr>
<tr><td>Data unit</td><td>1/yr</td></tr>
<tr><td>Description</td><td>Decay rate for the waste type j</td></tr>
<tr><td>Source of data</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th colspan="2">Waste type j</th><th>k_j</th></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.07</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.035</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.17</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.40</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>As per Table 7 of TOOL04.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>The project is located at São Paulo state (Southeastern region of Brazil) which possesses tropical weather conditions[11]:
MAT > 20ºC
MAP > 1,000mm</td></tr>
</table>

Data/Parameter	***W_x***
Data unit	T
Description	Total amount of waste disposed in a SWDS in year *x*
Source of data	Landfill's weight bridge, already validated in the 1st and 2nd crediting period.
Value(s) applied	Large amount of data. Please refer to the CERs calculation spreadsheet
Choice of data or measurement methods and procedures	Values taken from the weight bridge, located in the entrance of the landfill. The bridge measures the truck weight before and after the waste unload. The difference is equal to the amount of waste.
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter does not need to be monitored during the crediting period since the landfill was closed in 2007.

TOOL06: "Project emissions from flaring"

Data/Parameter	***$SPEC_{flare}$***
Data unit	Temperature - ºC Flow rate or heat flux – kg/h or m^3/h Maintenance schedule – number of days
Description	Manufacturer's flare specification for temperature and flow rate and maintenance schedule
Source of data	Flare manufacturer
Value(s) applied	Not used for *ex-ante* calculations
Choice of data or measurement methods and procedures	The flare specifications set by the manufacturer for the correct operation of the flare for the selected parameters are: (a) Minimum and maximum inlet flow rate, if necessary converted to flow rate at reference conditions or heat flux: Min. – 500Nm^3/h / Max. 2,500Nm^3/h for each flare (b) Minimum and maximum temperature: 800ºC – 1,300ºC (c) Maintenance schedule: every 365 days
Purpose of data	Calculation of project emissions
Additional comment	-

TOOL08: "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"

Data/Parameter	***Ru***
Data unit	Pa.m^3/kmol.K
Description	Universal ideal gases constant
Source of data	As per the applicable tool
Value(s) applied	8,314
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	***Pn***
Data unit	Pa
Description	Atmospheric pressure at normal conditions
Source of data	As per the applicable tool
Value(s) applied	101,325
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	***Tn***
Data unit	K
Description	Temperature at normal conditions
Source of data	As per the applicable tool
Value(s) applied	273.15
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of project emission
Additional comment	-

Data/Parameter	***MMi***
Data unit	kg/kmol
Description	Molecular mass of greenhouse gas *i*
Source of data	Tool
Value(s) applied	16.04 (for methane)
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

TOOL07: "Tool to calculate the emission factor for an electricity system"

Data/Parameter	$EF_{BM,2009}$
Data unit	tCO_2/MWh
Description	Build Margin CO_2 emission factor in year *y*
Source of data	The registered PDD from the second crediting period
Value(s) applied	0.0794
Choice of data or measurement methods and procedures	The *ex-ante* calculation vintage of this parameter was chosen as per the procedures of the *"Tool to calculate the emission factor for an electricity system"*.
Purpose of data	Calculation of baseline emissions
Additional comment	For methodological choices details, please refer to section B.6.1.

TOOL05: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"

Data/Parameter	$EF_{EL,j,y}$
Data unit	tCO_2/MWh
Description	Emission factor for electricity generation for source *j* in year
Source of data	*Default value from TOOL05*
Value(s) applied	1.3
Choice of data or measurement methods and procedures	Conservative default value provided by Option B2 of the tool.
Purpose of data	Calculation of project emissions due to electricity consumption from the diesel generator
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

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

The following data was used to calculate the *ex-ante* methane estimative (as per the tool *"Emissions from solid waste disposal sites"* :

- *Model correction factor to account for model uncertainties (ϕ)*: 0.75 (default value as per the Tool Application A and wet conditions under Option 1);
- *Default value from the SWDS emissions tool, fraction of methane in the SWDS gas (F):* 0.5 (default value as per the Tool);
- *Fraction of degradable organic carbon that can decompose (DOC_f):* 0.5 (default value for Application A);
- *MFC (Methane Conversion Factor):* MCF value is adopted according with the type of SWDS. The Bandeirantes Landfill is a managed SWDS; thus, the MCF adopted is equal to 1;
- W_x (Total amount of organic waste prevented disposed in year x, in tons): data from history of landfill's weight bridge, already validated in the 1st and 2nd crediting period. The landfill was closed in 2007.

The Oxidation factor, reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste, was considered when determining baseline emissions using formulae provided by the methodology ACM0001.

Table 2 – Historical deposited solid waste at the site.

Year	Deposited waste (tons)	Year	Deposited waste (tons)	Year	Deposited waste (tons)
1981	231,408	**1990**	1,206,964	**1999**	2,305,464
1982	313,633	**1991**	1,224,954	**2000**	1,964,424
1983	321,956	**1992**	1,508,817	**2001**	2,043,617
1984	325,585	**1993**	1,377,148	**2002**	2,082,855
1985	408,887	**1994**	1,616,710	**2003**	1,993,371
1986	801,366	**1995**	1,823,170	**2004**	1,965,347
1987	1,017,866	**1996**	1,971,651	**2005**	1,594,350
1988	1,283,852	**1997**	1,992,386	**2006**	1,974,799
1989	977,852	**1998**	2,142,325	**2007**	489,627

The historical average of each type of waste concentration is presented in the table below, which is comparable to municipal solid waste (MSW, heterogeneous mix of different solid waste types collected by the municipality of São Paulo, including household waste, garden/park waste and commercial/institutional waste):

Table 3 – Waste types historically disposed at the project site[12].

Category	% (wet basis)
Wood and wood products	0.65%
Pulp, paper and cardboard	12.37%
Food, food waste, beverages and tobacco	60.54%
Textiles	3.14%
Garden, yard and park waste	3.17%
Glass, plastic, metal, other inert waste	20.08%

In accordance with the ACM0001 methodology, *Case 3* is applicable to the project. Therefore, 20% discount is applied in total LFG capture from the landfill. Baseline emissions from SWDS methane are as follows:

Table 4 – Baseline emissions of methane from SWDS.

Year	$BE_{CH4,SWSD,y}$ (t_{CO2})	$F_{CH4,PJ,y}$ (t_{CH4})	$F_{CH4,BL,y}$ (t_{CH4})	$BE_{CH4,y}$ (t_{CO2})
23/12/2017	6,788	136	27	2,444
2018	252,107	5,042	1,008	90,758
2019	231,915	4,638	928	83,489
2020	214,080	4,282	856	77,069
2021	198,135	3,963	793	71,329
2022	183,744	3,675	735	66,148
2023	170,659	3,413	683	61,437
22/12/2024	154,780	3,096	619	55,721

b) Baseline emissions electricity generation

$EG_{PJ,y}$ is equal to the electricity produced by the proposed CDM Project Activity. For the purpose of *ex-ante* estimative it was estimated assuming the amount of LFG delivered to the power plant as well as conversion factors. The detailed calculation is presented in the CERs calculation spreadsheet attached to the PDD. The results are presented below in Table 5. Electricity effectively dispatched into the national grid is measured at AES Eletropaulo's substation, located around 14 km away from the landfill. Transmissions losses are estimated as 5.2% based on 2016 Eletropaulo's technical losses[13].

The calculation of the combined margin CO_2 emission factor for grid connected power generation ($EF_{grid,CM,y}$) follows the steps established in TOOL07. According to data published by the Brazilian DNA, the CO_2 operating margin emission factor of 2017 year (the most recent data available) is as follows:

$$EF_{grid,OM,2017} = 0.4287 tCO_2e/MWh$$

Regarding the CO_2 build margin emission factor, value considered in the 2nd crediting period is used following the EF Tool:

$$EF_{grid,BM,2009} = 0.0794 tCO_2e/MWh$$

While using applicable w_{OM} and w_{BM} for the 3rd crediting period, the CO_2 combined margin emission factor is

[12] FRAL CONSULTORIA LTDA., Caracterização dos Resíduos Sólidos Domiciliares do Município de São Paulo – Agrupamento Noroeste – Quadrimestre nov/dez/2008/jan/fev/2009 – 2009.

[13] 2016 Eletropaulo Administrative Report. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years following TOOL05.

as follows:

$$EF_{grid,CM} = 0.1667 tCO_2e/MWh$$

Applying these figures to Equation 11, we have the following results:

Table 5 – Baseline emissions due to electricity generation.

Year	$EG_{PJ,y}$ *(MWh/yr)*	$BE_{EC,y}$ *(tCO_2/yr)*
23/12/2017	616	108
2018	22,878	4,013
2019	21,045	3,691
2020	19,427	3,407
2021	17,980	3,154
2022	16,674	2,925
2023	15,487	2,716
22/12/2024	14,046	2,464

c) Project emissions due to electricity consumption from the diesel generator

As diesel is used only for emergency purposes (when the electricity generation facility is not operational), for the *ex-ante* estimation information presented in the last available monitoring period by the time of current PDD development is used. The total electricity consumed from the diesel generator from 01/01/2013 up to 31/12/2016 (four full years) was 935 MWh. Therefore, the 4-year average consumption of diesel oil is around 234MWh/yr.

Transmission losses can be neglected since the generator is next to the biogas facility. Therefore, $TDL_{j,y}$ = $TDL_{k,y}$ = 0%. The default conservative value of emission factor provided by Option B.2 of the tool is used, which is 1.3tCO_2/MWh. While applying values on Equation 18, project emissions due to electricity consumption are as follows:

Table 6 – Project emissions due to electricity consumption.

Year	Electricity Consumed (MWh)	CO_2 Emission Factor (tCO_2e/MWh)	$PE_{EC,j,y}$ *(tCO_2/yr)*
23/12/2017	6	1.3	8
2018	234		304
2019	234		304
2020	234		304
2021	234		304
2022	234		304
2023	234		304
22/12/2024	228		297

d) Project emission due to flaring

The calculation of the *ex-ante* methane emissions from flaring of vented gas has been estimated using the balance of methane in the LFG collected by the proposed project activity system and the methane in the LFG sent to the electricity generation facility. It is assumed that all the methane not used to generate electricity is to be flared in the enclosed flares.

As described in section B.6.1. above, Project Participants have opted to consider the default value for flare efficiency using Option B.2. of *TOOL08*. Then the project emissions due to flaring gases have been estimated as:

Table 7 – Baseline emissions from flaring.

Year	***$PE_{flare,y}$ (tCO₂e/year)***
23/12/2017	68
2018	2,521
2019	2,319
2020	2,141
2021	1,981
2022	1,837
2023	1,707
22/12/2024	1,548

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 23/12/2017	2,552	75	0	2,477
2018	94,771	2,825	0	91,946
2019	87,181	2,623	0	84,557
2020	80,476	2,445	0	78,031
2021	74,482	2,286	0	72,197
2022	69,073	2,142	0	66,931
2023	64,154	2,011	0	62,143
Up to 22/12/2024	58,184	1,844	0	56,340
Total	**530,871**	**16,251**	**0**	**514,620**
Total number of crediting years	7			
Annual average over the crediting period	75,839	2,322	0	73,517

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

"ACM0001 Methodology"

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	Calculation of baseline emissions
Additional comment	-

Data/Parameter	$Op_{j,h}$
Data unit	-
Description	Operation of the equipment that consumes the LFG
Source of data	Project participants
Value(s) applied	Not used for *ex-ante* calculations.
Measurement methods and procedures	In the context of the proposed project activity, equipment unit *j* using *the LFG* consists of the LFG facility and flares. Hence, the following parameters are to be used to ensure that the plant is operating in hour *h*: *For the electricity generation facility* • Products generated: electricity generation dispatched to the grid. *For the flaring system* • Temperature: according to the manufacturer's technical record, the combustion temperature varies from 800 to 1,300°C. Temperature shall varies between this range. In order to be conservative, only gas above 900°C will be accounted for emission reduction calculation. $Op_{j,h}$=0 when: • No products are generated in the hour *h* • Flame is not detected continuously in hour *h* (instantaneous measurements are made at least every minute); Otherwise, $Op_{j,h}$=1
Monitoring frequency	Hourly
QA/QC procedures	Electricity meters and thermocouples are subjected to a regular maintenance and testing regime to ensure accuracy. Flow meters are 5-year calibrated and thermocouples are yearly calibrated. Accuracy of the electricity meters and thermocouples are described in the monitoring tables of respective parameters.
Purpose of data	Calculation of baseline emissions
Additional comment	This is monitored to ensure methane destruction is claimed for methane used to generate electricity when the power plant is operational.

Data/Parameter	***$EG_{PJ,y}$***
Data unit	MWh
Description	Net amount of electricity generated using LFG in year *y*
Source of data	PLC data records
Value(s) applied	18,307 (average during the crediting period)
Measurement methods and procedures	There are electricity meters (principal and backup) installed at the project site and the power utility substation. The reading frequency from the electricity meter is continuously and daily recording. Data from the power utility (AES Eletropaulo) is used for invoice purposes and also for ER calculation.
Monitoring frequency	Continuous
QA/QC procedures	Electricity meters are subjected to regular maintenance and testing to ensure accuracy following the procedures from the National Electric System Operator ("ONS" from the Portuguese Operador Nacional do Sistema Elétrico), sub-module 12.3. Currently, calibration is conducted at every 5 years and will be changed in case of any future revisions from ONS. The accuracy of the equipment, as per the manufacturer specification is 0.2S (accuracy class 0.2).
Purpose of data	Calculation of baseline emissions
Additional comment	In accordance with ACM0001, this parameter is equivalent to $EC_{BL,k,y}$ in the tool. For ex-ante estimative, the amount of LFG collected and forwarded to the power plant was used to calculate the electricity generated during the crediting period. During periodic verifications, this parameter is to be directly measured using electricity meter.

Note: the depth and height of the water table in the SWDS is not monitored as the MCF has been selected as a default value as per Application A of the methodological tool *"Emissions from solid waste disposal sites"*.

TOOL08: "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"

Data/Parameter	***$V_{t,db}$***
Data unit	m^3 dry gas/h
Description	Volumetric flow of the gaseous stream in time interval *t* on a dry basis
Source of data	PLC data records
Value(s) applied	Not used for *ex-ante* calculations.
Measurement methods and procedures	Data is continuously measured by flow meters located in flares (FIR200 and FIR700) and generators (FIR300, FIR400, FIR500 and FIR600). Measurements of the flow are recorded electronically by PLC for each minute and aggregated for control and ER purposes. The data is archived electronically. The reading frequency is continuously and registered by the PLC.
Monitoring frequency	In accordance with the methodology, it is monitored on a minute basis, monthly aggregated and reported.

<table>
<tr><td>QA/QC procedures</td><td>

- Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory for all projects applying large scale methodology(ies);
- Monitoring under responsibility of the BLFGE Manager;
- Automatic readings of temperature and pressure are made by sensors/transmitters connected to the flow-meter; data is used to convert the gas-flow to Nm^3, thus no separate monitoring of pressure and temperature is necessary;
- Equipment calibration is conducted each 5 years.

Generators:

TAG	Equipment	Manufact.	Model	Serial Nr.	Accuracy (%)
FIR300	Flow meter	Incontrol	VTGEX200	VG083B6	1.0
	Pressure transmitter	SMAR	LD291	33007-06	0.2
	Temperature transmitter	ASTA	PT- 100	S502986	0.5993
FIR400	Flow meter	Incontrol	VTGEX200	VG084B6	1.0
	Pressure transmitter	SMAR	LD291	L42237	0.2
	Temperature transmitter	ASTA	PT- 100	S502987	0.1775
FIR500	Flow meter	Incontrol	VTGEX200	VG086B6	1.0
	Pressure transmitter	SMAR	LD291	33006-06	0.2
	Temperature transmitter	ASTA	PT- 100	S502988	0.8717
FIR600	Flow meter	Incontrol	VTGEX200	VG085B6	1.0
	Pressure transmitter	SMAR	LD291	33005-06	0.2
	Temperature transmitter	ASTA	PT- 100	S502989	0.1998

Flares:

Equipment	TAG	Manufact.	Model	Serial Nr.	Accuracy (%)
Flow meter	FIR200	Incontrol	VTGE X-200	VG15239	1.0
	FIR700	FCI	ST51	328849	2.5
Pressure transmitter	FIR200	SMAR	LD291	L454793	0.2
	FIR700	N/A	N/A	N/A	N/A
Temperature transmitter	FIR200	ASTA	PT-100	S377815	0.6471
	FIR700	N/A	N/A	N/A	N/A

In case of frequent failure or high discrepancy readings, equipment will be displaced.
</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>This parameter is used to determine the flow of methane in the LFG sent to the electricity generation facility ($F_{CH4,EL,y}$) and sent to the enclosed flares ($F_{CH4,flared,y}$).</td></tr>
</table>

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	PLC data records
Value(s) applied	Not used for *ex-ante* calculations.
Measurement methods and procedures	The data is continuously measured by the gas analyser and recorded electronically by PLC for each minute. The reading frequency is continuously and registered by the PLC.
Monitoring frequency	In accordance with the methodology, parameter is monitored on a minute basis. It is monthly aggregated and reported.
QA/QC procedures	Manufacturer: Rosemount - NUK Type: Binos 100M TAG: A100 Accuracy: 1.0% Serial number: 99965398 Calibration frequency: weekly at the plant and yearly by a third-party company The gas analyzer is subjected to a regular maintenance and testing regime to ensure accuracy. In case of frequent failure or high discrepancy readings, it will be displaced.
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter is used to determine the flow of methane in the LFG sent to the electricity generation facility ($F_{CH4,EL,y}$).

Data/Parameter	***Status of biogas destruction device***
Data unit	-
Description	Operational status of biogas destruction devices
Source of data	PLC data records
Value(s) applied	-
Measurement methods and procedures	Monitoring and documenting is undertaken by recording the energy production from methane captured or the operation of the flare by means of a flame detector and thermocouples to demonstrate the actual destruction of methane. Emission reductions will not accrue for periods in which the destruction device is not operational.
Monitoring frequency	Continuous
QA/QC procedures	
Purpose of data	Calculation of baseline emissions
Additional comment	For Flame detector devices refer to *TOOL06*

Data/Parameter	T_t
Data unit	K
Description	Temperature of the gaseous stream in time interval t
Source of data	Instruments with recordable electronic signal (analogical or digital)
Value(s) applied	Not used for *ex-ante* calculations.
Measurement methods and procedures	PLC data records
Monitoring frequency	Continuous
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory for all projects applying large scale methodology(ies).
Purpose of data	Calculation of baseline emissions
Additional comment	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, this parameter must be monitored continuously to assure the applicability condition is met. Also see $T_{EG,m}$ parameter.

TOOL06: "Project emissions from flaring"

Data/Parameter	***$T_{EG,m}$***
Data unit	°C
Description	Temperature in the exhaust gas of the enclosed flare in minute *m*
Source of data	PLC data records
Value(s) applied	Not used for *ex-ante* calculations.
Measurement methods and procedures	Data is measured by thermocouples installed in each flare and the reading frequency is continuously. Measurements of the temperature of the exhaust gas are recorded electronically by PLC at least each minute. The data is archived electronically. TAG / Manufacturer / Model / Serial Nr. / Accuracy(%): FIR200 / Thermoshaw / "S" / N/A / 0.25 or 1.5°C FIR700 / Thermoshaw / "S" / N/A / 0.25 or 1.5°C In case of frequent failure or high reading discrepancy, it will be displaced.
Monitoring frequency	Continuous
QA/QC procedures	Calibration is not applicable, however, thermocouples are yearly calibrated.
Purpose of data	Calculation of baseline emissions
Additional comment	-

TAG	**Manufacturer**	**Model**	**Serial Nr.**	**Accuracy(%)**
FIR200	Thermoshaw	"S"	N/A	0.25 or 1.5°C
FIR700		"S"	N/A	0.25 or 1.5°C

Data/Parameter	***$Flame_m$***
Data unit	Flame on or Flame off
Description	Flame detection of flare in the minute *m*
Source of data	PLC data records
Value(s) applied	Not used for *ex-ante* calculations.
Measurement methods and procedures	According to the operating manual from the flare manufacturer, there is a UV sensor and a burner control unit for automatic ignition and flame monitoring. The UV-sensor detects the flame and gives a signal to the automatic control burner. As soon as the flame has been burning for a given retention time, the automatic burner control opens the main gas valve. Then, valve that controls the flow of gas sent to flare enclosure automatically closes whenever no flame is detected by sensors.
Monitoring frequency	Once per minute. Detection of flame recorder as a minute that the flame was on, otherwise recorded as a minute that the flame was off depending on the flow of gas inside the flare enclosure.
QA/QC procedures	No calibration is required. Nonetheless, due to safety reasons, tests are conducted to ensure the sensor of the valve is functioning well.
Purpose of data	Calculation of baseline and project emissions when the flame is on
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	Not used for *ex-ante* calculations.
Measurement methods and procedures	Record the date that maintenance events were competed in year *y*. Records of maintenance logs must include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced, or needing to be replaced, source of replacement parts, serial numbers and calibration certificates.
Monitoring frequency	Annual

QA/QC procedures	Records must be kept in a maintenance log for two years beyond the life of the flare.
Purpose of data	Monitoring of this parameter is required for the case of enclosed flares and the project participant selects Option B to determine the 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 ($SPEC_{flare}$).
Additional comment	-

TOOL07: "Tool to calculate the emission factor for an electricity system"

Data/Parameter	$EF_{grid,OM,y}$
Data unit	tCO_2/MWh
Description	Simple adjusted operating margin CO_2 emission factor in year *y*
Source of data	The Brazilian DNA
Value(s) applied	0.4287
Measurement methods and procedures	The *ex-post* calculation vintage of this parameter was chosen as per the procedures of *TOOL07*.
Monitoring frequency	Continuous measurement and monthly recording
QA/QC procedures	Official source of data
Purpose of data	Calculation of baseline emissions
Additional comment	Value published by the Brazilian DNA from 2017 year was considered for ex-ante estimated purposes. For methodological choices details, please refer to section B.6.1.

TOOL05: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"

Data/Parameter	$EC_{PJ,y}$
Data unit	MWh
Description	Quantity of electricity consumed by the project electricity consumption source *j* in year *y*
Source of data	PLC data records
Value(s) applied	234 (based on 4-year average of monitored data)
Measurement methods and procedures	The electricity consumed by the plant is monitored through hours of operation from generator while applying the maximum output capacity of the generator 125kW, as a volume meter is not usual given the little consumption and capacity of generator. While adopting the maximum oil consumption capacity (44l/h) from manufacturer's specification, and applying diesel oil NCV and EF, it results in lower project emissions than when considering the installed capacity. Therefore, the approach considered by the PP is very conservative.
Monitoring frequency	The electricity consumed by the plant is monitored through hours of operation from generator.
QA/QC procedures	As there is no diesel volume meter, 1.3tCO_2e/MWh default value is used to calculate PE emissions. Calculated as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"..
Purpose of data	Calculation of project emissions
Additional comment	The project has one backup diesel generator in case of power supply interruption located at the landfill. Generator is not used for electricity generation to the grid.

Data/Parameter	$TDL_{k,y}$
Data unit	%
Description	Average technical transmission and distribution losses for providing electricity to source *k* in year *y*
Source of data	Local measurements e Eletropaulo’s records
Value(s) applied	5.2
Measurement methods and procedures	Historically measured difference between measurements conducted at the site and in the Eletropaulo substation.
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	Calculation of baseline emissions
Additional comment	-

B.7.2. Sampling plan

Not applicable. This section is intentionally left blank.

B.7.3. Other elements of monitoring plan

Section B.7.1. above describes the parameters that are to be monitored during the crediting period, as well as, the methods and procedures to be applied. Equipment is installed at the electricity generation plant is presented in the following diagram.

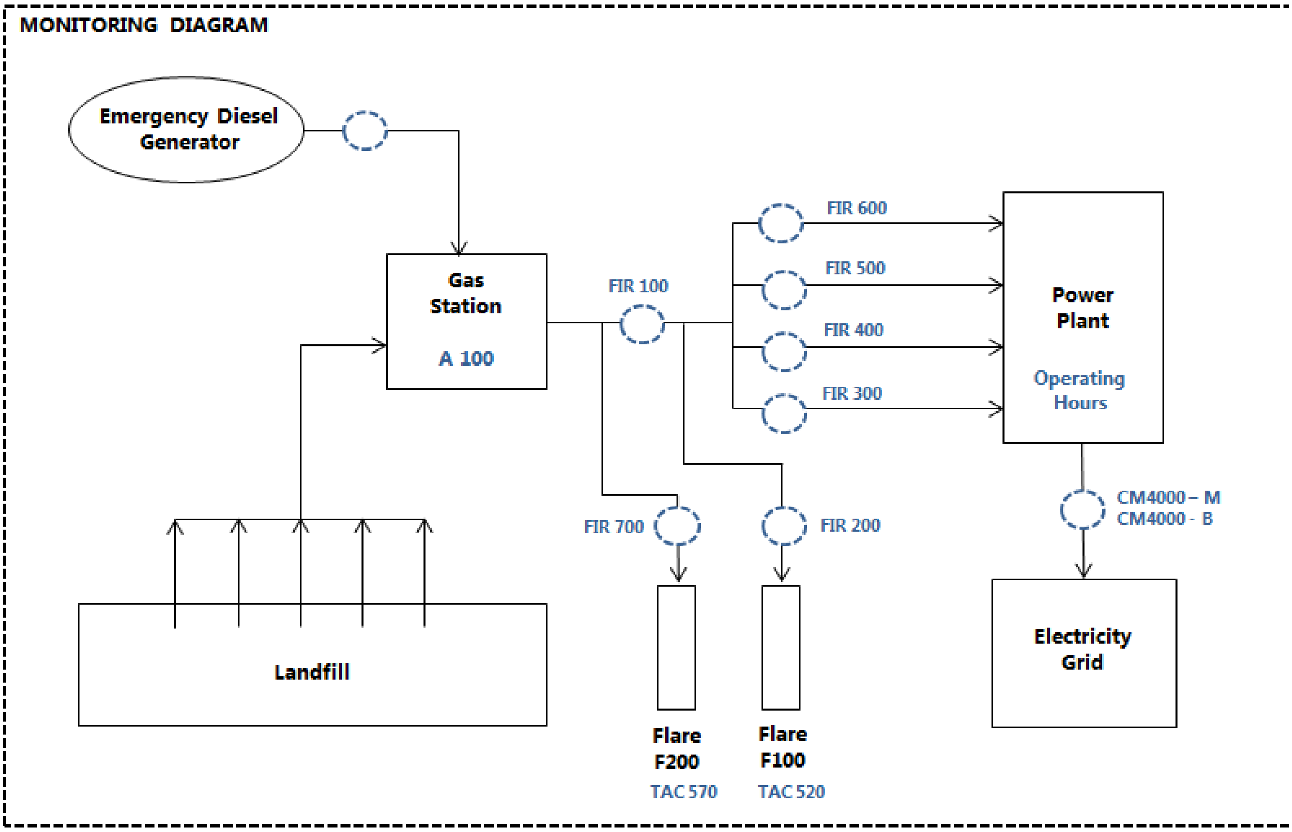

Figure 10 – Simplified diagram of monitoring equipment.

- FIR700, FIR 200, FIR 300, FIR 400, FIR 500, FIR 600: Flow meter - Register the total amount of landfill gas captured;
- FIR200 and FIR700: include flow meter, pressure and temperature transmitters - Register the amount of landfill gas flared;
- FIR300, FIR400, FIR500 and FIR600: include flow meter, pressure and temperature transmitters - Register the total amount of landfill gas combusted in the power plant to generate electricity;
- TAC520 and TAC 570: Thermocouples meters of the exhaust gas - Flares: F100 and F200, respectively;
- A100: methane fraction from the LFG;
- CM4000-M and CM4000-B: Electricity meter – Register electricity generation to the grid;
- PLC system monitoring - Diesel generator.

The detailed layout of the plant is as follows:

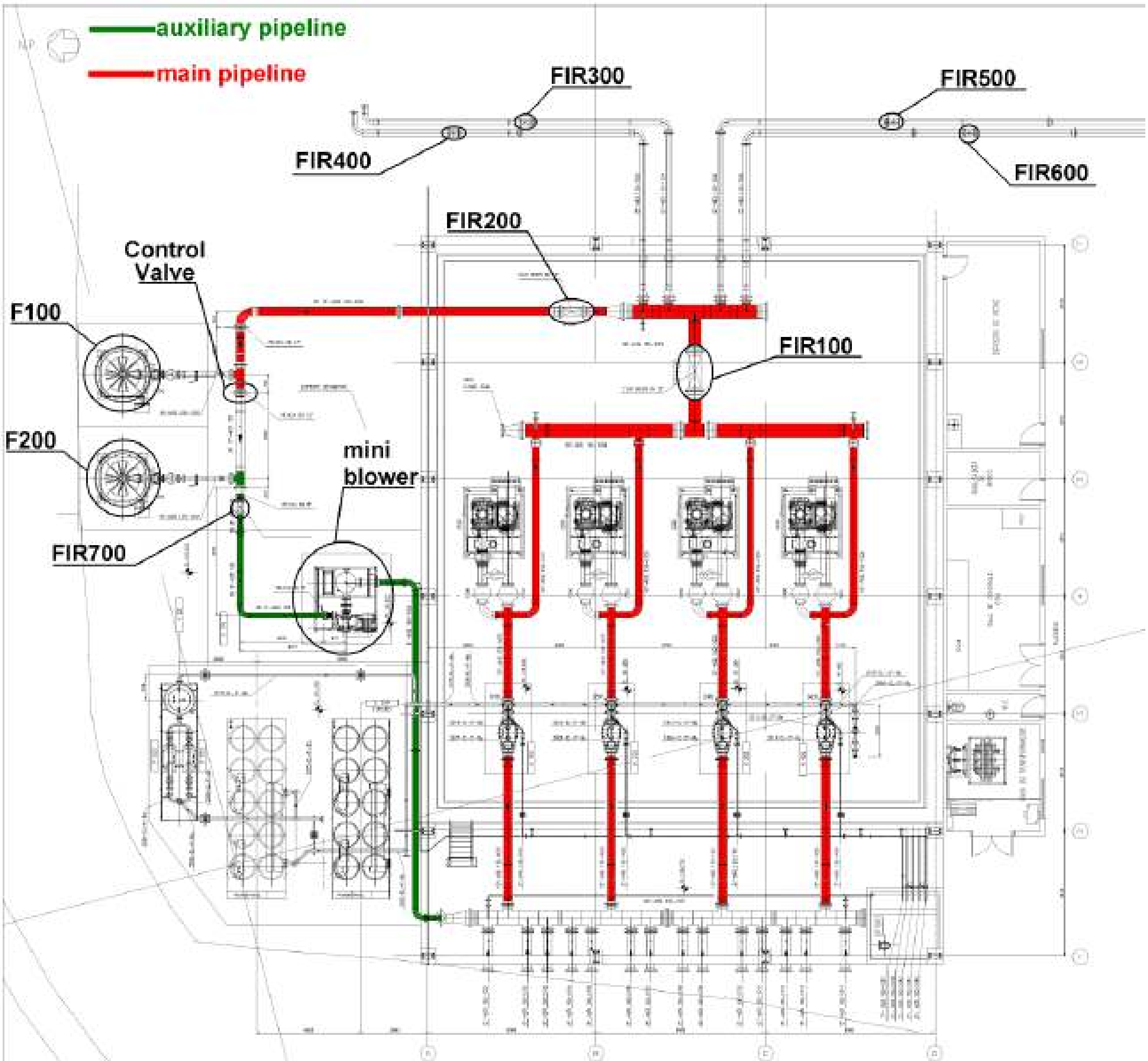

Figure 11 – Lay-out of the degassing plant.

Procedures described below are also to be taken into account while performing monitoring activities related to the proposed project activity.

a) Data transmission, processing and storage

The variables described in item B.7.1 are automatically registered in a supervisory computer system. Since all the registered data in the Supervisory System's hard disk is subjected to sabotage and technical failure, Biogás has developed the following actions to protect the monitoring system:

- The PLC is not connected to the Internet, thus the risk of virus is minimized;
- Only authorized persons have access to the data base of the system;
- Antivirus programs are installed at the system;
- Data backup:
  - A weekly CD backup of the Supervisory System in external hard disk;
  - A weekly backup of the Supervisory System's hard disk is made by the server of Biogás;

- Biogás Operational Environment Unit downloads regularly the primary data for the elaboration of the monitoring report.

During the crediting period, data was collected in a 5-minute interval, but since March 2018, the system was updated to consider 1-minute interval. This update was made since the project is under renewal of the crediting period and 1-minute interval is required by updated version of the project emission from flaring tool.

All monitored data and required for verification and issuance be kept and archived electronically for two years after the end of the crediting period or the last issuance of CERs, whichever occurs later.

b) Responsibilities

From the point of view of the plant operation, positions and roles for this CDM project activity are well defined. Duties, personnel replacement in the case of non-availability of the Operation Manager and O&M Coordinator and hiring requirements for job positions are determined in documented procedures presented in the functional organogram ad responsibility matrix.

c) Quality Assurance & Quality control

All parameters monitored inside the Biogas Station, including reading, transmitting and registration routine are under the Operation Manager and O&M Coordinator’s responsibility.

Every week, all data registered is downloaded from the PLC and a complete check to identify unconformities, such as unread registrations or troubles with the PLC (this unconformities happens mainly due to electricity blackouts) is made. All unconformities raised are promptly compared with operational events, registered by operators in the Operation Diary. Operators are oriented to perform a “Print-Screen” of the PLC Controlling System Panel every three hours. The picture printed presents all monitoring parameters and is saved in the computer’s hard disk.

The Backup Data Procedure[14] includes the management of the operational system and data record, as well as backup procedures. The Procedure for Calibration of Gases Analyser Panel – Methane and Oxygen[15] establishes procedures for calibration of the gas analyser panel and the Operation Manual for the Gas Plant Startup[16] establishes procedures to startup the gas plant after blackouts of power electricity supply from concessionary (Eletropaulo).

d) Training

All training was supplied to operators and technical assistants before the project’s implementation. Before performing its activities, every new operator has performed proper training, including:

- How to operate and start the plant;
- Reading instruments and recording of reports;
- Verification and calibration of gas analyser;
- Maintenance of equipment.
- Data Protection Measures.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

23/12/2003

[14] “Backup dos Dados do Sistema Supervisório da Usina”.

[15] “Calibração do Painel Analisador de Gases – Metano e Oxigênio”.

[16] “Manual de Operação para Partida da Planta de Gás”.

C.2. Expected operational lifetime of project activity

21 years, 0 months

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Third renewable crediting period.

C.3.2. Start date of crediting period

23/12/2017

C.3.3. Duration of crediting period

7 years, 0 months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

In Brazil, the sponsor of any project that involves construction, installation, expansion or operation of any polluting or potentially polluting activity or any other capable to cause environmental degradation is obliged to secure a several permits from the relevant environmental agency (federal and/or local, depending on the project).

Licenses required by the Brazilian environmental regulation (National Environmental Council – from the Portuguese CONAMA - *Conselho Nacional do Meio Ambiente* nr. 237/97[17]) are:

- The preliminary license (*Licença Prévia* or LP);
- The construction license (*Licença de Instalação* or LI); and
- The operating license (*Licenca de Operação* or LO).

In São Paulo, environmental impacts from project initiatives are analyzed by the State Secretary of Environment (SMA – *Secretaria de Estado do Meio Ambiente*) through its department for environmental impact assessment (DAIA) and state of São Paulo environmental agency (CETESB).

For BLFGE, a preliminary environmental report (RAP) was prepared, in accordance with state of São Paulo environmental legislation. This has been submitted to SMA for appraisal and questionings. After being analyzed by DAIA, a statement was forwarded to the developer, allowing it to proceed with the project and apply for the installation license. The licenses were issued by CETESB, after it made further considerations on the project through the RAP.

There are no transboundary impacts resulting from BLFGE. All the relevant impacts occur within Brazilian borders and are mitigated to comply with the environmental requirements for project's implementation. Therefore, BLFGE has been granted with operating licenses, which attest the project has been assessed by the environmental authorities, to whom no major impacts are predicted.

[17] Available at: http://www.mma.gov.br/port/ conama/res/res97/res23797.html.

D.2. Environmental impact assessment

As already mentioned, Aterro Sanitário Sítio Bandeirantes, the landfill where the proposed CDM Project Activity is located, has been designed with modern engineering practices that put it as a well-managed landfill under state of São Paulo environmental agency (CETESB) assessment.

Nevertheless, operation of a degasifying unit, with intention to flare the gas, either in flare equipment or in engines for energy generation, may cause gaseous emissions such as volatile organic compounds and dioxins that have to be analysed. This is not expected to happen considering the landfill gas goes through a treatment prior to be flared, and similar conditions have already been successfully applied by the project developer at its other landfill gas to energy project in Brazil.

The project activity operates with its working license in place and after conducted all the necessary studies as required by the environmental agency. All additional requirements will be satisfactorily fulfilled if required by the agency.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

This section is intentionally left blank since this information is not applicable for the third crediting period.

E.2. Summary of comments received

This section is intentionally left blank since this information is not applicable for the third crediting period.

E.3. Consideration of comments received

This section is intentionally left blank since this information is not applicable for the third crediting period.

SECTION F. Approval and authorization

The proposed project is registered as a CDM Project Activity (CDM Ref. 0164). The Letter of Approval (LoA) was granted by the Brazilian DNA on September 12th, 2005. A copy of the original document is available with Project Participants as well as on the project page at the UNFCCC’s website (https://cdm.unfccc.int/Projects/DB/DNV-CUK1134130255.56/view?cp=1).

Appendix 1. Contact information of project participants

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Appendix 2. Affirmation regarding public funding

No public funding for this project has been obtained.

Appendix 3. Applicability of methodologies and standardized baselines

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

Not applicable. This section is intentionally left blank. Please refer to sections B.6.1 and B.6.3. for details regarding the emission factor of the Brazilian Interconnected Grid calculation.

Appendix 5. Further background information on monitoring plan

This section is intentionally left blank. For details, please, refer to B.7.1. and B.7.2

Appendix 6. Summary report of comments received from local stakeholders

Not applicable.

Appendix 7. Summary of post-registration changes

According to §128 of CDM Project Cycle Procedure for Project of Activities, this PDD applies the following post-registration changes:

(b) *Permanent changes:*

(i) Corrections.

- Geographic coordinates

During the verification of the 3rd crediting period, an error was identified in the geographic coordinates recorded in the PDD, where the latitude is 23°'25'11.13"S and the longitude is 45°45'21.69"W. However, by visiting and consulting google earth, it is possible to notice that this location does not coincide with that of the project. Therefore, there is a need to correct this information in the registered PDD.

According to the google earth images, the correct coordinates of the project are as follows:

Latitude: 23°24'58.03''S

Longitude: 46°45'46.94''W

Figure 12 – Landfill location in accordance with the Google Earth.

- Corrections on "Purpose of Data" of the parameters monitored

It was identified that the descriptions of the parameters of the section B.7.1 Data and Parameters to be Monitored are not in accordance with the methodology "*ACM0001 Flaring or use of landfill gas (version 18)*" and the other tools applicable to the project. For each parameter that is monitored, its purpose must be indicated, whether it is for the calculation of the baseline or project emissions, and during the verification it was found that some parameters are described as project emissions, when in fact they are for the calculation of baseline emissions.

In view of this, the following parameters below were corrected according to the methodology:

Data/Parameter	$T_{EG,m}$
Description	Temperature in the exhaust gas of the enclosed flare in minute *m*
Purpose of data	Calculation of baseline emissions

Data/Parameter	$Flame_m$
Description	Flame detection of flare in the minute *m*
Purpose of data	Calculation of baseline and project emissions when the flame is on

Data/Parameter	***Status of biogas destruction device***
Description	Operational status of biogas destruction devices
Purpose of data	Calculation of baseline emissions

Data/Parameter	T_t
Description	Temperature of the gaseous stream in time interval t
Purpose of data	Calculation of baseline emissions

According to the procedures of "*CDM project standard for project activities (version 0.3.0)", - the project participants shall report in the revised PDD the impacts of the proposed or actual changes to the registered CDM project activity on the following*:

(a) *The applicability and application of the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents with which the project activity has been registered;*

The changes made to the PDD did not affect in any way the applicability of the methodologies, or any other standard that was previously recorded, as it is just a correction of information on the installed equipment.

(b) *The project boundary and any implications on the inclusion or exclusion of emissions sources and leakage emissions;*

There was no change in the project boundary and no inclusion or exclusion of emission sources.

(c) *The compliance of the monitoring plan with the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents*;

The project continues according to the monitoring plan previously registered.

(d) *The level of accuracy and completeness in the monitoring of the project activity compared with the requirements contained in the registered monitoring plan;*

There was no change in monitoring plan.

(e) *The additionality of the project activity;*

There was no change in the additionality of the project, so it remains the same.

(f) *The scale of the project activity.*

There was no change in the scale of the project, it remains the same as the registered PDD.

- Corrections of the Project Participants

  Allcot AG is also an authorized project participant and was not included in the last PDD.

(ii) registered monitoring plan.

There is a permanent change to the registered monitoring plan in the parameter ECPJ,y from the registered monitoring plan of the PDD. The Monitoring frequency of the ECPJ,y changed from The reading frequency from the electricity meter is continuously and the recording frequency is hourly to “The electricity consumed by the plant is monitored through hours of operation from generator” because there is no equipment from the electricity consumed.

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Document information

Version	*Date*	*Description*
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).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b

Version	*Date*	*Description*
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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