Programme of activities design document form
(Version 09.0)

BASIC INFORMATION	
Title of the PoA	Caixa Econômica Federal Solid Waste Management and Carbon Finance Project
Version number of the PoA-DD	3.0
Completion date of the PoA-DD	26/12/2019
Coordinating/managing entity	Caixa Econômica Federal
Host Parties	Brazil
Applied methodologies and standardized baselines	ACM0001: Flaring or use of landfill gas --- Version 19.0
Sectoral scopes	1: Energy industries (renewable - / non-renewable sources) 13: Waste handling and disposal

PART I. Programme of activities (PoA)

SECTION A. Description of PoA

A.1. Purpose and general description of PoA

The “Caixa Econômica Federal Solid Waste Management and Carbon Finance Project” PoA, hereafter termed as “Caixa’s PoA”, encompasses collection of LF and its destruction through flaring and/or use for: i) generating electricity; ii) supplying the LFG to consumers through a natural gas distribution network, dedicated pipeline and/or by using trucks.

Biogas generation provides an important contribution to environmental sustainability by reducing carbon dioxide emissions that otherwise would have occurred in the absence of the project. In the case of the proposed PoA, it reduces emissions of greenhouse gas (GHG) by LFG flaring and/or displacing energy generation (electricity and thermal) from fossil fuel sources (and CO_2 emissions). LFG can also be used to supply consumers through natural gas distribution network, dedicated pipeline or trucks.

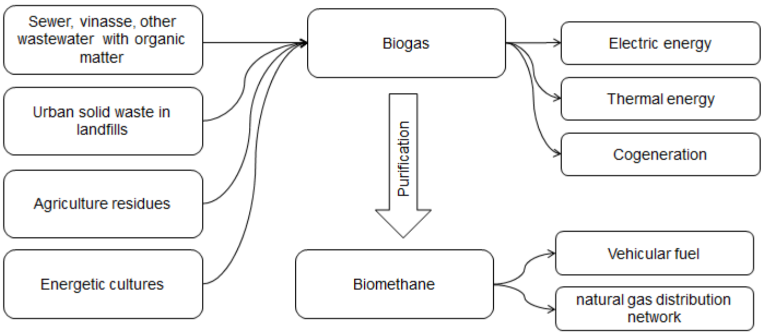

Figure 1: Generation sources and biogas application (source: adapted from http://www.iee.usp.br/agrener2015/sites/default/files/tematica8/747.pdf. Accessed on 25 Mar 2019).

The CDM component project activities (CPAs) encompassed by this PoA are implemented and directly managed by the landfill owners and operators that meet the criteria set by Caixa Econômica Federal as outlined in this PoA. The implementation and operation of the PoA is a voluntary action by the coordinating/managing entity (CME) Caixa Econômica Federal to encourage and provide access to finance low carbon technologies for the waste sector in Brazil.

Caixa Econômica Federal is the financial and technical intermediary in the PoA, providing assistance for the installation of LFG collection and destruction/utilization systems, taking the role of the CME in charge of validation and verification activities under the CDM under the framework for the implementation of the PoA.

Created in 1861, Caixa is the main agent of public policy for the Brazilian federal government and the third largest public bank in Latin America in year 2016[1]. Its network, the largest in Brazil, covered all 5,561 Brazilian municipalities with more than 17,000 service points in year 2012.

The Caixa’s PoA is in line with the goals outlined in the National Sanitation Policy and the National Energy Plan. The Caixa’s PoA may contribute towards sustainable development due to:

- GHG emission reductions through LFG flaring and/or renewable energy generation;
- Destruction of other air pollutants, such as hydrogen sulphide, that is present in trace quantities in LFG;

[1] Details about Caixa Econômica Federal are available at: <http://www.caixa.gov.br/site/english/About-Caixa/Paginas/default.aspx>.

- Global warming mitigation in line with local and national policies for GHG emission reductions and promotion of renewable energy as encouraged by the National Climate Change Plan[2] and the National Policy on Solid Waste[3];
- Improvement of LFG management and reduction of explosion and fire risks at the landfill site;
- Replicability of technology and know-how in the Host Country, since there are very few projects using LFG in spite of Brazilian's large potential;
- Capacity building and job creation, mainly during implementation and operation phases.

A.2. Physical/geographical boundary of PoA

The physical / geographical boundary for the Caixa's PoA is the whole country of Brazil. All the CPAs included in the PoA shall be implemented in Brazil by taking into consideration all applicable national and/or sectoral policies and regulations.

Figure **2:** Physical/Geographical boundary of the PoA (source: modified from http://biblioteca.uol.com.br/atlas/index.htm. Accessed on 26 Mar 2019).

A.3. Technologies/measures

Each CPA encompassed by the Caixa's PoA will consist of one of the 8 (eight) potentially identified CPA design scenarios as summarized in the table below:

Table 1: Scenarios applied to CPA under this PoA.

CPA design scenario	Destruction of methane emissions and/or displacement of a more-GHG-intensive service Capture of landfill gas (LFG) and its flaring and/or use to produce energy and/or use to supply consumers			
	Destruction of methane emission	Displacement of a more-GHG-intensive service	Release of LFG from the SWDS under the baseline scenario	Combination of types of use for collected LFG under the project scenario (for the displacing of a more-GHG-intensive-

[2] Details regarding the Brazilian Climate Change Plan are available at: <https://www.mma.gov.br/clima/politica-nacional-sobre-mudanca-do-clima/plano-nacional-sobre-mudanca-do-clima>.

[3] Details regarding the Brazilian Policy on Solid Waste are available at: <https://www.mma.gov.br/pol%C3%ADtica-de-res%C3%ADduos-s%C3%B3lidos>.

				service)
1.1	Yes	No. All collected LFG is flared.	Partial	Not applicable
1.2	Yes		Total	Not applicable
2.1	Yes	Yes. Share of collected LFG is used as gaseous fuel for electricity generation	Partial	No combination
2.2	Yes		Total	No combination
3.1	Yes	Yes. Share of collected LFG is supplied to consumer(s)	Partial	No combination
3.2	Yes		Total	No combination
4.1	Yes	Yes. Share of collected LFG is used as gaseous fuel for electricity generation and supplied to consumer(s)	Partial	Yes. Combination occurs.
4.2	Yes		Total	Yes. Combination occurs.

A typical CPA may include the following components:

a) LFG Collection Infrastructure – applicable to all scenarios

The LFG is extracted from the landfill and transported by pipelines to the gas plant, and it receives treatment before being used as fuel or flaring. The collecting system involves the installation of vertical and horizontal wells, and the installation of wellheads on top to collect the LFG usually emitted directly to the atmosphere in the baseline. An example of wellhead and the detail of its construction are presented as follows.

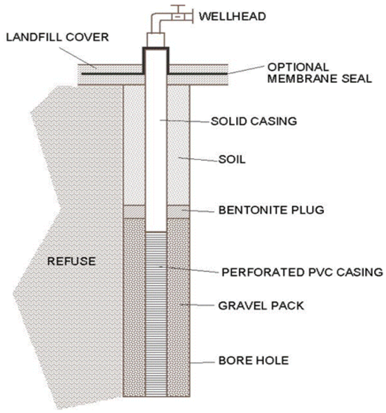

Figure 3: Internal detail of a well and wellhead (source: USEPA, 1996)[4].

The use of the few existing wells is not recommended, as they are quite shallow and not properly placed across the landfill surface. Wells shall guarantee the efficiency of the controlled drainage of the landfill as well as of the LFG collection. The quantity of wells is determined in the project design, but it is subjected to adjustment depending on conditions observed during the project installation and commissioning. Also, condensate extraction and condensate storage systems are designed at strategic low points throughout the LFG collection infrastructure.

b) Gas Station (pre-treatment system) and Upgrading Gas Facility – applicable when LFG is used

The Gas Station is the facility where the gas is suctioned from the landfill and where the gas receives the proper treatment, depending on the final use of the gas. Usually, the Gas Station is composed by blowers and condensate knock-outs. 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. They are also equipped with necessary safety equipment as well as noise reducing housing.

Sophisticated gas analyzing and gas measuring instruments are used on the pressure side of the gas plant to ensure safety, process and operating best controls. Once analyzed and properly controlled and measured, the LFG can be used as a fuel for the gas engines which drive electrical generators.

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4 USEPA – United States Environmental Agency; *Turning a Liability into an Asset: a Landfill Gas-to-Energy Project Development Handbook*; LMOP – Landfill Methane Outreach Program, 1996.

As a source of methane, LFG can also be used to replace the consumption of Natural Gas while following quality requirements from the National Petroleum Agency ("ANP" from the Portuguese Agência Nacional do Petróleo)[5]. Prior to the introduction of the biogas to the natural gas distribution grid, it will be treated in an upgrading facility, where most of the non-methane gases will be removed from the stream.

c) LFG Flare System – applicable to all scenarios

Whenever LFG exceeds the processing capacity of the energy plant or it is not operational, the gas is sent to the flaring system. LFG can be burned in an open air (open flare) or in a vertical cylindrical or rectilinear enclosure (enclosed flare). The flare system includes blowers to cause negative pressure in the LFG pipeline (before the blowers) and positive pressure (after the blowers) to direct LFG to the flare(s).

d) Transportation Infrastructure – applicable when LFG is used

After treatment, the biogas can be transported through pipelines to generators, NG distribution network, dedicated pipeline or by trucks. When LFG is sent to trucks or the distribution network, LFG may be further compressed/liquefied prior to its transportation and emissions from the transportation shall be accounted.

The PoA indeed involves technology transfer and improvement in LFG management practices in Brazil. For the implementation of electricity generation infrastructure (using LFG as fuel) and supply of upgraded LFG to consumer(s) (through natural gas distribution network/dedicated pipeline or by using trucks or through a combination of both of these LFG transportation options), applied technology is currently not widely applied in Brazil yet.

e) Backup captive off-grid electricity generator(s) – applicable when fossil fuel is used for backup power generation

The installation of a backup captive off-grid electricity generator(s) operated with diesel oil may also be encompassed by the CPA(s) in order to meet the electricity demand of the particular CPA(s) in case of interruptions of electricity supply.

f) Other equipment using fossil fuel – applicable when fossil fuel is used for purpose other than electricity generation and/or transportation of upgraded LFG

Under all CPA design scenarios, fossil fuel may be used for purpose other than electricity generation (e.g. consumption of Liquefied Petroleum Gas (LPG) for igniting the flare(s).

The eventual consumption at a CPA level of fossil fuel (for purpose other than electricity generation and/or for transportation of LFG by trucks) do not represent alternative for the use of LFG either. Therefore, these measures involving consumption of fossil fuel do not interfere in the identification of potential CPA design, neither in their selection or eligibility criteria for inclusion of CPAs.

A.4. Coordinating/managing entity

The coordinating/managing entity of PoA, which is the entity responsible for communicating with the CDM Executive Board, is Caixa Econômica Federal (Caixa).

A.5. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host Party)	Caixa Econômica Federal (public entity)	No

[5] ANP Resolution # 658 issued on 29/06/2017 establishes the necessary requirements of the biomethane from landfills and waste water stations. According to this resolution, LFG shall have 90% methane content.

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Spain	International Bank for Reconstruction and Development acting as the Trustee of the Carbon Partnership Facility (multilateral fund)	No
	Kingdom of Spain – Ministry for the Ecological Transition & Ministry of Economy and Business (public entity)	No
Norway	Norwegian Ministry of Climate and Environment (public entity)	No
Sweden	Swedish Energy Agency (public entity)	No

A.6. Public funding of PoA

Not applicable. There is no public funding from Annex I Parties of UNFCCC for the Caixa's PoA. Therefore, the PoA does not result in a diversion of an official development assistance (ODA).

SECTION B. Management system

Operational and management plan:

Caixa Econômica Federal, the CME of the Caixa's PoA, has established the operational and management plan which includes the following:

a) **Letter of Intent and provisions to ensure that those operating the CPA are aware and have agreed that their activity is being subscribed to the PoA**: If a landfill site operator is interested in joining the Caixa's PoA, it shall submit a letter of intent (LoI) to participate in Caixa's PoA. The LoI will indicate their voluntary participation within the Caixa's PoA, their authorization to give the financial information relevant for the projects evaluation, and confirmation that they are not part of any other registered CDM project or PoA. Then the CPA proponent will be briefed by Caixa Econômica Federal about the criteria for inclusion under the PoA.

b) **System/procedure to avoid double accounting e.g. to avoid the case of including a new CPA that has been already registered either as CDM project activity or as a CPA of another PoA**: After receiving the LoI, Caixa Econômica Federal will proceed to confirm that the project is not part of another Program, or contained as another registered CDM project, by double checking the projects geographical coordinates with the Brazilian DNA and with published information from the UNFCCC website. At this point, a unique number will be assigned to the CPA, which will serve for reference within Caixa's database which will contain the projects location (GPS coordinates) and private operator's name, among other details.

c) **Eligibility assessment**: Caixa Econômica Federal will collect the necessary information to conduct an analysis of the project design as per the eligibility criteria for each potential CPA design scenario as established in Section K of the PoA-DD.

d) **Memorandum of agreement**: If the CPA proponent qualifies, a Memorandum of Agreement (MoA) shall be negotiated and signed. The MoA will outline responsibilities for the development of the project to meet basic technical and financial criteria, as well as the criteria and documentation

requirements under the CPA. This will include the role of Caixa Econômica Federal and the CPA operator in the PoA.

e) **Data gathering and documentation**: After the MoA is signed, the detailed project information necessary to elaborate the CPA-DD will be collected. This includes the project additional technical and financial information on the CPA, feasibility study, evidences etc. Caixa Econômica Federal will make itself available to the landfill site operator to provide this service.

f) **CPA-DD preparation**: After the necessary information and documentation requirements have been incorporated in the CPA-DD and Caixa Econômica Federal has approved the final version of the document, Caixa Econômica Federal as CME will submit the information to the DOE for inclusion as per the rules and procedures of inclusions of CPAs under the registered PoA.

g) **Inclusion of CPA in the PoA**: After the DOE confirms that the CPA is eligible for inclusion under the PoA, Caixa Econômica Federal will finalize the financing arrangements for carbon finance and the monitoring arrangements for the specific CPA-DD. During CPA operation, the monitoring plan (as outlined in Part I sections K of this PoA-DD) will be strictly followed by Caixa Econômica Federal and the CPA project implementer. Training of the CPA project implementer staff will also be provided at this time to ensure that data monitoring and recording, reporting, internal quality control, operation, calibration, and maintenance are followed by the CPA Project Implementer.

h) **A record keeping system for each CPA under the PoA**. Caixa Econômica Federal will maintain the Monitoring Reports for each of the CPA included in the PoA, including a list of all projects that are under review for inclusion in the PoA and approved for inclusion in the PoA and the status of verification. A database will be developed to contain the major project features important for identifying the CPA and quantifying the emission reductions. This documentation will ensure no double counting occurs in the claiming of emission reductions since each CPA will list the location (GPS coordinates), ownership and a copy of the letter of confirmation from the CPA proponent that the CPA is not a component of another CDM programme or project activity. Monitored data will be kept by project implementers. Recorded data will be kept for two years after the end of the crediting period.

Monitoring plan: For each potential CPA design scenario, all relevant parameters included in the monitoring plan shall be independently recorded and monitored for each CPA under this PoA, being the responsibility of each CPA proponent with guidance set by Caixa Econômica Federal. With this data recorded, Caixa Econômica Federal will prepare a separate Monitoring Report for each CPA with verification and CER issuance purposes. Caixa Econômica Federal will maintain a database for all CPAs and data will be kept for at least 2 years after the end of the crediting period.

Under this PoA, the CPAs will be independently monitored and verified, where the project implementers will be responsible for collecting and recording all the information and Monitoring Reports will be sent to Caixa Econômica Federal. The Monitoring Reports for future monitoring periods will be made available to the DOE for verification, as Caixa Econômica Federal will be the main interlocutor with the DOE, taking responsibility of quality assurance of monitored data and making Monitoring Reports available to the DOE.

Data Collection: The CPA proponents are required to submit a monthly Monitoring Report to Caixa through their local lending centers. The data will be checked for completeness and quality and placed in a central database located at the Headquarter of Caixa Econômica Federal – Environmental Program and Management Department (EPMD) that includes all projects under the PoA. Hardcopies of the monthly reports will also be kept on file.

Field visits: Caixa Econômica Federal will undertake bi-annual field visits, or as necessary depending on CPA evaluated needs. This will serve as an additional quality check of the monthly Monitoring Report, to view the operation of the installed monitoring devices to ensure they are working properly and a means of following up on any questions on the data and any monitoring issues.

Calculation of emission reductions: for each potential CPA design scenario, Caixa Econômica Federal will use the aggregated data to calculate the emission reductions achieved based on the formulas for ex-post determination of emission reduction achieved by each CPA as per GHG calculation and monitoring requirements of ACM0001 and applied methodological tools. This database will be updated monthly based on the reports received.

Database for CPAs to prevent double counting and status of verification: In order to have control over the individual calculations for emission reductions in each CPA, the database will always refer to the uniquely assigned reference number for each CPA, associated with its geographical location and private operator's name. For each CPA, the database will also contain information on the status of verification and issuance of CERs, as well as project information, to provide transparent and verifiable means of preventing double counting.

Training: Caixa Econômica Federal will provide technical support/training to assist the landfill site operators establishing their system of monitoring and reporting with the proper quality controls, troubleshooting on monitoring issues, and in undertaking calibration by identifying service providers.

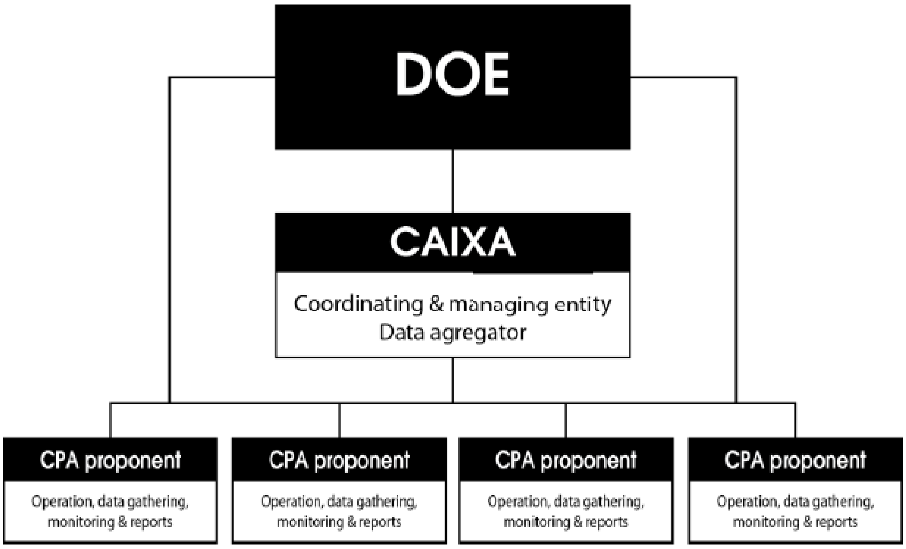

Figure 4: Schematic representation of the monitoring plan.

Each CPA will be in charge of their record keeping system for monitored raw data, while Caixa Econômica Federal will keep records of the Monitoring Reports for each CPA; for quality assurance, Monitoring Reports will be crossed checked with raw data upon site visits conducted by Caixa Econômica Federal.

No change in the design and operational conditions of landfill sites hosting CPAs

Design and operational conditions/aspects of landfill sites hosting CPAs under the Caixa's PoA are not to be changed after the implementation of the CPAs. As required by ACM0001 (version 19.0), any change in the management of the landfill hosting a CPA after the implementation of the CPA should be justified by referring to technical or regulatory specifications.

SECTION C. Demonstration of additionality of PoA

Not applicable[6].

[6] According to §285 of the CDM PS for Programmes of Activities (v2.0), the coordinating/managing entity is not required to reassess the additionality of the PoA nor update the section of the PoA-DD relating to additionality while renewing the crediting period.

SECTION D. Start date and duration of PoA

D.1. Start date of PoA

22/09/2010.

NOTE: This date is the date of publication of the PoA-DD for global stakeholder process (GSP).

D.2. Duration of PoA

28 years, 0 months.

SECTION E. Environmental impacts

E.1. Level at which environmental impacts analysis is undertaken

1. Environmental Analysis is done at PoA level ☐
2. Environmental Analysis is done at CPA level ☒

In Brazil, there are no specific environmental policies or regulations regarding LFG capture and destruction. However, the Brazilian national and state laws and regulations require that an environmental analysis should be performed for any kind of landfill. Therefore, the analysis will be done at an individual/specific CPA level as most of the impacts are confined to each CPA landfill site.

E.2. Analysis of environmental impacts

Not applicable. Given the particularities of each project, the environmental analysis as well as the documentation mentioned above will be carried out at the CPA level.

E.3. Environmental impact assessment

Not applicable. Given the particularities of each project, the environmental impact assessment will be carried out at the CPA level.

SECTION F. Local stakeholder consultation

F.1. Level at which local stakeholder consultation is undertaken

The stakeholders consultations will be held, recorded and included into CPA documents as described in the following sections:

Level at which local stakeholder comments are invited:

1. Local stakeholder consultation is done at PoA level ☐
2. Local stakeholder consultation is done at CPA level ☒

Due to the wide range of CPAs geographical positions, local consultation will be done at an individual/specific CPA level to ensure full participation and consultation of local stakeholders of the landfill sites participating in the PoA. A local stakeholder consultation will be conducted for every CPA.

Description how comments by local stakeholders are invited and compiled:

To be done at the CPA level. As required by the Interministerial Commission on Global Climate Change (CIMGC), the Designated Authority (DNA) for Brazil, letters must be sent for comments to local stakeholders

as part of the procedures for analysing CDM projects with at least two weeks in advance from the start of validation / inclusion process.

F.2. Modalities for local stakeholder consultation

Not applicable. To be done at the CPA level. All comments received will be included in the specific CPA-DD.

F.3. Summary of comments received

Not applicable. To be done at the CPA level. All comments received will be included in the specific CPA-DD.

F.4. Consideration of comments received

Not applicable. To be done at the CPA level. All clarifications requested by local attending stakeholders will be addressed during the meetings and recorded on each specific CPA-DD.

SECTION G. Approval and authorization

The letters of approval from Parties involved in the Programme of Activities are available at: <https://cdm.unfccc.int/ProgrammeOfActivities/poa_db/Q9LW74OKAXMUZPCE3IJBVS16025HDT/view>.

PART II. Generic component project activity (CPA)

SECTION H. Description of generic CPA

H.1. Title of generic CPA

CPA-[XX landfill name][7]

H.2. Reference number of generic CPA

CPA-[XX] [8]

H.3. Purpose and general description of generic CPA

The proposed Component Project Activity (CPA) is to be implemented as part of the CDM PoA: Caixa Econômica Federal Solid Waste Management and Carbon Finance Project.

The proposed CPA consists of [landfill name] LFG flaring and/or using for [i) generating electricity; ii) supplying the LFG to consumers through a natural gas distribution network, dedicated pipeline or by using trucks]. [landfill name] has [landfill capacity] and was opened since [opening year]. [described the previous/current LFG destination].

The CPA is planned to become operational in [date of operation startup] and is located in [city] municipality, [state], [region of Brazil] region of Brazil. The geographic coordinates of the CPA are as follows.

[MAP OF THE PROJECT LOCATION]

Geographic Coordinates	*[landfill name]*
Longitude (West)	[LONGITUDE]
Latitude (South)	[LATITUDE]

Figure 5: Location of the CPA.

The objective of the CPA-[XX landfill name] is to capture and [flaring and/ or use] methane generated by the anaerobic decay of organic waste from the [landfill name] landfill.

The CPA-[XX landfill name] may thus contribute to sustainable development through the following activities that also provides the following additional and important local environmental and social benefits:

- GHG emission reductions through LFG flaring and/or renewable energy generation;
- Destruction of other air pollutants, such as hydrogen sulphide, that is present in trace quantities in LFG;
- Global warming mitigation in line with local and national policies for GHG emission reductions and promotion of renewable energy as encouraged by the National Climate Change Plan[9] and the National Policy on Solid Waste[10];

[7] The term “CPA-XX [landfill name]” will be adjusted/converted in specific CPA(s) by taking into account the number and title of the CPA (with title representing the name of the landfill site hosting the CPA in question).

[8] The term “CPA-XX” will be adjusted/converted in specific CPA(s) by taking into account the number of the CPA.

[9] Details regarding the Brazilian Climate Change Plan are available at: <https://www.mma.gov.br/clima/politica-nacional-sobre-mudanca-do-clima/plano-nacional-sobre-mudanca-do-clima>.

[10] Details regarding the Brazilian Policy on Solid Waste are available at: <https://www.mma.gov.br/pol%C3%ADtica-de-res%C3%ADduos-s%C3%B3lidos>.

- Improvement of LFG management and reduction of explosion and fire risks at the landfill site;
- Replicability of technology and know-how in the Host Country, since there are very few projects using LFG in spite of Brazilian's large potential;
- Capacity building and job creation, mainly during implementation and operation phases.

H.4. Technologies/measures

The technology to be employed in CPA-[XX landfill name] involves improvement of landfill gas collection and flaring, through the installation of an active recovery system composed by:

- Gas extraction wells with wellhead flow control and monitoring;
- A wellfield gas conveyance system ("laterals" and "header");
- A Gas Station and/or an upgrading gas facility;
- A flaring system; and,
- [optional: A pipeline to inject the gas to NG network, dedicated pipeline or consumer through trucks].

Table 2: Project's equipment technical description.

Description	Blower	Compressor	Flare	El. Generator (if applicable)	Diesel Generator (if applicable)
Manufacturer	[MANUFACTURER]	[MANUFACTURER]	[MANUFACTURER]	[MANUFACTURER]	[MANUFACTURER]
Model	[MODEL]	[MODEL]	[MODEL]	[MODEL]	[MODEL]
Quantity	[QUANTITY]	[QUANTITY]	[QUANTITY]	[QUANTITY]	[QUANTITY]
Capacity per unit	[CAPACITY]	[CAPACITY]	[CAPACITY]	[CAPACITY]	[CAPACITY]

SECTION I. Application of methodologies and standardized baselines

I.1. References to methodologies and standardized baselines

ACM0001: Flaring or use of landfill gas (version 19.0)[11].

ACM0001 also refers to the following tools:

- TOOL02 - Combined tool to identify the baseline scenario and demonstrate additionality (v7.0)[12];
- TOOL03 - Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (v3.0)[13];
- TOOL04 - Emissions from solid waste disposal sites (v8.0)[14];
- TOOL05 - Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (v3.0)[15];
- TOOL06 - Project emissions from flaring (v3.0)[16];
- TOOL08 - Tool to determine the mass flow of a greenhouse gas in a gaseous stream (v3.0)[17];

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

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

[13] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf

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

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

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

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

- TOOL09 - Determining the baseline efficiency of thermal or electric energy generation systems (v2.0)[18];
- TOOL10 - Tool to determine the remaining lifetime of equipment (v1.0)[19];
- TOOL11 - Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (v3.0.1.)[20];
- TOOL12 - Project and leakage emissions from transportation of freight (v1.1.0)[21];
- TOOL32 - Positive lists of technologies (v2.0)[22].

[In case any tool(s) is(are) not applicable, explain the reason for the non-applicability].

[If applicable, include TOOL07 – Tool to calculate the emission factor for an electricity system (v7.0)[23]]

[While assessing additionality in the light of investment analysis (step 3 of TOOL02), TOOL27 (v9.0)[24] shall be considered]

I.2. Applicability of methodologies and standardized baselines

ACM0001 is applicable under the following conditions:

Table 3: ACM0001 applicability conditions applied to the CPA.

Applicability Condition	Justification
(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	The design of the CPA-[XX landfill name] encompasses [new or existing] solid waste disposal site (SWDS). Prior to the project, [choose one of the options listed in item (b)]. Under the CPA scenario, the LFG will be captured and used for [choose one of the options listed in item (c), excluding item ii) since heat generation is not applicable to this PoA]. In addition, the CPA-[XX landfill name] will not reduce the amount of organic waste that would be recycled in the absence of the CPA. This condition can be evidenced by local and national waste management practices.

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

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

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

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

[22] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-32-v1.pdf

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

[24] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v9.0.pdf

Applicability Condition	Justification
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.	Therefore, the quoted applicability condition is thus satisfactory met.
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 most plausible baseline scenario for the CPA-[XX landfill name] is [describe the baseline scenario for the LFG and for each of the products generated, excluding heat generation which is not applicable under this PoA]. Therefore, the quoted applicability condition is thus satisfactory met.
This methodology is not applicable: (a) In combination with other approved methodologies. For instance, ACM0001 cannot be used to claim emission reductions for the displacement of fossil fuels in a kiln or glass melting furnace, where the purpose of the CDM project activity is to implement energy efficiency measures at a kiln or glass melting furnace; (b) If the management of the SWDS in the project activity is deliberately changed during the crediting in order to increase methane generation compared to the situation prior to the implementation of the project activity.	Neither options (a) and/or (b) occur. The only methodology used in CPA-[XX landfill name] is ACM0001. No change is expected to occur in CPA-[XX landfill name] in order to increase the methane generation prior to the project. Therefore, the quoted applicability condition is thus satisfactory met.

Regarding applicability tools, CPA-[XX landfill name] applies the following tools.

[choose the applied tools for the proposed CPA in the table below]

Table 4: Applicability conditions from tools applied to the CPA.

Tool	Applicability condition	Justification
TOOL02	Applicable to project activities in order to determine	The tool is applied to CPA-[XX landfill

Tool	Applicability condition	Justification
	the baseline scenario and demonstration of additionality as indicated in ACM0001. Applicable to all types of proposed project activities.	name] in order to determine the baseline scenario and assessment of additionality.
TOOL03	This tool provides procedures to calculate project and/or leakage CO_2 emissions from the combustion of fossil fuels. It can be used in cases where CO_2 emissions from fossil fuel combustion are calculated based on the quantity of fuel combusted and its properties.	The tool is applied to CPA-[XX landfill name] since the project uses fossil fuels to [describe the use of fossil fuel in the project].
TOOL04	The tool can be used to determine emissions for the following types of applications: (a) Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS; (b) Application B: The CDM project activity avoids the disposal of waste at a SWDS (for example, waste is composted).	The tool is applied to CPA-[XX landfill name] in order to determine emissions from SWDS while applying Application A.
TOOL05	This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated: (a) Scenario I: Electricity is supplied to the grid; (b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or (c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities. For electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption: (a) Scenario A: Electricity consumption from the grid; (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s); (c) Scenario C: Electricity consumption from the grid and fossil fuel fired captive power plant(s).	The tool is applied to CPA-[XX landfill name] in order to monitor: [Electricity generated in the: - Baseline emissions while applying scenario I/II/III. - Project emissions while applying scenario I/II/III. - Leakage emissions while applying scenario I/II/III. Or Electricity consumption while applying scenario A/B/C].
TOO06	This tool is applicable to the flaring of flammable greenhouse gases in enclosed or open flares where: (a) Methane is the component with the highest concentration in the flammable residual gas; and (b) The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).	The tool is applied to CPA-[XX landfill name] as the a) methane is the component with the highest concentration in the flammable residual gas (LFG) and b) the source of the residual gas is from a biogenic source (landfill).
TOO08	Typical applications of this tool are methodologies where the flow and composition of residual or flared gases or exhaust gases are measured for the determination of baseline or project emissions.	The tool is applied to CPA-[XX landfill name] to determine the amount of methane (CH_4) in the LFG measured for the calculation of baseline and project emissions. Therefore, applicability condition of tool is met.
TOOL09	This tool is applicable to energy generation systems that: (a) Generate only electricity (and no heat); or (b) Produce only thermal energy (and no	The tool is applied to CPA-[XX landfill name] in order to determine the baseline scenario for heat in energy generation system that generate

Tool	Applicability condition	Justification
	electricity); or (c) Produce both electricity and thermal energy (cogeneration). Then, the tool can be used to estimate the baseline energy efficiency of an air heater, boiler, glass melting furnace(s) or kiln in order to determine baseline emissions associated with heat generation, as prescribed in ACM0001.	electricity (option a).
TOOL10	The tool provides guidance to determine the remaining lifetime of baseline or project equipment. The tool may, for example, be used for project activities which involve the replacement of existing equipment with new equipment or which retrofit existing equipment as part of energy efficiency improvement activities.	The tool is applied to CPA-XX [landfill name] as the LFG was previously used in operational equipment before the CPA implementation.
TOOL11	The tool is applicable at the time of the renewal of the crediting period.	The tool is applied to CPA-[XX landfill name] as this document refers to the renewal of the crediting period of the CPA.
TOOL12	This tool is applicable to project activities which involve freight transportation by road and where transportation is not the main project activity while applying the following options: (a) Option A: monitoring fuel consumption; or (b) Option B: using conservative default values.	The tool is applied to CPA-[XX landfill name] in order to calculate CO_2 emissions from vehicles/trucks used for the LFG transportation and CH_4 leak emissions during transportation.
TOOL32	The project activities and PoAs at new or existing landfills (greenfield or brownfield) are deemed automatically additional, if it is demonstrated that prior to the implementation of the project activities and PoAs the landfill gas (LFG) was only vented and/or flared (in the case of brownfield projects) or would have been only vented and/or flared (in the case of greenfield projects) but not utilized for energy generation, and that under the project activities and PoAs any of the following conditions are met: (a) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW; (b) The LFG is used to generate heat for internal or external consumption; (c) The LFG is flared.	The tool is applied to CPA-[XX landfill name] as the LFG from the [new/existing] SWDS was [describe the CPA compliance with conditions a/b/c]
TOOL07	This tool is used to calculate the emission factor for a project electricity system either for grid power plants only or including off-grid power plants. Applicable to project activities that substitute grid electricity by generating electricity or result in energy savings.	The tool is applied to CPA-[XX landfill name] as the CPA is expected to consume some or all of the electricity generated electricity from LFG.
TOOL27	This tool is applicable to project activities that apply TOOL02 that use the investment analysis for the demonstration of additionality and/or the identification of the baseline scenario.	The tool is applied to CPA-[XX landfill name] as the selection of the baseline scenario and assessment of additionality are based on the investment analysis.

I.3. Application of multiple methodologies

Not applicable.

I.4. Project boundary, sources and greenhouse gases (GHGs)

According to ACM0001, the project boundary includes the site where the LFG is captured and, as applicable:

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

(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 CPA-[XX landfill name], the project boundary includes [include the CPA boundary according to itens above].

[mention the applicable case: the project boundary is the site of the project activity where the gas is captured and destroyed/used.

[If electricity is sourced from grid and/or electricity is dispatched to grid, includes: "Given that the electricity for project activity is sourced from grid and/or electricity generated by the LFG captured would have been generated by power generation sources connected to the grid, the project boundary shall include all the power generation sources connected to the grid to which the project activity is connected to".

If the electricity for project activity is from a captive generation source or electricity generated by the captured LFG would have been generated by a captive power plant, the captive power plant shall be included in the project boundary.]

The greenhouse gases and emission sources included in or excluded from the CPA boundary are presented in the following table.

Table 5: GHG and emission sources included in the CPA boundary.

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Emissions from decomposition of waste at the SWDS site	CH_4	Yes	The major source of emissions in the baseline
		N_2O	No	N_2O emissions are small compared to CH_4 emissions from SWDS. This is conservative
		CO_2	No	CO_2 emissions from decomposition of organic waste are not accounted since the CO_2 is also released under the CPA
	Emissions from electricity generation	CO_2	Yes	May be an important emission source if power generation is included in the project activity
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Emissions from heat generation	CO_2	No	Excluded. Heat generation is not included in the CPA
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Emissions from the use of natural gas	CO_2	No	Excluded for simplification. This is conservative
		CH_4	Yes	May be an important emission source if supply of LFG through a natural gas distribution network, dedicated pipeline or using trucks is included in the CPA
		N_2O	No	Excluded for simplification. This is conservative
Project scenario	Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from electricity consumption due to the project activity	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from flaring	CO_2	No	Emissions are considered negligible
		CH_4	Yes	May be an important emission source
		N_2O	No	Emissions are considered negligible
	Emissions from distribution of LFG using trucks and dedicated pipelines	CO_2	Yes	May be an important emission source
		CH_4	Yes	May be an important emission source
		N_2O	No	Emissions are considered negligible

The following figure illustrates the boundary of the CPA.

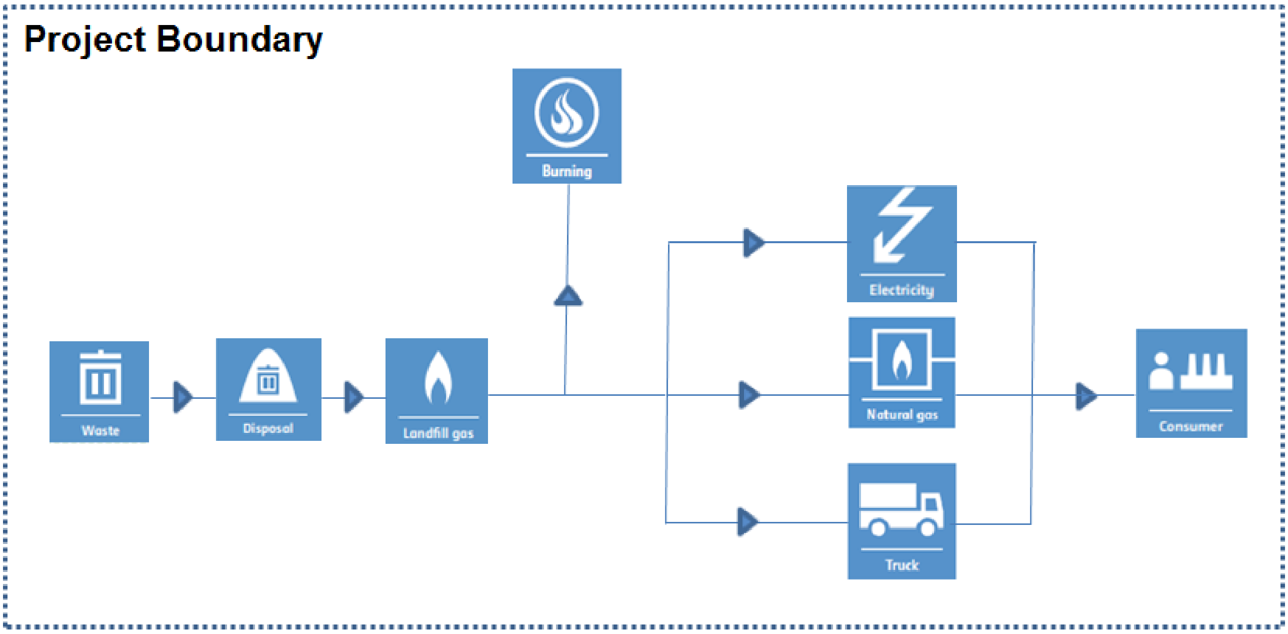

Figure 6: The CPA boundary considering all possible scenarios for the proposed CPA[25].

I.5. Establishment and description of baseline scenario

According to ACM0001, project participants may either apply i) the simplified procedures or ii) the procedures to select the most plausible baseline scenario and demonstrate additionality. In the case of CPA-[XX landfill name], option [i) / ii) is chosen] as follows:

[Consider the option chosen below: i) simplified procedures or ii) procedures according to TOOL02]

i) Simplified procedures to identify the baseline scenario and demonstrate additionality

According to ACM0001, TOOL32 shall be used in order to apply the simplified procedures to identify the baseline scenario and demonstrate additionality. According to TOOL32, the following types of project activities at new or existing landfills (greenfield or brownfield) are deemed automatically additional, if prior to the implementation of the project activity the LFG was or would have been only vented and/or flared but not utilized for energy generation:

a) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW;
b) The LFG is used to generate heat for internal or external consumption;
c) The LFG is flared.

The baseline scenario for LFG is assumed to be the atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.

If all or part of the electricity generated by the project activity is exported to the grid, the baseline scenario for all or the part of the electricity exported to the grid is assumed to be electricity generation in existing and/or new grid-connected power plants. If all or part of the electricity is supplied to off-grid application, the baseline electricity generation equipment is assumed to correspond to the default emission factor from Option B2 of TOOL05. Under the baseline scenario, no electricity generation would occur at the [landfill name] and

[25] To be adjusted depending on the activities involved in the CPA. Icons taken from the CDM Methodology Booklet, Nov 2018 (up to EB101). Available at: <https://cdm.unfccc.int/methodologies/index.html>.

electricity (in equivalent amount of electricity to be generated under the project scenario) would be generated by existing grid-connected power plants (and addition of new power generation units) within the National Electricity Grid of Brazil.

ii) Procedures according to the "Combined tool to identify the baseline scenario and demonstrate additionality"

According to TOOL02, the following steps shall be considered:

STEP 0: Demonstration whether the proposed project activity is the first-of-its-kind

STEP 1: Identification of alternative scenarios
Identification of the baseline scenario for the CPA-[XX landfill name]

SUB-STEP 1a: Define alternatives to the CPA-[XX landfill name]
According to ACM0001, the following alternatives for the LFG destruction shall be taken into consideration:

- LFG1: The CPA-[XX landfill name] 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;
- 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.

In addition to the alternative baseline scenarios identified for the LFG destruction, alternative scenarios for LFG use shall be also identified. In the case of electricity generation, alternative(s) shall include, inter alia:

- 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;

For the supply of LFG to a natural gas distribution network and/or dedicated pipeline and/or distribution of compressed/liquefied using trucks, the baseline is assumed to be the supply with natural gas.

In the case of heat generation, it is not part of CPA-[XX landfill name] as it does not encompass the use of LFG for heating or thermal purposes (i.e. use of collected LFG as gaseous fuel in boiler, air heater, glass melting furnace(s) and/or kiln). Therefore, scenarios H1 through H7 from ACM0001 are not considered in the baseline identification analysis.

Outcome of Step 1a: The alternatives to be taken into consideration after step 1a) are to be identified on an individual/specific CPA level.

SUB-STEP 1b: Consistency with mandatory applicable laws and regulations
So far, there are still no legal restrictions or requirements/obligations for LFG collection and destruction in Brazil. Moreover, there are still no legal restrictions or requirements/obligations for using collected LFG for generation of electricity (or any other type of LFG use) in Brazil either.

Outcome of Sub-step 1b: The alternatives to be taken into consideration after step 1b) are to be identified on an individual/specific CPA level.

STEP 2: Barrier analysis + STEP 3: Investment analysis + STEP 4: Common practice analysis

[Describe how the CPA is additional following the steps of the TOOL02. In case additionality is assessed in the light of step 3, TOOL27 shall be considered. Step 4 shall be assessed following TOOL24: common practice analysis].

I.6. Estimation of emission reductions
I.6.1. Explanation of methodological choices

Baseline Emissions (BE_y)

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

$$BEy = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}$$ **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)
$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year *y* (t CO_2/yr)
$BE_{NG,y}$	=	Baseline emissions associated with natural gas use in year *y* (t CO_2/yr)

Since heat generation is not include in the PoA boundaries, $BE_{HG,y}$ parameter is zero.

1. **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 account26.

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

Where:

$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (tCO_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* (tCH_4/yr) ;
$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year *y* (tCH_4/yr) ;
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4).

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

$F_{CH4,BL,y}$ is determined depending on the requirement to destroy methane and the existence of methane capture system in the baseline:

[26] $OX_{top-layer}$ 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.

Table 6: ACM0001 cases available for the determination of the methane that would be flared in the baseline.

Situation at the start of the project activity	Requirement to destroy methane	Existing LFG capture and destruction system
Case 1	No	No
Case 2	Yes	No
Case 3	No	Yes
Case 4	Yes	Yes

[Include the applicable case to the CPA as follows]

Case 1: No requirement to destroy methane exists and no existing LFG capture system

$$F_{CH4,BL,y} = 0 \quad \textbf{Equation 3}$$

Case 2: Requirement to destroy methane exists and no existing LFG capture system

$$F_{CH4,BL,y} = F_{CH4,BL,R,y} \quad \textbf{Equation 4}$$

$F_{CH4,BL,R,y}$ should be determined based on the information contained in the requirement to destroy methane, as follows:

(a) If the requirement specifies the amount of methane that must be flared then that amount is $F_{CH4,BL,R,y}$;

(b) If the requirement specifies a percentage of the captured LFG that is required to be flared, the amount shall be calculated as follows:

$$F_{CH4,BL,R,y} = \rho_{reg,y} \times F_{CH4,PJ,capt,y} \quad \textbf{Equation 5}$$

Where:

$F_{CH4,BL,R,y}$	=	Amount of methane in the LFG which is flared in the baseline due to a requirement in year y (tCH_4/yr);
$\rho_{reg,}$	=	Fraction of LFG that is required to be flared due to a requirement in year y;
$F_{CH4,PJ,capt,y}$	=	Amount of methane in the LFG which is captured in the project activity in year y (tCH_4/yr).

In order to determine $F_{CH4,PJ,capt,y}$, the following options are available:
Option 1: Using TOOL08; or

Option 2: Calculate as the sum of the amount of methane that is sent to the flare, electricity generating or heat generating equipment in year y as measured in section 5.4.1.1, however, not taking into account the working hours of the equipment:

(i) If the requirement does not specify the amount or percentage of LFG that should be destroyed but requires the installation of a capture system, without requiring the captured LFG to be flared then:

$$F_{CH4,BL,R,y} = 0 \quad \textbf{Equation 6}$$

(ii) If the requirement does not specify any amount or percentage of LFG that should be destroyed, but requires the installation of a system to capture and flare the LFG, then a typical destruction rate of 20 per cent is assumed:

$$F_{CH4,BL,R,y} = 0.2 \times F_{CH4,PJ,capt,y} \quad \textbf{Equation 7}$$

Case 3: No requirement to destroy methane exists and a LFG capture system exists

$$F_{CH4,BL,y} = F_{CH4,BL,sys,y} \quad \textbf{Equation 8}$$

If the amount of methane captured with the existing system can be monitored separately from the amount captured under the project, and the efficiency of the existing system is not impacted on by the project system during the crediting period(s), then $F_{CH4,BL,sys,y}$ is determined as follows:

$$F_{CH4,BL,sys,y} = F_{CH4,sent,flare,y}$$ **Equation 9**

Where:

$F_{CH4,BL,sys,y}$ = Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system (tCH_4/yr);

$F_{CH4,sent,flare,y}$ = Amount of methane in the LFG which is sent to the flare in year y (tCH_4/yr).

$F_{CH4,sent,flare,y}$ is determined using TOOL08, where the gaseous stream the tool shall be applied to is the pipeline collecting LFG from the existing LFG capture system.

If there is no monitored data available, but there is historic data on the amount of methane that was captured in the year prior to the implementation of the project activity, then in this situation:

$$F_{CH4,BL,sys,y} = F_{CH4,hist,y}$$ **Equation 10**

In determining $F_{CH4,hist,y}$ it is assumed that the fraction of LFG that was recovered in the year prior to the implementation of the project activity will be the same fraction recovered under the project activity:

$$BE_{CH4,hist,y} = \frac{F_{CH4,BL,x-1}}{F_{CH4,x-1}} \times F_{CH4,PJ,y}$$ **Equation 11**

Where,

$F_{CH4,hist,y}$ = Historical amount of methane in the LFG which is captured and destroyed (tCH_4/yr);

$F_{CH4,BL,x-1}$ = Historical amount of methane in the LFG which is captured and destroyed in the year prior to the implementation of the project activity (tCH_4/yr);

$F_{CH4, x-1}$ = Amount of methane in the LFG generated in the SWDS in the year prior to the implementation of the project activity (tCH_4/yr);

$F_{CH4, PJ,y}$ = Amount of methane in the LFG which is captured in the project activity in year y (tCH_4/yr).

$F_{CH4,x-1}$ is determined using TOOL04. If there is no monitored or historic data on the amount of methane that was captured in the year prior to the implementation of the project situation, then:

$$F_{CH4,BL,sys,y} = 0.2 \times F_{CH4,PJ,y}$$ **Equation 12**

Case 4: Requirement to destroy methane exists and LFG capture system exists

$$F_{CH4,BL,y} = \max\left(F_{CH4,BL,R,y}; F_{CH4,BL,sys,y}\right)$$ **Equation 13**

Where,

$F_{CH4,BL,R,y}$ = Amount of methane in the LFG which is flared in the baseline due to a requirement in year y (tCH_4/yr);

$F_{CH4,BL,sys,y}$ = Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system (tCH_4/yr).

$F_{CH4,BL,R,y}$ and $F_{CH4,BL.sys,y}$ are determined according to the respective procedures for Case 2 and Case 3 above.

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

An *ex-ante* estimate of $F_{CH4,PJ,y}$ is required to estimate baseline emission of methane from the SWDS as follows:

$$F_{CH4,PJ,y} = \frac{\eta_{PJ} \times BE_{CH4,SWDS,y}}{GWP_{CH4}}$$ **Equation 14**

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

$BE_{CH4,SWDS,y}$ shall be determined following TOOL04 while using Application A as follows:

$$BE_{CH_\$,SWDS,y} = \varphi y \times (1-f_y) * GWP_{CH_4} * (1-OX) * \frac{16}{12} * F * DOC_{f,y} * MCFy * \sum_{x=1}^{y} \sum_{j} (W_{j,x} * DOC_j \times e^{-k_j(y-x)} * (1-e^{-k_j}))$$ **Equation 15**

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);
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 14 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).

While following TOOL04, ACM0001 requires:

(a) 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 equation 2 above;
(b) In the tool, x begins with the year that the SWDS started receiving wastes (e.g. the first year of SWDS operation); and
(c) Sampling to determine the fractions of different waste types is not necessary because the waste composition can be obtained from previous studies.

- ***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 16**

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).

[Include the following as applicable]

- *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 17**

Where:

$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year *y* (tCH_4/yr);
$F_{CH4,sent\_flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year *y* (tCH_4/yr);
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year *y* (tCO_2e/yr);
GWP_{CH4}	=	Global warming potential of CH_4 ($tCO_2e/t\ CH_4$).

$F_{CH4,sent\_flare,y}$ is determined directly using TOOL08 and $PE_{flare,y}$ is determined while using TOOL06. If LFG is flared through more than one flare, then $PE_{flare,y}$ is the sum of the emissions for each flare determined separately.

$F_{CH4,EL,y}$, $F_{CH4,HG,y}$ and $F_{CH4,NG,y}$ are 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. Therefore, working hours shall be monitored for the equipment that consumes the LFG ($Op_{j,h,y}$), following ACM0001 specifications.

TOOL08 presents the following options to determine the mass flow of GHG i in a gaseous stream $F_{i,t}$:

Table 7: Options available for the determination of GHG in a gaseous stream.

Option	Flow of gaseous stream	Volumetric fraction
A	Volume flow – dry basis	dry or wet basis
B	Volume flow – wet basis	dry basis
C	Volume flow – wet basis	wet basis
D	Mass flow – dry basis	dry or wet basis

In case of option A and D, as flow measurement on a dry basis is not doable for a wet gaseous stream, it is necessary to demonstrate that the gaseous stream is dry to use this option. There are two ways to do this:

(a) Measure the moisture content of the gaseous stream ($C_{H2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H_2O/m^3 dry gas; or
(b) Demonstrate that the temperature of the gaseous stream (Tt) is less than 60ºC (333.15 K) at the flow measurement point.

While applying option B, the absolute humidity is required for calculations choosing the following options:

- <u>Option 1</u>: Calculation using measurement of the moisture content

This option determines the absolute humidity of the gaseous stream ($m_{H2O,t,db}$) from measurements of the moisture content of the gas considering the following equation:

$$m_{H2O,t,db} = \frac{C_{H2O,t,db,n}}{10^6 \times \rho_{t,db,n}}$$ **Equation 18**

Where:

$m_{H2O,t,db}$	=	Absolute humidity of the gaseous stream in time interval t on a dry basis (kgH_2O/kg dry gas);
$C_{H2O, t,db,n}$	=	Moisture content of the gaseous stream in time interval t on a dry basis at normal conditions (mg H_2O/m^3 dry gas);
$\rho_{t,db,n}$	=	Density of the gaseous stream in time interval t on a dry basis at normal conditions (kg dry gas/m^3 dry gas).

And:

$$\rho_{t,db,n} = \frac{P_n \times MM_{t,db}}{R_u \times T_n}$$ **Equation 19**

Where:

$\rho_{t,db,n}$	=	Density of the gaseous stream in time interval t on a dry basis at normal conditions (kg dry gas/m^3 dry gas);
P_n	=	Absolute pressure at normal conditions (Pa);
T_n	=	Temperature at normal conditions (K);
$MM_{t,db}$	=	Molecular mass of the gaseous stream in a time interval t on a dry basis (kg dry gas/kmol dry gas);
R_u	=	Universal ideal gases constant (Pa.m^3/kmol.K).

The molecular mass of the gaseous stream ($MM_{t,db}$) is estimated as follows:

$$MM_{t,db} = \sum_k v_{k,t,db} \times MM_k$$ **Equation 20**

Where:

$MM_{t,db}$	=	Molecular mass of the gaseous stream in a time interval t on a dry basis (kg dry gas/kmol dry gas);
$v_{k,t,db}$	=	Volumetric fraction of gas k in the gaseous stream in time interval t on a dry basis (m^3 gas k/m^3 dry gas);
MM_k	=	Molecular mass of gas k (kg/kmol);
k	=	All gases, except H_2O, contained in the gaseous stream (e.g. N_2, CO_2, O_2, CO, H_2, CH_4, N_2O, NO, NO_2, SO_2, SF_6 and PFCs).

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

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

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

$$m_{H2O,t,db,sat} = \frac{p_{H2O,t,sat} \times MM_{H2O}}{(P_t - p_{H2O,t,sat}) \times MM_{t,db}}$$ **Equation 21**

Where:

$m_{H2O,t,db,sat}$	=	Saturation absolute humidity in time interval t on a dry basis (kgH_2O/kg dry gas);

$p_{H2O,t,sat}$	=	Saturation pressure of H_2O at temperature Tt in time interval t (Pa);
T_t	=	Temperature of the gaseous stream in time interval t (K);
P_t	=	Absolute pressure of the gaseous stream in time interval t (Pa);
MM_{H2O}	=	Molecular mass of H_2O (kg H_2O/kmol H_2O);
$MM_{t,db}$	=	Molecular mass of the gaseous stream in a time interval t on a dry basis (kg dry gas/kmol dry gas).

Equation and methods for each of the options available to calculate $F_{i,t}$ are as follows:

Option A: flow of gaseous stream in dry basis and volume fraction in dry or wet basis

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

$$\mathrm{F_{i,t}} = V_{t,db} \times v_{i,t,db} \times \rho_{i,t}$$ **Equation 22**

With:

$$\rho_{i,t} = \frac{P_t \times MM_i}{R_u \times T_t}$$ **Equation 23**

Where:

$F_{i,t}$	=	Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h);
$V_{t,db}$	=	Volumetric flow of the gaseous stream in time interval t on a dry basis (m³ dry gas/h);
$v_{i,t,db}$	=	Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m³ gas i/m³ dry gas);
$\rho_{i,t}$	=	Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i/m³ gas i);
P_t	=	Absolute pressure of the gaseous stream in time interval t (Pa);
MM_i	=	Molecular mass of greenhouse gas i (kg/kmol);
R_u	=	Universal ideal gases constant (Pa.m³/kmol.K);
T_t	=	Temperature of the gaseous stream in time interval t (K).

Option B: flow of gaseous stream in wet basis and volume fraction in dry basis

The mass flow of greenhouse gas i ($F_{i,t}$) is determined according to equations 22 and 23. The volumetric flow of the gaseous stream in time interval t on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis as follows:

$$V_{t,db} = \frac{V_{t,wb}}{(1 + \times\, v_{H2O,t,db})}$$ **Equation 24**

Where:

$V_{t,db}$	=	Volumetric flow of the gaseous stream in time interval t on a dry basis (m³ dry gas/h);
$V_{t,wb}$	=	Volumetric flow of the gaseous stream in time interval t on a wet basis (m³ wet gas/h);
$v_{H2O,t,db}$	=	Volumetric fraction of H_2O in the gaseous stream in time interval t on a dry basis (m³ H_2O/m³ dry gas).

And:

$$v_{H2O,t,db} = \frac{m_{H2O,t,db} \times MM_{t,db}}{MM_{H2O}}$$ **Equation 25**

Where:

$v_{H2O,t,db}$	=	Volumetric fraction of H_2O in the gaseous stream in time interval t on a dry basis (m³ H_2O/m³ dry gas);
$m_{H2O,t,db}$	=	Absolute humidity in the gaseous stream in time interval t on a dry basis (kg H_2O/kg dry gas), calculated using option 1 or 2 above;
$MM_{t,db}$	=	Molecular mass of the gaseous stream in time interval t on a dry basis (kg dry gas/kmol

		dry gas) using equation 20;
MM_{H2O}	=	Molecular mass of H_2O (kg H_2O/kmol H_2O).

<u>Option C</u>: flow of gaseous stream in <u>wet</u> basis and volume fraction in <u>wet</u> basis

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

$$\mathrm{F_{i,t}} = V_{t,wb,n} \times v_{i,t,wb} \times \rho_{i,n}$$ **Equation 26**

With:

$$\rho_{i,n} = \frac{P_n \times MM_i}{R_u \times T_n}$$ **Equation 27**

Where:

$F_{i,t}$	=	Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h);
$V_{t,wb,n}$	=	Volumetric flow of the gaseous stream in time interval t on a wet basis at normal conditions (m³ wet gas/h);
$v_{i,t,wb}$	=	Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a wet basis (m³ gas i/m³ wet gas);
$\rho_{i,n}$	=	Density of greenhouse gas i in the gaseous stream at normal conditions (kg gas i/m³ wet gas i);
P_n	=	Absolute pressure at normal conditions (Pa);
T_n	=	Temperature at normal conditions (K);
MM_i	=	Molecular mass of greenhouse gas i (kg/kmol);
R_u	=	Universal ideal gases constant (Pa.m^3/kmol.K).

The following equation should be used to convert the volumetric flow of the gaseous stream from actual conditions to normal conditions of temperature and pressure:

$$V_{t,wb,n} = V_{t,wb} \times \left(\frac{T_n \times T_t}{P_t \times P_n}\right)$$ **Equation 28**

Where:

$V_{t,wb,n}$	=	Volumetric flow of the gaseous stream in a time interval t on a wet basis at normal conditions (m^3 wet gas/h);
$V_{t,wb}$	=	Volumetric flow of the gaseous stream in time interval t on a wet basis (m³ wet gas/h);
T_n	=	Pressure of the gaseous stream in time interval t (Pa);
T_t	=	Temperature of the gaseous stream in time interval t (K);
P_t	=	Absolute pressure at normal conditions (Pa);
P_n	=	Temperature at normal conditions (K).

<u>Option D</u>: flow of gaseous stream in <u>dry</u> basis and volume fraction in <u>dry or wet</u> basis

The mass flow of greenhouse gas i ($F_{i,t}$) is determined according to equations 22 and 23. The volumetric flow of the gaseous stream in time interval t on a dry basis ($V_{t,db}$) is determined by converting the mass flow of the gaseous stream to a volumetric flow as follows:

$$V_{t,db} = \frac{M_{t,db}}{\rho_{t,db}}$$ **Equation 29**

Where:

$V_{t,db}$	=	Volumetric flow of the gaseous stream in time interval t on a dry basis (m^3 dry gas/h);
$M_{t,db}$	=	Mass flow of the gaseous stream in time interval t on a dry basis (kg/h);
$\rho_{t,db}$	=	Density of the gaseous stream in time interval t on a dry basis (kg dry gas/m^3 dry gas).

And:

$$\rho_{t,db} = \frac{P_t \times MM_{t,db}}{R_u \times T_t}$$ **Equation 30**

Where:

$\rho_{t,db}$	=	Density of the gaseous stream in time interval t on a dry basis (kg dry gas/m^3 dry gas);
$MM_{t,db}$	=	Molecular mass of the gaseous stream in a time interval t on a dry basis (kg dry gas/kmol dry gas);
P_t	=	Pressure of the gaseous stream in time interval t (Pa);
T_t	=	Temperature of the gaseous stream in time interval t (K).

The molecular mass of the gaseous stream ($MM_{t,db}$) is calculated Equation 20.

2. **Baseline emissions associated with electricity generation ($BE_{EC,y}$)**

$BE_{EC,y}$ shall be calculated using TOOL05, where:

(a) 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
(b) $EC_{BL,k,y}$ in the tool is equivalent to the net amount of electricity generated using LFG in year y ($EG_{PJ,y}$).

According to TOOL05, the generic approach is as follows:

$$BE_{EC,y} = \sum EC_{BL,k,y} \times EF_{EL,k,y} \times (1 + TDL_{k,y})$$ **Equation 31**

Where:

$BE_{EC,y}$	=	Baseline emissions from electricity consumption in year y (tCO_2 / yr);
$EC_{BL,k,y}$	=	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.

$EF_{EL,k,y}$ depends on the scenarios of electricity generation:

<u>Scenario A:</u> Electricity consumption from the grid

- Option A1: calculate de combined margin emission factor of the grid using the steps of TOOL07, where $EF_{EL,j/k/l,y} = EF_{grid,CM,y}$.

<u>Scenario B:</u> Electricity consumption from an off-grid captive power plant

- Option B1: The emission factor for electricity generation is determined based on the CO_2 emissions from fuel combustion and the electricity generation in the captive power plant(s) installed at the site of the electricity consumption source.

In case where none of the captive power plants is a cogeneration plant or where the heat generation is ignored (subject to the conditions outlined above), the emission factor of the captive power plant(s) is calculated as follows:

$$EF_{EL,j/k/l,y} = \frac{\sum_n \sum_i FC_{n,i,t} \times NCV_{i,t} \times EF_{CO2,i,t}}{\sum_n EG_{n,t}}$$ **Equation 32**

Where:

$EF_{EL,j/k/l,y}$	=	Emission factor for electricity generation for source j, k or l in year y (tCO_2/MWh);
$FC_{n,i,t}$	=	Quantity of fossil fuel type i fired in the captive power plant n in the time period t (mass or

volume unit);

$NCV_{i,t}$ = Average net calorific value of fossil fuel type i used in the period t (GJ /mass or volume unit);

$EF_{CO2,i,t}$ = Average CO_2 emission factor of fossil fuel type i used in the period t (tCO_2 / GJ);

$EG_{n,t}$ = Quantity of electricity generated in captive power plant n in the time period t (MWh);

i = Fossil fuel types fired in captive power plant n in the time period t;

j = Sources of electricity consumption in the project;

k = Sources of electricity consumption in the baseline;

l = Leakage sources of electricity consumption;

n = Fossil fuel fired captive power plants installed at the site of the electricity consumption source j, k or l;

t = Time period for which the emission factor for electricity generation is determined (which can be the monitored period or the most recent historical three years prior to the implementation of the project activity for baseline electricity consumption sources if no captive power plant is operated during the monitored period at the site of the baseline electricity consumption source.

In other cases, the CO_2 emission factor for electricity generation is calculated by allocating the fuel consumption between electricity and heat generation, as follows:

$$EF_{EL,j/k/l,y} = \frac{\sum_n \left[\sum_i \left(FC_{n,i,t} \times NCV_{i,t}\right) - \frac{HG_{n,t}}{\eta_{boiler}}\right] \times EF_{CO2,n,t}}{\sum_n EG_{n,t}}$$ **Equation 33**

Where:

$EF_{EL/j/k/l,y}$ = Emission factor for electricity generation for source j, k or l in year y (tCO_2/MWh)

$FC_{n,i,t}$ = Quantity of fossil fuel type i fired in the captive power plant n in the time period t (mass or volume unit);

$NCV_{i,t}$ = Average net calorific value of fossil fuel type i used in the period t (GJ /mass or volume unit);

$HG_{n,t}$ = Quantity of heat co-generated in captive power plant n in the time period t (GJ);

η_{boiler} = Efficiency of the boiler in which heat is assumed to be generated in the absence of a cogeneration plant;

$EF_{CO2,n,t}$ = Average CO_2 emission factor of the fossil fuels fired in the captive power plant n in the time period t (tCO_2/GJ);

$EG_{n,t}$ = Quantity of electricity generated in captive power plant n in the time period t (MWh);

n = Fossil fuel fired captive power plants installed at the site of the electricity consumption source j, k or l;

t = Time period for which the emission factor for electricity generation is determined (which can be the monitored period or the most recent historical three years prior to the implementation of the project activity for baseline electricity consumption sources if no captive power plant is operated during the monitored period at the site of the baseline electricity consumption source;

i = Fossil fuel types fired in captive power plant n in the time period t;

j = Sources of electricity consumption in the project;

k = Sources of electricity consumption in the baseline;

l = Leakage sources of electricity consumption.

The parameter $EF_{CO2,n,t}$ is determined as follows:

(a) In case of captive power plants that have only used one single fuel type since their start of operation (except small amount of start-up fuel), use the CO_2 emission factor of that fuel type ($EF_{CO2,n,t} = EF_{CO2,i}$);

(b) In the case of captive power plants that have used multiple fuel types since their start of operation, choose among the following options:

(i) For baseline electricity consumption, use the fuel type with the lowest CO_2 emission factor ($EF_{CO2,i,t}$) among the fuel types that were used in the period prior to the start of the project activity; the period considered shall be a minimum of one year and a maximum of three years;

(ii) For project electricity consumption, use the fuel type with the highest CO_2 emission factor ($EF_{CO2,i,t}$) among the fuel types that have been used in the period since the start of the project activity until the end of the monitored period in question;

(iii) Nevertheless, if electricity is consumed from the same captive power plant for both the baseline and project (and/or leakage); and the electricity consumption of the project and leakage sources is greater than the electricity consumption of the baseline sources, then the CO_2 emission factor ($EF_{CO2,i,t}$) as per sub-paragraph (b) (ii) shall be used for both. On the other hand, if electricity is consumed from the same captive power plant for both the baseline and project (and/or leakage); and the electricity consumption of the baseline sources is greater than the electricity consumption of the project and/or leakage sources, then the CO_2 emission factor ($EF_{CO2,i,t}$) as per subparagraph (b) (i) shall be used for both;

(iv) Calculate an average CO_2 emission factor for the period t, provided that the decision on the fuel mix is outside the control of the project participants (e.g. in the case of leakage electricity consumers or in cases where the fuel mix is fixed through mandatory regulations or determined by a centralized dispatch authority, as follows:

$$\mathrm{EF}_{\mathrm{CO2,n,t}} = \frac{\sum_i FC_{n,i,t} \times NCV_{i,t} \times EF_{CO2,i,t}}{\sum_i FC_{n,i,t} \times NCV_{i,t}}$$ **Equation 34**

Where:

$EF_{CO2,n,t}$	=	Average CO_2 emission factor of the fossil fuels fired in the captive power plant n in the time period t (tCO_2/GJ);
$FC_{n,i,t}$	=	Quantity of fossil fuel type i fired in the captive power plant n in the time period t (mass or volume unit);
$NCV_{i,t}$	=	Average net calorific value of fossil fuel type i used in the period t (GJ /mass or volume unit);
$EF_{CO2,i,t}$	=	CO_2 emission factor of the fossil fuel type i used in the time period t (tCO_2/GJ);
n	=	Fossil fuel fired captive power plants installed at the site of the electricity consumption source j, k or l;
t	=	Time period for which the emission factor for electricity generation is determined (which can be the monitored period or the most recent historical three years prior to the implementation of the project activity for baseline electricity consumption sources if no captive power plant is operated during the monitored period at the site of the baseline electricity consumption source;
i	=	Fossil fuel types fired in captive power plant n in the time period t.

(v) Calculate the average CO_2 emission factor, as per equation 38 above, for (a) the period of the most recent three years prior to the implementation of the project activity and for (b) the monitored period in question, and use the value that is more conservative.

<u>Scenario C:</u> Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s)
Under this scenario, the consumption of electricity in the baseline may result in different emission levels, depending on the situation of the project activity. The following three cases can be differentiated:

- Case C.I: Grid electricity. The implementation of the project activity only affects the quantity of electricity that is supplied from the grid and not the operation of the captive power plant.
- Case C.II: Electricity from captive power plant(s). The implementation of the project activity is clearly demonstrated to only affect the quantity of electricity that is generated in the captive power plant(s) and does not affect the quantity of electricity supplied from the grid.
- Case C.III: Electricity from both the grid and captive power plant(s). The implementation of the project activity may affect both the quantity of electricity that is generated in the captive power plant(s) and the quantity of electricity supplied from the grid. According to TOOL05, case C.III should

be chosen as a conservative approach, in case of doubts.

All chosen options should be transparent presented in the CPA-DD. In case of option A1 where the combined margin emission factor of the grid is used ($EF_{EL,j/k/l,y}$ = $EF_{grid,CM,y}$), steps of TOOL07 shall be considered as follows:

- 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 May 26th, 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.

- 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[27] 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 7 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 CPA.

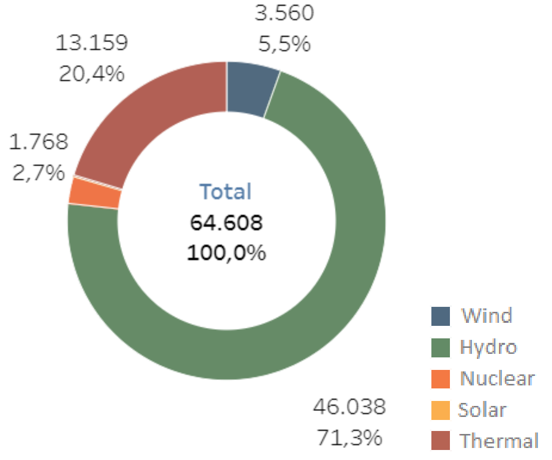

Figure 7: Electricity generation in the Brazilian interconnected system by source, 2014 to 2018 (GWh)
Source: ONS: Histórico da Operação. Available at <http://www.ons.org.br/Paginas/resultados-da-operacao/historico-da-operacao/geracao_energia.aspx>.

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

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. Therefore, option b) and c) are the only available options, which are also calculated and made publicly available by the Brazilian DNA. Following the approach chosen for the first crediting period, option c) is chosen applying the *ex-post* data vintage.

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

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

$$EF_{grid,OM-DD,y} = \frac{\sum_h EG_{PJ,h} \times EF_{EL,DD,h}}{EG_{PJ,y}}$$ **Equation 35**

Where:

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

The $EF_{EL,DD,h}$ parameter is calculated and updated by the Brazilian DNA.

- **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:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$ **Equation 36**

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.

The $EF_{grid,BM,y}$ parameter is calculated and updated by the Brazilian DNA.

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.

Following the approach chosen for the first crediting period, option 1 is chosen and shall be fixed during the second crediting period.

- **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:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$ **Equation 37**

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 to TOOL07, values adopted for w_{OM} and w_{BM} are equal to 0.5 for both parameters during the 1st crediting period. 0.25 for w_{OM} and 0.75 for W_{BM}, respectively, for renewable energy projects during the 2nd crediting period, excluding wind and solar.

1. Baseline emissions associated with natural gas use ($BE_{NG,y}$)

$$BE_{NG,y} = 0.0504 \times F_{CH4,NG,y} \times EF_{CO2,NG,y}$$ **Equation 38**

Where:

$BE_{NG,y}$	=	Baseline emissions associated with natural gas use in year y (tCO_2e/yr);
$EF_{CO2,NG,y}$	=	Average CO_2 emission factor of natural gas in the natural gas network or dedicated pipeline or in the trucks in year y (tCO_2e/TJ);
$F_{CH4,NG,y}$	=	Amount of methane in the LFG which is sent to the natural gas distribution network or dedicated pipeline or to the trucks in year y (tCH_4/yr).

According to ACM0001, $EF_{CO2,NG,y}$ is determined following TOOL03, where $EF_{CO2,NG,y}$ = $COEF_{i,y}$. The following options can be used, where option A is the preferred approach if data is available:

- Option A: $COEF_{i,y}$ based on the chemical composition of the fossil fuel type:

$COEF_{i,y} = w_{C,i,y} \times \frac{44}{12}$, when fossil measured in mass unit **Equation 39**

Or

$COEF_{i,y} = w_{C,i,y} \times \rho_{i,y} \times \frac{44}{12}$, when fossil measured in volume unit **Equation 40**

Where:

$COEF_{i,y}$	=	CO_2 emission coefficient of fuel type i (tCO_2/mass or volume unit);
$w_{C,i,y}$	=	Weighted average mass fraction of carbon in fuel type i in year y (tC/mass unit of the fuel);
$\rho_{i,y}$	=	Weighted average density of fuel type i in year y (mass unit/volume unit of the fuel);
i	=	Fuel types combusted in process j during the year y.

- Option B: $COEF_{i,y}$ based on the net calorific value and CO_2 emission factor of the fossil fuel type:

$$\mathrm{COEF_{i,y}} = \mathrm{NCV_{i,y}} \times EF_{CO2,i,y}$$ **Equation 41**

Where:

$NCV_{i,y}$	=	Weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit);
$EF_{CO2,i,y}$	=	Weighted average CO_2 emission factor of fuel type i in year y (tCO_2/GJ).

Project Emissions (PE_y)

Project emissions are calculated as follows:

$$\mathrm{PE_y} = \mathrm{PE_{EC,y}} + \mathrm{PE_{FC,y}} + \mathrm{PE_{DT,y}} + \mathrm{PE_{SP,y}}$$ **Equation 42**

Where:

$PE_{EC,y}$	=	Emissions from consumption of electricity due to the project activity in year *y* (tCO_2/yr);
$PE_{FC,y}$	=	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year *y* (tCO_2/yr);
$PE_{DT,y}$	=	Emissions from the distribution of compressed/liquefied LFG using trucks, in year y (tCO_2/yr);
$PE_{SP,y}$	=	Emissions from the supply of LFG to consumers through a dedicated pipeline, in year y (tCO_2/yr)

1. Emissions from consumption of electricity ($PE_{EC,y}$)

$PE_{EC,y}$ shall be calculated according to TOOL05 and, while applying the tool, the following shall be considered:

(a) $EC_{PJ,k,y}$ in the tool is equivalent to the amount of electricity consumed by the project activity in year y ($EC_{PJ,y}$); and

(b) If in the baseline a proportion of LFG is destroyed ($F_{CH4,BL,y} > 0$), then the electricity consumption in the tool ($EC_{PJ,j,y}$) should refer to the net quantity of electricity consumption (i.e. the increase due to the CPA).

The generic approach is for $PE_{EC,y}$ calculation is as follows:

$$\mathrm{PE_{EC,y}} = \sum \mathrm{EC_{PJ,j,y}} \times \mathrm{EF_{EL,j,y}} \times (1 + \mathrm{TDL_{j,y}})$$ **Equation 43**

Where:

$EC_{PJ,j,y}$	=	Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr);
$EF_{EL,j,y}$	=	Emission factor for electricity generation for source *j* in year *y* (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.

$EF_{EL,k,y}$ depends on the scenarios of electricity consumption:

<u>Scenario A:</u> Electricity consumption from the grid

- Option A1: calculate de combined margin emission factor of the grid using the steps of TOOL07, where $EF_{EL,j/k/l,y} = EF_{grid,CM,y.}$
- Option A2: use the conservative default value of 1.3tCO_2/MWh.

<u>Scenario B:</u> Electricity consumption from an off-grid captive power plant

- Option B1: the emission factor for electricity generation is determined based on the CO_2 emissions from fuel combustion and the electricity generation in the captive power plant(s) installed at the site of the electricity consumption source. In this case, the $EF_{EL,j/k/l,y}$ parameter can be calculated by using equation 32, 33 and 34.
- Option B2: use the conservative default value of 1.3tCO_2/MWh.

TOOL05 also presents alternative options to monitor project emissions from electricity consumption if scenario B (electricity consumption from an off-grid captive power plant) is applied:

- Option B3: project emissions are determined by considering all CO_2 emissions from fossil fuel combustions based on TOOL03.
- Option B4: project emissions are calculated based on the rated capacity of the captive power planta and by assuming 1.3tCO_2/MWh emission factor and 8,760 hours of operation:

$$PE_{EC,j,y} = 11{,}400 \times \frac{tCO_2}{MW} \times PP_{CP,j}$$ **Equation 44**

Where:

$PE_{EC,j,y}$	=	Project emissions from electricity consumption by source(s) j in year y (tCO_2 / yr);
$PP_{CP,j}$	=	Rated capacity of the captive power plant(s) that provide the project electricity consumption source(s) j with electricity (MW);
j	=	Project electricity consumption sources that are supplied with power from captive power plant(s) installed at one site.

Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s)

- Case C.I: Grid electricity. The implementation of the project activity only affects the quantity of electricity that is supplied from the grid and not the operation of the captive power plant.
- Case C.II: Electricity from captive power plant(s). The implementation of the project activity is clearly demonstrated to only affect the quantity of electricity that is generated in the captive power plant(s) and does not affect the quantity of electricity supplied from the grid.
- Case C.III: Electricity from both the grid and captive power plant(s). The implementation of the project activity may affect both the quantity of electricity that is generated in the captive power plant(s) and the quantity of electricity supplied from the grid. According to TOOL05, case C.III should be chosen as a conservative approach, in case of doubts.

All chosen options should be transparently presented in the CPA-DD. While applying option A1 above, TOOL07 shall be considered as presented in item 2 – baseline emission associated with electricity generation, using equations 35, 36 and 37.

2. Emissions from consumption of fossil fuel ($PE_{FC,y}$)

$PE_{FC,y}$ shall be calculated according to TOOL03 and, while applying the tool, the following shall be considered:

(a) Processes j in the tool correspond to the sources of fossil fuel consumption due to the project activity other than for electricity generation or and any on-site transportation by trucks or cars;

(b) If in the baseline a proportion of LFG is captured and flared ($F_{CH4,BL,y}$ > 0), then the fossil fuels consumption used in calculation ($FC_{i,j,y}$) should refer to the net of that consumed in the baseline. The determination of the amount of fossil fuels consumed in the baseline shall be transparently documented in the CDM-PDD.

Project emissions due to fossil fuel consumption are calculated according to the following equation:

$$PE_{FC,j,y} = \sum FC_{i,j,y} \times COEF_{i,y}$$ **Equation 45**

Where:

$PE_{FC,j,y}$	=	CO_2 emissions from fossil fuel combustion in process j during the year y (tCO_2/yr);
$FC_{i,j,y}$	=	Quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr);
$COEF_{i,y}$	=	CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit);
i	=	fuel types combusted in process j during the year y.

$COEF_{i,y}$ shall be calculated by choosing option A or B of TOOL03, applying equation 39, 40 and 41 of the PoA-DD.

3. Emissions from the distribution of compressed/liquefied LFG using trucks ($PE_{DT,y}$)

$PE_{DT,y}$ shall be calculated as follows:

$$PE_{DT,y} = PE_{TR,y} + PE_{leaks,y}$$ **Equation 46**

Where:

$PE_{DT,y}$	=	Project emissions from the distribution of compressed/liquefied LFG using trucks, in year y (tCO_2/yr);
$PE_{TR,y}$	=	Emissions from the transportation of compressed/liquefied LFG using trucks, in year y (tCO_2/yr);
$PE_{leaks,y}$	=	Emissions from CH_4 leaks during the transportation of compressed/liquefied LFG, in year y (tCO_2/yr).

<u>Emissions from transportation of compressed/liquefied LFG using trucks</u>

$PE_{TR,y}$ shall be determined according to TOOL12 as follows:

$$PE_{TR,m} \text{or } LE_{TR,m} = \sum_{f} D_{f,m} \times FR_{f,m} \times EF_{CO2,f} \times 10^{-6}$$ **Equation 47**

Where:

$PE_{TR,m}$	=	Project emissions from transportation of freight monitoring period m (t CO_2);
$LE_{TR,m}$	=	Leakage emissions from transportation of freight monitoring period m (t CO_2);
$D_{f,m}$	=	Return trip distance between the origin and destination of freight transportation activity f in monitoring period m (km);
$FR_{f,m}$	=	Total mass of freight transported in freight transportation activity f in monitoring period m (t);
$EF_{CO2,f}$	=	Default CO_2 emission factor for freight transportation activity f (g CO_2/t km);
f	=	Freight transportation activities conducted in the project activity in monitoring period m.

While applying the TOOL12, the following shall be considered:

(a) Transportation activity f in the tool corresponds to the distribution of compressing/liquefied LFG from the biogas processing plant to consumer(s) through using trucks;

(b) The freight transported is the compressed/liquefied LFG.

$PE_{TR,y}$ can be calculated using option a) monitoring fuel consumption or b) using conservative values. While applying option (a), TOOL03 shall be used and the following shall be considered:

(a) Parameter $PE_{FC,j,y}$ in the tool corresponds to the parameter $PE_{TR.m}$ or $LE_{TR,m}$ in this tool;

(b) Element process j corresponds to the combustion of fuels in the vehicles;

(c) If biofuels are used, then the corresponding CO_2 emission factor of the fossil fuels that would most likely be used in the absence of the use of biofuels should be used. If biofuel blends are consumed, then the CO_2 emission factor of the fossil fuel used in the blend shall be used, as a conservative simplification.

In case of option (b), default values from TOOL12 shall be considered.

<u>Emissions from CH_4 leaks during transportation of compressed/liquefied LFG</u>

$PE_{leaks,y}$ shall be calculated as follows:

$$PE_{leaks,y} = GWP_{CH4} \times (F_{CH4,NG,TR,y} - F_{CH4,NG-cons,y})$$ **Equation 48**

Where:

$PE_{leaks,y}$	=	Emissions from CH_4 leaks during the transportation of compressed/liquefied LFG, in year y (tCO_2/yr);
GWP_{CH4}	=	Global Warming Potential of CH_4;
$F_{CH4,NG,TR,y}$		Amount of methane in the LFG which is sent to trucks in year y;
$F_{CH4,NG\text{-}cons,y}$		Amount of methane in the LFG which is delivered to consumers using trucks in year y (tCH_4/yr).

4. Emissions from supply LFG to consumers through a dedicated pipeline ($PE_{SP,y}$)

$PE_{SP,y}$ shall be calculated as follows:

$$PE_{SP,y} = 0.0504 \times DEFT_{SP,y} \times F_{CH4,NG,y}$$ **Equation 49**

Where:

$PE_{SP,y}$	=	Project emissions from the supply of LFG to consumers due to physical leakage from the dedicated pipeline, in year y (tCO_2/yr);
$DEFT_{SP,y}$	=	Default emission factor for the supply of LFG to consumers due to physical leakage through the dedicated pipeline (tCO_2e/TJ);
$F_{CH4,NG,y}$	=	Amount of methane in the LFG which is sent to the consumer through a dedicated pipeline in year y (tCH_4/yr).

In addition to project emissions above, emissions from flaring shall also be accounted as follows.

5. Emissions from flaring ($PE_{flare,y}$)

Project emissions from flaring shall be calculated according to steps presented in TOOL06 as follows:

- **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* ($F_{CH4,m}$) shall be determined using the procedures set out by TOOL08, following the requirements set out in the applicability of the tool.

$F_{CH4,m}$, 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 ($F_{CH4,RG,m}$) and shall be determined on a dry basis.

- **STEP 2** – Determination of flare efficiency

The flare efficiency depends on the combustion efficiency of in the flare and the time that the flare is operating. For determining the efficiency of enclosed flares project participants shall choose to determine the efficiency based on monitored data or the option to apply a default value. For open flares a default value must be applied.

a) Open flare

In the case of open flares, the flare efficiency in the minute m ($\eta_{flare,m}$) is 50% when the flame is detected in the minute m ($Flame_m$), otherwise $\eta_{flare,m}$ is 0%.

b) Enclosed flare

In the case of enclosed flares, project participants may choose between the following two options to determine the flare efficiency for minute m ($\eta_{flare,m}$) and shall document in the CDM-PDD which option is selected: i) apply a default value for flare efficiency or ii) measure the flare efficiency.

Option A: Default value: 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:

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

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

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

For enclosed flares that are defined as low height flares, the flare efficiency shall be adjusted, as a conservative approach, by subtracting 10 percentile points. For example, the default value applied shall be 80%, rather than 90%.

Option B: Measured: the flare efficiency for the minute m is measured when three conditions are met:

- 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 (SPECflare) in minute m; and
- The flame is detected in minute m ($Flame_m$).
- Otherwise $\eta_{flare,m}$ is 0%.

For the measurement of the flare efficiency, the following options should be determined as follows according to TOOL06:

Option B.1: The measurement is conducted by an accredited entity at least on a biannual basis

In this case, efficiency is calculated as follows:

$$\eta_{flare,calc,y} = 1 - \frac{1}{n}\sum_{t=1}^{n}\left(\frac{F_{CH4,EG,t}}{F_{CH4,RG,t}}\right) - 0.05$$ **Equation 50**

Where:

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

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

Option B.2: The flare efficiency is measured in each minute.

In this case, efficiency is calculated as follows:

$$\eta_{flare,calc,m} = 1 - \frac{F_{CH4,EG,m}}{F_{CH4,RG,m}}$$ **Equation 51**

Where:

$\eta_{flare,calc,m}$	=	Flare efficiency in the minute m;
$F_{CH4,EG,m}$	=	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the minute m (kg);
$F_{CH4,RG,m}$	=	Mass flow of methane in the residual gas on a dry basis at reference conditions in the minute m (kg).

$F_{CH4,RG,m}$ is calculated according to Step 1. $F_{CH4,EG,m}$ is determined according to step 2.1-2.4 below:

- **STEP 2.1** – Determine the methane mass flow in the exhaust gas on a dry basis

$$F_{CH4,EG,m} = V_{EG,m} \times fc_{CH4,EG,m} \times 10^{-6}$$ **Equation 52**

Where:

$F_{CH4,EG,m}$	=	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the minute m (kg);
$V_{EG,m}$	=	Volumetric flow of the exhaust gas of the flare on a dry basis at reference conditions in minute m (m^3);
$fc_{CH4,EG,m}$	=	Concentration of methane in the exhaust gas of the flare on a dry basis at reference conditions in minute m (mg/m^3).

- **STEP 2.2** – Determine the volumetric flow of the exhaust gas ($V_{EG,m}$)

$$V_{EG,m} = Q_{EG,m} \times M_{RG,m}$$ **Equation 53**

Where:

$V_{EG,m}$	=	Volumetric flow of the exhaust gas of the flare on a dry basis at reference conditions in minute m (m^3);
$Q_{EG,m}$	=	Volume of the exhaust gas on a dry basis at reference conditions per kilogram of residual gas on a dry basis at reference conditions in minute m (m^3 exhaust gas/kg residual gas);
$M_{RG,m}$	=	Mass flow of the residual gas on a dry basis at reference conditions in the minute m (kg).

- **STEP 2.3** – Determine the mass flow of the residual gas ($M_{RG,m}$)

$$V_{EG,m} = Q_{EG,m} \times M_{RG,m}$$ **Equation 54**

Where:

$M_{RG,m}$	=	Mass flow of the residual gas on a dry basis at reference conditions in the minute m (kg);
$\rho_{RG,ref,m}$	=	Density of the residual gas at reference conditions in minute m (kg/m^3);
$V_{RG,m}$	=	Volumetric flow of the residual gas on a dry basis at reference conditions in the minute m (m^3)

And:

$$\rho_{RG,ref,m} = \frac{P_{ref}}{\frac{R_u}{MM_{RG,m}} \times T_{ref}}$$ **Equation 55**

Where:

$\rho_{RG,ref,m}$	=	Density of the residual gas at reference conditions in minute m (kg/m^3);
$P_{ref,m}$	=	Atmospheric pressure at reference conditions (Pa);
R_u	=	Universal ideal gas constant ($Pa.m^3/kmol.K$);
$MM_{RG,m}$	=	Molecular mass of the residual gas in minute m (kg/kmol);
T_{ref}	=	Temperature at reference conditions (K).

Use the equation below to calculate $MM_{RG,m.}$ When applying this equation, project participants may choose to either a) use the measured volumetric fraction of each component *i* of the residual gas, or b) as a simplification, measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2). The same equation applies, irrespective of which option is selected.

$$MM_{RG,m} = \sum_{i} (v_{i,RG,m} \times MM_i)$$ **Equation 56**

Where:

$MM_{RG,m}$	=	Molecular mass of the residual gas in minute m (kg/kmol);
$V_{i,RG,m}$	=	Volumetric fraction of component i in the residual gas on a dry basis at reference conditions in the hour h;

MM_i	=	Molecular mass of residual gas component i (kg/kmol);
i	=	Components of the residual gas. If Option (a) is selected to measure the volumetric fraction, then i = CH_4, CO, CO_2, O_2, H_2, H_2S, NH_3, N_2 or if Option (b) is selected then i = CH_4 and N_2.

- **STEP 2.4** – Determine the volume of the exhaust gas on a dry basis at reference conditions per kilogram of residual gas ($Q_{EG,m}$)

$$Q_{EG,m} = Q_{CO2,EG,m} + Q_{O2,EG,m} + Q_{N2,EG,m}$$ **Equation 57**

Where:

$Q_{EG,m}$	=	Volume of the exhaust gas on a dry basis per kg of residual gas on a dry basis at reference conditions in the minute m (m^3 /kg residual gas);
$Q_{CO2,EG,m}$	=	CO_2 volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m^3 /kg residual gas);
$Q_{O2,EG,m}$	=	O_2 volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m3 /kg residual gas);
$Q_{N2,EG,m}$	=	N_2 volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m^3 /kg residual gas).

<u>With:</u>

$$Q_{O2,EG,m} = n_{O2,EG,m} \times VM_{ref}$$ **Equation 58**

Where:

$Q_{O2,EG,m}$	=	O_2 volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m^3 /kg residual gas);
$n_{O2,EG,m}$	=	O_2 (moles) in the exhaust gas per kg of residual gas flared on a dry basis at reference conditions in minute m (kmol/kg residual gas);
VM_{ref}	=	Volume of one mole of any ideal gas at reference temperature and pressure (m^3/kmol).

$$Q_{N2,EG,m} = VM_{ref} \times \left[\frac{MF_{N,RG,m}}{2 \times AM_N} + (\frac{1 - v_{O2,air}}{v_{O2,air}}) \times (F_{O2,RG,m} + n_{O2,EG,m})\right]$$ **Equation 59**

Where:

$Q_{N2,EG,m}$	=	N_2 (volume) in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m^3 /kg residual gas);
VM_{ref}	=	Volume of one mole of any ideal gas at reference temperature and pressure (m^3/kmol);
$MF_{N,RG,m}$	=	Mass fraction of nitrogen in the residual gas in the minute m;
AM_N	=	Atomic mass of nitrogen (kg/kmol);
$v_{O2,air}$	=	Volumetric fraction of O_2 in air;
$F_{O2,RG,m}$	=	Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in minute m (kmol/kg residual gas);
$n_{O2,EG,m}$	=	O_2 (moles) in the exhaust gas per kg of residual gas flared on a dry basis at reference conditions in minute m (kmol/kg residual gas).

$$Q_{CO2,EG,m} = \frac{MF_{C,RG,m}}{AM_C} \times VM_{ref}$$ **Equation 60**

Where:

$Q_{CO2,EG,m}$	=	CO_2 volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m^3 /kg residual gas);
$MF_{C,RG,m}$	=	Mass fraction of carbon in the residual gas in the minute m;
AM_C	=	Atomic mass of carbon (kg/kmol);

VM_{ref}	=	Volume of one mole of any ideal gas at reference temperature and pressure (m^3/kmol).

$$n_{O2,EG,m} = \frac{v_{O2,EG,m}}{\left[1 - (\frac{v_{O2,EG,m}}{v_{O2,air}})\right] \times \left[\frac{MF_{C,RG,m}}{AM_C} + \frac{MF_{N,RG,m}}{2 \times AM_N} + \left(\frac{1 - v_{O2,air}}{v_{O2,air}}\right) \times F_{O2,RG,m}\right]} \quad \textbf{Equation 61}$$

Where:

$n_{O2,EG,m}$	=	O_2 (moles) in the exhaust gas per kg of residual gas flared on a dry basis at reference conditions in minute m (kmol/kg residual gas);
$v_{O2,EG,m}$	=	Volumetric fraction of O_2 in the exhaust gas on a dry basis at reference conditions in the minute m;
$v_{O2,air}$	=	Volumetric fraction of O_2 in the air;
$MF_{C,RG,m}$	=	Mass fraction of carbon in the residual gas in the minute m;
AM_C	=	Atomic mass of carbon (kg/kmol);
$MF_{N,RG,m}$	=	Mass fraction of nitrogen in the residual gas in the minute m;
AM_N	=	Atomic mass of nitrogen (kg/kmol);
$F_{O2,RG,m}$	=	Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in minute m (kmol/kg residual gas).

$$F_{O2,RG,m} = \frac{MF_{C,RG,m}}{AM_C} + \frac{MF_{H,RG,m}}{4 \times AM_H} - \frac{MF_{O,RG,m}}{2 \times AM_O} \quad \textbf{Equation 62}$$

Where:

$F_{O2,RG,m}$	=	Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in minute m (kmol/kg residual gas);
$MF_{C,RG,m}$	=	Mass fraction of carbon in the residual gas in the minute m;
AM_C	=	Atomic mass of carbon (kg/kmol);
$MF_{H,RG,m}$	=	Mass fraction of hydrogen in the residual gas in the minute m;
AM_H	=	Atomic mass of hydrogen (kg/kmol);
$MF_{O,RG,m}$	=	Mass fraction of oxygen in the residual gas in the minute m;
AM_O	=	Atomic mass of oxygen (kg/kmol).

Determine the mass fractions of carbon, hydrogen, oxygen and nitrogen in the residual gas, using the volumetric fraction of component i in the residual gas and applying the equation below. In applying this equation, the project participants may choose to either a) use the measured volumetric fraction of each component i of the residual gas, or (b) as a simplification, measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2). The same equation applies, irrespective of which option is selected.

$$MF_{j,RG,m} = \frac{\sum_i v_{i,RG,m} \times AM_j \times NA_{j,i}}{MM_{RG,m}} \quad \textbf{Equation 63}$$

Where:

$MF_{j,RG,m}$	=	Mass fraction of element j in the residual gas in the minute m;
$v_{i,RG,m}$	=	Volumetric fraction of component i in the residual gas on a dry basis in the minute m;
AM_J	=	Atomic mass of element j (kg/kmol);
$NA_{j,i}$	=	Number of atoms of element j in component i;
$MM_{RG,m}$	=	Molecular mass of the residual gas in minute m (kg/kmol);
i	=	Elements C, O, H and N;
j	=	Component of residual gas. If Option (a) is selected to measure the volumetric fraction, then i = CH_4, CO, CO_2, O_2, H_2, H_2S, NH_3, N_2 or if Option (b) is selected then I = CH_4 and N_2.

For enclosed flares that are defined as low height flares, the flare efficiency in the minute m ($\eta flare,m$) shall be adjusted, as a conservative approach, by subtracting 10 percentile points from the efficiency. For example, if the measured value was 99%, then the value to be used shall correspond to 89%.

- **STEP 3** – 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:

$$PE_{flare,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3}$$ **Equation 64**

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.*

Leakage (LE_y)

According to ACM0001, no leakage effects are accounted for under this methodology.

Emission Reductions (ER_y)

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$ **Equation 65**

Where:

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

I.6.2. Data and parameters fixed ex ante

ACM0001 – Flaring or use of landfill gas

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	Default value from ACM0001
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	Consistent with how oxidation is accounted for TOOL04.
Purpose of data	Calculation of baseline emissions of methane from SWDS ($BE_{CH4,y}$).
Additional comment	$OX_{top\text{-}layer}$ 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 TOOL04. 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 very small, as the operators of the SWDS have in most cases an incentive to maintain a high methane concentration in the LFG. For these reasons, the oxidation factor shall be included in the calculation of baseline emissions whereas the effect of oxidation is, as a conservative assumption, neglected under the project activity.

Data/Parameter	**$F_{CH4,BL,x-1}$**
Data unit	tCH_4/yr
Description	Historical amount of methane in the LFG which is captured and destroyed in the year prior to the implementation of the CPA-[XX landfill name]
Source of data	Information recorded by the SWDS operator
Value(s) applied	[$F_{CH4,BL,x-1}$]
Choice of data or Measurement methods and procedures	Applicable to Case 3 of section 5.4.1.3
Purpose of data	Calculation of baseline emissions of methane from SWDS ($BE_{CH4,y}$).
Additional comment	-

Data/Parameter	**GWP_{CH4}**
Data unit	tCO_2e/tCH_4
Description	Global warming potential of CH_4
Source of data	IPCC Fourth Assessment Report (AR4)
Value(s) applied	25
Choice of data or Measurement methods and procedures	Default value.
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	The applied value shall be updated according to any future CDM-EB or COP/MOP decisions.

Data/Parameter	**η_{PJ}**
Data unit	Dimensionless
Description	Efficiency of the LFG capture system that will be installed in the CPA
Source of data	[source of data]
Value(s) applied	[η_{PJ}]
Choice of data or Measurement methods and procedures	According to ACM0001, technical specifications of the LFG capture system to be installed (if available) or a default value of 50 per cent can be used.
Purpose of data	Calculation of baseline emissions of methane from SWDS ($BE_{CH4,y}$).
Additional comment	Applicable to section 5.4.1.2

TOOL04 – Emissions from SWDS

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	Select the maximum value from the following: (a) contract or regulation requirements specifying the amount of methane that must be destroyed/used (if available) and (b) historic data on the amount captured
Value(s) applied	0
Choice of data or Measurement methods and procedures	According to ACM0001, fy 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 equation (2) of the methodology.
Purpose of data	Calculation of (ex-ante) baseline emissions of methane from SWDS ($BE_{CH4,y}$).
Additional comment	-

Data/Parameter	**$\Phi_{default}$**
Data unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	TOO04
Value(s) applied	0.75
Choice of data or Measurement methods and procedures	Applicable to application A while applying option 1 of TOOL04.
Purpose of data	Calculation of (ex-ante) baseline emissions of methane from SWDS ($BE_{CH4,y}$).
Additional comment	-

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	0.1
Choice of data or Measurement methods and procedures	Default value of TOOL04.
Purpose of data	Calculation of (ex-ante) baseline emissions of methane from SWDS ($BE_{CH4,y}$).
Additional comment	-

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	Default value of TOOL04.
Purpose of data	Calculation of baseline emissions of methane from SWDS ($BE_{CH4,y}$).
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	Default value of TOOL04.
Purpose of data	Calculation of baseline emissions of methane from SWDS ($BE_{CH4,y}$).
Additional comment	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. This default value can only be used for: (a) Application A; or (b) Application B if the tool is applied to MSW. An alternative to using the default factor is to estimate $DOC_{f,y}$ or $DOC_{f,m}$ using equations (9), (10) and (11) of TOOL04.

Data/Parameter	**$MCF_{default}$**
Data unit	-
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Value(s) applied	1.0
Choice of data or Measurement methods and procedures	Applicable to anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e.waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) levelling of the waste.
Purpose of data	Calculation of baseline emissions of methane from SWDS ($BE_{CH4,y}$).
Additional comment	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. In case of a water table above the bottom of the SWDS, a larger proportion of the SWDS is anaerobic and MCF shall be estimated according to equation 12 of TOOL04.

<table>
<tr><td>Data/Parameter</td><td>DOCj</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>Waste type j</th><th>DOCj (% wet waste)</th></tr>
<tr><td>Wood and wood products</td><td>43</td></tr>
<tr><td>Pulp, paper and cardboard (other than sludge)</td><td>40</td></tr>
<tr><td>Food, food waste, beverages and tobacco (other than sludge)</td><td>15</td></tr>
<tr><td>Textiles</td><td>24</td></tr>
<tr><td>Garden, yard and park waste</td><td>20</td></tr>
<tr><td>Glass, plastic, metal, other inert waste</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>Default value of TOOL04</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions of methane from SWDS ($BE_{CH4,y}$).</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

<table>
<tr><td>Data/Parameter</td><td>kj</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" rowspan="2">Waste type j</th><th colspan="2">Boreal and Temperate (MAT≤20°C)</th><th colspan="2">Tropical (MAT>20°C)</th></tr>
<tr><th>Dry (MAP/PET <1)</th><th>Wet (MAP/PET >1)</th><th>Dry (MAP< 1000mm)</th><th>Wet (MAP > 1000 mm)</th></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.04</td><td>0.06</td><td>0.045</td><td>0.07</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.02</td><td>0.03</td><td>0.025</td><td>0.035</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.05</td><td>0.10</td><td>0.065</td><td>0.17</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.06</td><td>0.185</td><td>0.085</td><td>0.40</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>Default value of TOOL04</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions of methane from SWDS ($BE_{CH4,y}$).</td></tr>
<tr><td>Additional comment</td><td>Document in the CPA-DD the climatic conditions at the SWDS site (temperature, precipitation and, where applicable, evapotranspiration). Use long-term averages based on statistical data, where available. Provide references.</td></tr>
</table>

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

Data/Parameter	**$PP_{CP,j}$**
Data unit	MW
Description	Rated capacity of the captive power plant(s) that provide the project consumption source(s) j with electricity
Source of data	Name plate capacity of the captive power plant, manufacturer's specifications or catalogue references
Value(s) applied	[$PP_{CP,j}$]
Choice of data or Measurement methods and procedures	Following TOOL05
Purpose of data	Calculation of project emissions due to electricity consumption
Additional comment	In case of uncertainty a conservative value should be chosen.

TOOL06 – Project emissions from flaring

Data/Parameter	**$SPEC_{flare}$**
Data unit	Temperature - °C Flow rate or heat flux - kg/h or m^3 /h Maintenance schedule - number of days
Description	Manufacturer's flare specifications for temperature, flow rate and maintenance schedule
Source of data	Flare manufacturer
Value(s) applied	[$SPEC_{flare}$]
Choice of data or Measurement methods and procedures	Only applicable in case of enclosed flares. The maintenance schedule is not required if Option A is selected to determine flare efficiency of an enclosed flare.
Purpose of data	Calculation of project emissions from flaring ($PE_{flare,y}$)
Additional comment	All specification and operation details/requirements valid for flare(s) will be based on information provided by the equipment manufacturer.

Data/Parameter	**$\eta_{flare,m}$**
Data unit	%
Description	Flare efficiency for minute m
Source of data	TOOL06
Value(s) applied	[$\eta_{flare,m}$]
Choice of data or Measurement methods and procedures	Default value for [open or enclosed] flares.
Purpose of data	Calculation of project emissions from flaring ($PE_{flare,y}$)
Additional comment	Open flares: 50% Enclosed flares: 80% for low height flares and 90% for high height flares

*All constant values presented in TOOL06 shall be considered when applicable as follows:

Constants used in equations Parameter	SI Unit	Description	Value
MM_{CH4}	kg/mol	Molecular mass of methane	16.04
MM_{CO}	kg/mol	Molecular mass of carbon monoxide	28.01
MM_{CO2}	kg/mol	Molecular mass of carbon dioxide	44.01
MM_{O2}	kg/mol	Molecular mass of oxygen	32.00

MM_{H2}	kg/mol	Molecular mass of hydrogen	2.02
MM_{N2}	kg/mol	Molecular mass of nitrogen	28.02
AM_C	kg/mol (g/mol)	Atomic mass of carbon	12.00
AM_H	kg/mol (g/mol)	Atomic mass of hydrogen	1.01
AM_O	kg/mol (g/mol)	Atomic mass of oxygen	16.00
AM_N	kg/mol (g/mol)	Atomic mass of nitrogen	14.01
$v_{O2,air}$	Dimensionless	O_2 volumetric fraction of air	0.21
MV_n	m^3/kmol	Volume of one mole of any ideal gas at reference conditions	22.414
$\rho_{CH4,n}$	kg/m^3	Density of methane gas at reference conditions	0.716
$NA_{i,j}$	Dimensionless	Number of atoms of element j in component i, depending on molecular structure	
VM_{ref}	m^3/kmol	Volume of one mole of any ideal gas at Reference temperature and pressure	22.4

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	TOOL08
Value(s) applied	8,314
Choice of data or Measurement methods and procedures	Default value
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	-

Data/Parameter	**MMi**
Data unit	kg/kmol
Description	Molecular mass of greenhouse gas i
Source of data	TOOL08
Value(s) applied	16.04 for methane
Choice of data or Measurement methods and procedures	Default value
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	-

Data/Parameter	**MMk**
Data unit	kg/kmol
Description	Molecular mass of gas k
Source of data	TOOL08
Value(s) applied	For gases k that are greenhouse gases apply values for MMi:
Choice of data or Measurement methods and procedures	Default value
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	-

Compound	Structure	Molecular mass (kg / kmol)
Nitrogen	N_2	28.01
Oxygen	O_2	32.00
Carbon monoxide	CO	28.01
Hydrogen	H_2	2.02
Nitric oxide	NO	30.01
Nitrogen dioxide	NO_2	46.01
Sulphur dioxide	SO_2	64.06

Data/Parameter	$\mathbf{MM_{H2O}}$
Data unit	kg/kmol
Description	Molecular mass of water
Source of data	TOOL08
Value(s) applied	18.0152
Choice of data or Measurement methods and procedures	Default value
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	-

Data/Parameter	$\mathbf{P_n}$
Data unit	Pa
Description	Total pressure at normal conditions
Source of data	TOOL08
Value(s) applied	101,325
Choice of data or Measurement methods and procedures	Default value
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	-

Data/Parameter	**T_n**
Data unit	K
Description	Temperature at normal conditions
Source of data	TOOL08
Value(s) applied	273.15
Choice of data or Measurement methods and procedures	Default value
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	-

TOOL10 - Tool to determine the remaining lifetime of equipment

Data/Parameter	RL
Data unit	years or hours
Description	Remaining lifetime of the baseline or project equipment
Source of data	[choose option applicable (a) Use manufacturer's information on the technical lifetime of equipment and compare to the date of first commissioning; (b) Obtain an expert evaluation; (c) Use default values]
Value(s) applied	[RL]
Choice of data or Measurement methods and procedures	According to TOOL10.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

TOOL12 - Project and leakage emissions from transportation of freight

Data/Parameter	**$EF_{CO2,f}$**
Data unit	gCO_2/t km
Description	Default CO_2 emission factor for freight transportation activity f
Source of data	TOOL12
Value(s) applied	(see table below)
Choice of data or Measurement methods and procedures	Applicable to option B of TOOL12.
Purpose of data	Calculation of project emissions from distribution of compressed/liquefied LFG using trucks ($PE_{TR,m}$).
Additional comment	-

Value(s) applied:

Vehicle class	Emission factor (gCO_2/t km)
Light vehicles	245
Heavy vehicles	129

TOOL07 – Tool to calculate the emission factor for an electricity system

Data/Parameter	$EF_{grid,BM,y}$
Data unit	Build margin CO_2 emission factor in year y
Description	tCO_2/MWh
Source of data	The Brazilian DNA
Value(s) applied	0.1370
Choice of data or Measurement methods and procedures	Option 1 of the TOOL07 for $EF_{grid,BM,y}$, i.e. ex-ante data vintage. The updated value is used, i.e. 2018 year.
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	While applying option 1, 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.

Data/Parameter	W_{BM}
Data unit	%
Description	Weighting of build margin emissions factor
Source of data	Default from TOOL07
Value(s) applied	75
Choice of data or Measurement methods and procedures	Default value applied for the second crediting period according to TOOL07.
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	-

Data/Parameter	W_{OM}
Data unit	%
Description	Weighting of operating margin emissions factor
Source of data	Default from TOOL07
Value(s) applied	25
Choice of data or Measurement methods and procedures	Default value applied for the second crediting period according to TOOL07.
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	-

I.6.3. Modalities for ex ante calculation of emission reductions

Baseline emissions (BE_y)

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

As the CPA applies [case 1/2/3/4], $F_{CH4,BL,y}$ is determined as [method/equation based on the applicable case]. Therefore, ex-ante $F_{CH4,PJ,y}$ is presented below considering 25 GWP_{CH4} and a LFG capture efficiency of [η_{PJ}] efficiency, based on equation 14:

Table 8: Amount of methane that would be generated in the SWDS and flared/used during the crediting period

Year	$BE_{CH4,SWSD,y}$	$F_{CH4,PJ,y}$

For ex-ante determination of $F_{CH4,PJ,y}$, $BE_{CH4,SWSD,y}$ is determined considering the following historical deposit of waste at the SWDS and equation 15:

[Include historical deposit of waste at the SWDS – type and quantities]

Considering historical data on quantities and types of waste, and default values determined at the PoA-DD as required by ACM0001,$BE_{CH4,y}$ is as follows according to equation 2:

Table 9: Baseline emissions generated during the crediting period.

Year	$BE_{CH4,SWSD,y}$	$F_{CH4,PJ,y}$	$F_{CH4,BL,y}$	$BE_{CH4,y}$

For the ex-post determination of $F_{CH4,PJ,y}$, it shall be considered the sum of methane which is used for flaring, electricity generation and/or natural gas distribution network, while applying [option A/B/C/D] of TOOL08.

2. Baseline emissions associated with electricity generation ($BE_{EC,y}$)

$EG_{PJ,y}$ is equal to the electricity produced by the proposed CPA. For ex-ante estimation purposes, it was assumed that 90% of LFG generated was used for electricity generation; the other 10% was considered to be flared. Transmissions losses (TDL_{ky}) are estimated as [TDL_{ky}].

The emission factor for electricity generation ($EF_{EL,k,y}$) is based on [scenario A/B/C].

[include depending on the $EF_{EL,k,y}$ scenario]

<u>Scenario A:</u> Electricity consumption from the grid

In this case, $EF_{EL,j/k/l,y} = EF_{grid,CM,y}$ and is determined following steps of TOOL07. As described in the PoA-DD, the CO_2 operating margin emission factor shall be calculated using option c) dispatch data analysis and will be updated at the time of the CPA verification. According to the most recent data available by the Brazilian DNA, the CO_2 operating margin emission factor for [year] year is:

$$EF_{grid,OM,y} = [EF_{grid,OM,y}]\ tCO_2e/MWh$$

The CO_2 build margin emission factor applies option 1, i.e. ex-ante data vintage, therefore, it will remain fixed during the second crediting period based on the most recent information available at the time of the submission of the PoA-DD request for renewal:

$$EF_{grid,BM,2018} = 0.1370\ tCO_2e/MWh$$

While using the applicable w_{OM} and w_{BM}, the CO_2 combined margin emission factor is as follows:

$$EF_{grid,CM,y} = [EF_{grid,CM,y}]\ tCO_2e/MWh$$

<u>Scenario B:</u> Electricity consumption from an off-grid captive power plant

$EF_{EL,k,y}$ is [$EF_{EL,k,y}$] determined while applying option B1 and [equation 32/equation 33 of the PoA-DD].

<u>Scenario C:</u> Electricity consumption from an off-grid captive power plant

Under scenario C, the CPA applies [case C.I/C.II/C.III] since [reason why the option is applicable].The resulted value is [$EF_{EL,k,y}$].

Applying values above to equation 35, we have the following:

Table 10: Baseline emissions due to electricity generation.

Year	$EG_{PJ,y}$	$BE_{EC,y}$

3. Baseline emissions associated with natural gas use ($BE_{NG,y}$)

$BE_{NG,y}$ is calculated considering the amount of methane in the LFG which is sent to the natural gas (NG) network or dedicated pipeline or trucks ($FCH_{4,NG,y}$), and the CO_2 emission factor of the NG. $EF_{CO2,NG,y}$ is determined applying [option A/B] of TOOL03.

[include values and reference depending on the option chosen]

Baseline emissions included in this CPA are as follows considering equation 1:

Table 11: Total baseline emissions.

Year	$BE_{CH4,y}$	$BE_{EC,y}$	$BE_{NG,y}$	Total BE_y

Project Emissions (PE_y)

1. Emissions from consumption of electricity ($PE_{EC,y}$)

Project emissions occur in the CPA due to electricity consumption from [source of electricity consumption]. Amount of electricity generation considered for ex-ante estimation is based on [reference for electricity generation]. [include value and reference for $TDL_{j,y}$, if applicable].

For the emission factor ($EF_{EL,j,y}$) calculation, [describe if the generic approach or scenario A, B or C is considered. Describe assumptions].

Therefore, considering the [$EC_{PJ,j,y}$] MWh/year, [$EF_{EL,j,y}$] tCO_2/MWh and transmission losses [$TDL_{j,y}$], $PE_{EC,y}$ is [$PE_{EC,y}$] tCO_2e/year while applying equation 43.

2. Emissions from consumption of fossil fuel ($PE_{FC,y}$)

Project emissions from fossil fuel combustion occur in the CPA due to [emission source and fossil fuel used]. [$FC_{i,j,y}$] is estimated to be used based on [source of information]. $COEF_{i,y}$ is [$COEF_{i,y}$] calculated while applying [equation 39/equation 40] of the PoA-DD following TOOL03. [describe assumptions and source of information for $COEF_{i,y}$ determination]

Therefore, considering the [$FC_{i,j,y}$] and [$COEF_{i,y}$], $PE_{EC,y}$ is [$PE_{FC,y}$] tCO_2e/year while applying equation 44.

3. Emissions from the distribution of compressed/liquefied LFG using trucks ($PE_{DT,y}$)

$PE_{DT,y}$ is determined by equation 45 as the sum of emissions from the transportation of compressed/liquefied LFG ($PE_{TR,y}$) and CH_4 leaks during transportation ($PE_{leaks,y}$) by trucks and shall be calculated using TOOL12.

$PE_{TR,y}$ will be calculated using equation 46 while applying option [a/b], i.e. [monitored values or default values]. For ex-ante estimation, the following parameters were considered:

- $D_{f,m}$ = [$D_{f,m}$] km;
- $FR_{f,m}$ = [$FR_{f,m}$] t;
- $EF_{CO2,f}$ = [$EF_{CO2,f}$] gCO_2/t km.

Therefore, $PE_{TR,y}$ [$PE_{TR,y}$] is tCO_2e/year.

Regarding methane leaks ($PE_{leaks,y}$), they are calculated using equation 47 considering [% of leakage]% leakage. Since the amount of methane sent to trucks is [$F_{CH4,NG,TR,y}$], $PE_{leaks,y}$ is [$PE_{leaks,y}$] tCO_2e/year.

Since $PE_{TR,y}$ is [$PE_{TR,y}$] and $PE_{leaks,y}$ is [$PE_{leaks,y}$], $PE_{DT,y}$ is [$PE_{DT,y}$] tCO_2e/year.

4. Emissions from supply LFG to consumers through a dedicated pipeline ($PE_{SP,y}$)

$PE_{SP,y}$ is calculated considering the amount of methane in the LFG sent to consumer ($F_{CH4,NG,y}$) and the default emission factor for supplying LFG via dedicated pipeline ($DEFT_{SP,y}$), which is 2.2 tCO_2e/TJ according to ACM0001.

For the ex-ante estimative of $F_{CH4,NG,y}$, [$F_{CH4,NG,y}$] is considered. Applying equation 48, $PE_{SP,y}$ is [$PE_{SP,y}$] tCO_2e/year.

5. Emissions from flaring ($PE_{flare,y}$)

Project emissions from flaring are calculated following steps of TOOL06. Flare(s) used in the CPA is(are) [open flare / enclosed flare]. Flare efficiency will be [monitored/fixed considering the default value of TOOL06]. [describe how $PE_{flare,y}$ is and will be determined].

Therefore, $PE_{flare,y}$ is [$PE_{flare,y}$] tCO_2e/year.

Project emissions included in this CPA are as follows considering equation 49 and emissions from flaring:

Table 12: CPA project emissions.

Year	$PE_{EC,y}$	$PE_{FC,y}$	$PE_{DT,y}$	$PE_{SP,y}$	$PE_{flare,y}$	Total PE_y

Leakage (LE_y)

As described in section I.6.1, there are no additional leakage effects.

Emission Reductions (ER_y)

Emission reductions are calculated according to equation 50 as follows.

Table 13: Total emission reductions generated in the CPA.

Year*	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
Year 1	0	[CERs_year]	0	[CERs_year]
Year 2	0	[CERs_year]	0	[CERs_year]
Year 3	0	[CERs_year]	0	[CERs_year]
Year 4	0	[CERs_year]	0	[CERs_year]
Year 5	0	[CERs_year]	0	[CERs_year]
Year 6	0	[CERs_year]	0	[CERs_year]
Year 7	0	[CERs_year]	0	[CERs_year]
Total (tonnes of CO_2 e)	0	[total_CERs]	0	[total_CERs]

*[CREDITING PERIOD]

I.7. Monitoring plan

CPA-[XX landfill name] will develop an operational plan that defines a standard against which the project performance will be measured in terms of its emission reductions and compliance with all standards and criteria under the PoA. Monitoring will be the responsibility of [CPA implementer] staff operating the landfill.

The monitoring plan has the following purposes:

- Establish and maintain a reliable and accurate monitoring system;
- Provide guidance for the participants on the implementation of necessary measurement and record management procedures;
- Provide guidance for properly transmit Monitoring Reports to Caixa Econômica Federal;
- Guidance for meeting or exceeding CDM requirements for verification and certification purposes.

The monitoring plan covers:

1) Monitoring team members' duties and routine reminders;
2) Monitoring schedules;
3) QA/QC procedures;
4) Service forms for data reporting;
5) Corrective action and maintenance plans;

The monitoring methodology is based on direct measurement of the amount of LFG captured and destroyed at the flare(s), LFG utilized as fuel in electricity generation infrastructure in order to determine the amount of methane effectively destroyed. The monitoring plan provides for continuous measurement of the quantity of LFG used and quality of LFG flared/utilized.

LFG flow meter(s) and CH_4 content gas analyzer(s) will be recording continuously the amount of methane flared/utilized as part of the operation of CPA-[XX landfill name]. These equipment/instruments are very sensitive, so rigid QA/QC procedures for equipment maintenance and calibration will be developed and performed by [CPA implementer] staff[28], who also will ensure that proper monitoring procedures are performed and monitoring information is sent on a regular basis to Caixa Econômica Federal.

All landfill facilities will have all monitoring devices on-site.

Devices and Methods for Data Collection:
Electricity consumption: Standard electricity meter(s) will be used for monitoring electricity consumption by CPA-[XX landfill name].
LFG measurements: LFG flow meter(s), gas analyser(s), thermocouple(s), LFG temperature sensor(s) and LFG pressure meter(s) will be used to determine the amount of methane that is flared/used at CPA-[XX landfill name]. Meters shall be subject to regular maintenance, testing and calibration.

Monitored Data:
[Project implementer] staff has operational and data collection obligations to fulfill, in order to maximize the GHG emissions reductions, ensuring that sufficient information is available to calculate ERs in a transparent and verifiable manner, allowing a fast and successful verification of these ERs.

Caixa Econômica Federal will take responsibility for the collection of monitored data in CPA-[XX landfill name], the emission reduction estimates, producing the Monitoring Reports and reporting to the DOE. Caixa Econômica Federal will also maintain all necessary data to undertake this PoA monitoring plan, such as a list of all projects under review for inclusion in the PoA and the performing data and parameters for each included CPA.

All data provided by CPA-[XX landfill name] operators will be checked for completeness and quality and placed on a central database owned by Caixa Econômica Federal. All data recording of the monitored data

[28] Regular calibration of the monitoring devices will be undertaken by those responsible for the measurements, as per manufacturer specifications. Archiving of calibration report will be done both in hard copies and in soft copies.

will include paper and electronic versions, backup systems and periodic checking for data entry mistakes. All records will be kept for at least 2 years after the end of the duration of the PoA.

Note:
The permanent change in the programme design + revision in monitoring plan (that is summarized in Appendix 7) resulted in replacement of the previously applied CDM baseline and monitoring methodology from ACM0001 (version 11) + previously applied methodological tool to the latest version of ACM0001 (version 19.0) + latest version of all applicable methodological tools.

The scale and the level of accuracy and completeness in overall monitoring of CPA(s) under the Caixa's PoA are not adversely affected by such post-registration changes. Monitoring (including the design of the monitoring plan) and GHG calculation approaches are however improved and complemented, thus meeting related monitoring requirements of ACM0001 (version 19.0) + latest version of all applicable methodological tools for CPA(s) under the revised programme design configuration.

I.7.1. Data and parameters to be monitored

ACM0001 – Flaring or use of landfill gas

Data/Parameter	**Management of SWDS**
Data unit	-
Description	Management of SWDS
Source of data	[Use different sources of data: (a) Original design of the landfill; (b) Technical specifications for the management of the SWDS; (c) Local or national regulations]
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the CPA-[XX landfill name].
Measurement methods and procedures	Original construction and operational design of the [landfill name] landfill should be confirmed as not being modified. This is to ensure that no practice aiming to increase methane generation in the landfill has been occurring after the implementation of the CPA. As required by ACM0001 (version 19.0), any change in the management of the [landfill name] landfill after the implementation of the CPA should be justified by referring to technical or regulatory specifications.
Monitoring frequency	Annually
QA/QC procedures	N/A
Purpose of data	Calculation of baseline emissions for the CH_4 from the SWDS ($BE_{CH4,y}$).
Additional comment	-

Data/Parameter	$F_{CH4,BL,R,y}$
Data unit	tCH_4/yr
Description	Amount of methane in the LFG which is flared due to a requirement in year y
Source of data	[monitoring equipment]
Value(s) applied	[$F_{CH4,BL,R,y}$]
Measurement methods and procedures	Information of the host country's regulatory requirements relating to LFG, contractual requirements, or requirements to address safety and odour concerns
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions for the CH_4 from the SWDS ($BE_{CH4,y}$).
Additional comment	Applicable to Case 2 of ACM0001 (section 5.4.1.3)

Data/Parameter	$\rho_{reg,y}$
Data unit	Dimensionless
Description	Fraction of LFG that is required to be flared due to a requirement in year y
Source of data	[source of data]
Value(s) applied	[$\rho_{reg,y}$]
Measurement methods and procedures	Information of the host country's regulatory requirements relating to LFG, contractual requirements, or requirements to address safety and odour concerns
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions for the CH_4 from the SWDS ($BE_{CH4,y}$).
Additional comment	Applicable to Case 2 of ACM0001 (section 5.4.1.3)

Data/Parameter	$Op_{j,h}$
Data unit	-
Description	Operation of the equipment that consumes the LFG
Source of data	CPA implementer
Value(s) applied	-
Measurement methods and procedures	For each equipment unit j using the LFG monitor that the plant is operating in hour h by the monitoring any one or more of the following three parameters: (a) Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer's specifications of the burning equipment. Document and justify the location and minimum threshold in the PDD; (b) Flame. Flame detection system is used to ensure that the equipment is in operation; (c) Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnaces. This option is not applicable to brick kilns. Opj,h=0 when: (a) One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); (b) Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); (c) No products are generated in the hour h. Otherwise, Opj,h=1
Monitoring frequency	Hourly
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions and project emissions.
Additional comment	-

Data/Parameter	**$EG_{PJ,y}$**
Data unit	MWh
Description	Amount of electricity generated using LFG by the project activity in year y
Source of data	Electricity meter
Value(s) applied	[$EG_{PJ,y}$]
Measurement methods and procedures	Monitor net electricity generation by the project activity using LFG.
Monitoring frequency	Continuous
QA/QC procedures	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company
Purpose of data	Calculation of baseline emissions associated with electricity generation ($BE_{EC,y}$)
Additional comment	-

Data/Parameter	**$EG_{EC,y}$**
Data unit	MWh
Description	Amount of electricity consumed by the project activity in year y
Source of data	Electricity meter
Value(s) applied	[$EG_{EC,y}$]
Measurement methods and procedures	Sources of consumption shall include, where applicable, electricity consumed for the operation of the LFG capture system, for any processing and upgrading of the LFG, for transportation of the LFG to the flare or other applications (boilers, power generators), for the compression of the LFG into the natural gas network, etc.
Monitoring frequency	Continuous
QA/QC procedures	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company
Purpose of data	Calculation of project emissions due to electricity consumption ($BE_{EC,y}$)
Additional comment	

Data/Parameter	**$F_{CH4,NG-cons,y}$**
Data unit	tCH_4/year
Description	Amount of methane in the LFG which is delivered to consumers using trucks in year y
Source of data	[source of data]
Value(s) applied	[$F_{CH4,NG-cons,y}$]
Measurement methods and procedures	Determined using TOOL08.
Monitoring frequency	Per batch and aggregated annually
QA/QC procedures	-
Purpose of data	Calculation of project emissions due to CH_4 leaks during transportation ($PE_{leaks,y}$)
Additional comment	-

Data/Parameter	$F_{CH4,NG\ TR,y}$
Data unit	tCH_4/year
Description	Amount of methane in the LFG which is sent to trucks in year y
Source of data	[source of data]
Value(s) applied	[$F_{CH4,NG\ TR,y}$]
Measurement methods and procedures	Determined using TOOL08.
Monitoring frequency	Per batch and aggregated annually
QA/QC procedures	-
Purpose of data	Calculation of project emissions due to CH_4 leaks during transportation ($PE_{leaks,y}$)
Additional comment	-

Data/Parameter	$F_{CH4,NG,y}$
Data unit	tCH_4/year
Description	Amount of methane in the LFG which is sent to the natural gas distribution network or dedicated pipeline or to the trucks in year y
Source of data	[source of data]
Value(s) applied	[$F_{CH4,NG,y}$]
Measurement methods and procedures	Determined using TOOL08.
Monitoring frequency	Continuous and aggregated annually in case of natural gas distribution network and dedicated pipeline. Pre-batch and aggregated annually in case of trucks
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions associated with natural gas use ($BE_{NG,y}$)
Additional comment	-

Data/Parameter	CAPEX and OPEX
Data unit	Currency (USD, EUR, etc.)
Description	Total investment to implement the project and total cost to operate the project
Source of data	[engineering, procurement and construction contracts; and maintenance contracts]
Value(s) applied	[CAPEX and OPEX]
Measurement methods and procedures	The information provided for CAPEX shall indicate the investment made: (i) in the collection and flaring system; (ii) in the power plant and connection to the grid (if applicable); and (iii) in the purchase of the new boiler or refurbishment of the existing one and in the steam/hot air pipeline if steam/hot air is exported out of the project boundary (if applicable). The information supplied for OPEX shall indicate the costs for: (i) staff and maintenance involved in the operation of the collection and flaring system; and (ii) staff and maintenance involved in the operation of the collection and power generation system.
Monitoring frequency	At the first issuance request after each phase of the project is fully implemented
QA/QC procedures	Audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors
Purpose of data	-
Additional comment	Applicable when using the simplified procedures to identify the baseline scenario and demonstrate additionality (section 5.3.1 of ACM0001).

Data/Parameter	Tariff of electricity exported
Data unit	Currency (USD, EUR, etc.)
Description	Tariff of the electricity exported
Source of data	[power purchase agreement]
Value(s) applied	[tariff of electricity exported]
Measurement methods and procedures	-
Monitoring frequency	At the first issuance request after each phase of the project is fully implemented
QA/QC procedures	Audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors
Purpose of data	-
Additional comment	Applicable when using the simplified procedures to identify the baseline scenario and demonstrate additionality.

TOOL03 – Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion

Data/Parameter	**$FC_{i,j,y}$**
Data unit	Mass or volume unit per year (e.g. ton/yr or m^3 /yr)
Description	Quantity of fuel type i combusted in process j during the year y
Source of data	Onsite measurements
Value(s) applied	[$FC_{i,j,y}$]
Measurement methods and procedures	• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; • In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Monitoring frequency	Continuously
QA/QC procedures	The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of data	Calculation of project emissions from fossil fuel consumption ($PE_{FC,y}$)
Additional comment	-

Data/Parameter	**$w_{C,i,y}$**
Data unit	tC/mass unit of the fuel
Description	Weighted average mass fraction of carbon in fuel type i in year y
Source of data	[Consider the option applicable <table><tr><td>Data source</td><td>Conditions for using the data source</td></tr><tr><td>(a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr><tr><td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr></table>]
Value(s) applied	[$w_{C,i,y}$]
Measurement methods and procedures	Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	The mass fraction of carbon should be obtained for each fuel delivery, from which weighted average annual values should be calculated.
QA/QC procedures	[Verify if the values under (a) and (b) are within the uncertainty range of the product of the IPCC default values as provided in Table 1.2 and Table 1.3, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in (b) should have ISO17025 accreditation or justify that they can comply with similar quality Standards]
Purpose of data	Calculation of project emissions from fossil fuel consumption ($PE_{FC,y}$)
Additional comment	Applicable where Option A of TOOL03 is used.

<table>
<tr><td>Data/Parameter</td><td>$\rho_{i,y}$</td></tr>
<tr><td>Data unit</td><td>Mass unit/volume unit</td></tr>
<tr><td>Description</td><td>Weighted average density of fuel type i in year y</td></tr>
<tr><td>Source of data</td><td>[Consider the option applicable
<table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>(a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr>
<tr><td>(c) Regional or national default values</td><td>If (a) is not available

These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).</td></tr>
</table>
]</td></tr>
<tr><td>Value(s) applied</td><td>[$\rho_{i,y}$]</td></tr>
<tr><td>Measurement methods and procedures</td><td>Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency</td><td>The density of the fuel should be obtained for each fuel delivery, from which weighted average annual values should be calculated</td></tr>
<tr><td>QA/QC procedures</td><td>-</td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions from fossil fuel consumption ($PE_{FC,y}$)</td></tr>
<tr><td>Additional comment</td><td>Applicable where Option A is used and where $FC_{i.j.y}$ is measured in a volume unit. Preferably the same data source should be used for $w_{C,i,y}$ and $\rho_{i,y}$.</td></tr>
</table>

<table>
<tr><td>Data/Parameter</td><td>$NCV_{i,y}$</td></tr>
<tr><td>Data unit</td><td>GJ per mass or volume unit (e.g. GJ/m³, GJ/ton)</td></tr>
<tr><td>Description</td><td>Weighted average net calorific value of fuel type i in year y</td></tr>
<tr><td>Source of data</td><td><table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>(a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr>
<tr><td>(c) Regional or national default values</td><td>If (a) is not available

These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>(d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (a) is not available</td></tr>
</table></td></tr>
<tr><td>Value(s) applied</td><td>[$NCV_{i,y}$]</td></tr>
<tr><td>Measurement methods and procedures</td><td>For (a) and (b): Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency</td><td>For (a) and (b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For (c): Review appropriateness of the values annually. For (d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures</td><td>[Verify if the values under (a), (b) and (c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in (a), (b) or (c) should have ISO17025 accreditation or justify that they can comply with similar quality standards]</td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions from fossil fuel consumption ($PE_{FC,y}$)</td></tr>
<tr><td>Additional comment</td><td>Applicable where Option B of TOOL03 is used.</td></tr>
</table>

Data/Parameter	$\mathbf{EF_{CO2,i,y}}$
Data unit	tCO_2/GJ
Description	Weighted average CO_2 emission factor of fuel type i in year y
Source of data	[Consider the option applicable <table><tr><td>Data source</td><td>Conditions for using the data source</td></tr><tr><td>(a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr><tr><td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr><tr><td>(c) Regional or national default values</td><td>If (a) is not available These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).</td></tr><tr><td>(d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (a) is not available</td></tr></table>]
Value(s) applied	[$EF_{CO2,i,y}$]
Measurement methods and procedures	[For (a) and (b): Measurements should be undertaken in line with national or international fuel standards]
Monitoring frequency	[For (a) and (b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For (c): Review appropriateness of the values annually. For (d): Any future revision of the IPCC Guidelines should be taken into account]
QA/QC procedures	-
Purpose of data	Calculation of project emissions from fossil fuel consumption ($PE_{FC,y}$)
Additional comment	Applicable where option B of TOOL03 is used. For (a): If the fuel supplier does provide the NCV value and the CO2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO2 factor should be used. If another source for the CO2 emission factor is used or no CO2 emission factor is provided, Options (b), (c) or (d) should be used

TOOL04 – Emissions from solid waste disposal sites
No parameters need to be monitored under TOOL04; all parameters under TOOL04 are fixed ex-ante and they are presented in section I.6.2.

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 TOOL04.

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

Data/Parameter	**$EF_{grid,CM,y}$**
Data unit	tCO_2/MWh
Description	Combined margin emission factor for the grid in year y
Source of data	Calculated according to TOOL07
Value(s) applied	[$EF_{grid,CM,y}$]
Measurement methods and procedures	As per TOOL07
Monitoring frequency	As per TOOL07
QA/QC procedures	As per TOOL07
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	Applicable to scenarios A and C (cases C.I and C.III).

Data/Parameter	**$TDL_{j,y}$ and $TDL_{k,y}$ and $TDL_{l,y}$**
Data unit	-
Description	Average technical transmission and distribution losses for providing electricity to source j, k or l in year y
Source of data	[In case of scenario B and scenario C, case C.II, assume TDLj/k/l,y = 0 as a simplification. In case of other scenarios (scenario A and scenario C, cases C.I and C.III), choose one of the following options: 1. Use annual average value based on the most recent data available within the host country; 2. Use as default values of 20% for: (a) project or leakage electricity consumption sources; (b) baseline electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is larger than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies; 3. Use as default values of 3% for: (a) baseline electricity consumption sources; (b) project and leakage electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is smaller than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies]
Value(s) applied	[$TDL_{j,y}$ and $TDL_{k,y}$ and $TDL_{l,y}$]
Measurement methods and procedures	[For (a): TDLj/k/l,y should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation]
Monitoring frequency	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	-

Data/Parameter	**$FC_{n,i,t}$**
Data unit	Mass or volume unit at reference conditions per year (in m^3 , ton or l)
Description	Quantity of fossil fuel type i fired in the captive power plant n in the time period t
Source of data	Annual data during the crediting period: Onsite measurements Historical data: Historical records / onsite measurements.
Value(s) applied	[$FC_{n,i,t}$]
Measurement methods and procedures	• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a maintenance per supplier specifications; • In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions
Monitoring frequency	Continuously, aggregated at least annually
QA/QC procedures	The consistency of metered fuel consumption quantities should be cross-checked with an annual energy balance that is based on purchased quantities and stock changes.
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	Only applicable if option B1 of TOOL05 is used.

Data/Parameter	**$EG_{n,t}$**
Data unit	MWh
Description	Quantity of electricity generated in captive power plant n in the time period t
Source of data	Onsite measurements
Value(s) applied	[$EG_{n,t}$]
Measurement methods and procedures	Use electricity meters
Monitoring frequency	Continuously, aggregated at least annually
QA/QC procedures	Cross check measurement results with records for sold electricity where relevant
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	Only applicable if option B1 of TOOL05 is used.

Data/Parameter	**$NCV_{i,t}$**
Data unit	GJ / mass or volume unit
Description	Average net calorific value of fossil fuel type i used in the period t
Source of data	[Consider the option applicable <table><tr><td>Data source</td><td>Conditions for using the data source</td></tr><tr><td>(a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr><tr><td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr><tr><td>(c) Regional or national default values</td><td>If (a) is not available These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).</td></tr><tr><td>(d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (a) is not available</td></tr></table>]
Value(s) applied	[$NCV_{i,t}$]
Measurement methods and procedures	[For (a) and (b): Measurements should be undertaken in line with national or international fuel standards].
Monitoring frequency	[For (a) and (b): The NCV should be obtained for each fuel delivery, from which weighted average values for the period t should be calculated For (c): Review appropriateness of the values annually For (d): Any future revision of the IPCC Guidelines should be taken into account]
QA/QC procedures	Verify if the values under (a), (b) and (c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall out this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	Only applicable if option B1 of TOOL05 is used

<table>
<tr><th>Data/Parameter</th><th>$EF_{CO2,i,t}$</th></tr>
<tr><td>Data unit</td><td>tCO_2 / GJ</td></tr>
<tr><td>Description</td><td>CO_2 emission factor of fossil fuel type i used in the period t</td></tr>
<tr><td>Source of data</td><td>[Consider the option applicable
<table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>(a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr>
<tr><td>(c) Regional or national default values</td><td>If (a) is not available

These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>(d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (a) is not available</td></tr>
</table>
]</td></tr>
<tr><td>Value(s) applied</td><td>[$EF_{CO2,i,t}$]</td></tr>
<tr><td>Measurement methods and procedures</td><td>[For (a) and (b): Measurements should be undertaken in line with national or international fuel standards. For a): If the fuel supplier does provide the NCV value and the CO2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO2 factor should be used. If another source for the CO2 emission factor is used or no CO2 emission factor is provided, options (b), (c) or (d) should be used.]</td></tr>
<tr><td>Monitoring frequency</td><td>[For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average values for the period t should be calculated For (c): Review appropriateness of the values annually For (d): Any future revision of the IPCC Guidelines should be taken into account]</td></tr>
<tr><td>QA/QC procedures</td><td>-</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions and/or project emissions.</td></tr>
<tr><td>Additional comment</td><td>Only applicable if option B1 of TOOL05 is used</td></tr>
</table>

Data/Parameter	**$EC_{PJ,j,y}$; $EC_{LE,I,y}$**
Data unit	MWh/yr
Description	Quantity of electricity consumed by the project electricity consumption source j in year y Net increase in electricity consumption of source i in year y as a result of leakage
Source of data	Direct measurement or calculated based on measurements from more than one electricity meters
Value(s) applied	[$EC_{PJ,j,y}$; $EC_{LE,I,y}$]
Measurement methods and procedures	Use electricity meters installed at the electricity consumption sources.
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	[See observation in TOOL05]
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	[See observation in TOOL05] If applicable, measurement records will be crosschecked against available grid-sourced electricity purchasing receipts/invoices.

Data/Parameter	**$EC_{BL,k,y}$**
Data unit	MWh/yr
Description	Quantity of electricity that would be consumed by the baseline electricity consumption source k in year y
Source of data	Direct measurement or calculated based on measurements from more than one electricity meters
Value(s) applied	[$EC_{BL,k,y}$]
Measurement methods and procedures	Use electricity meters installed at the electricity consumption sources.
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	[See observation in TOOL05]
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	[See observation in TOOL05]

Data/Parameter	$EG_{PJ,grid,y}$ or $EG_{PJ,facility,I,y}$
Data unit	MWh/year
Description	Quantity of electricity generated and supplied by the project power plant to the grid in year y Quantity of electricity generated and supplied by the project power plant to the consumers/electricity consuming facility i in year y
Source of data	Direct measurement or calculated based on measurements from more than one electricity meters
Value(s) applied	[$EG_{PJ,grid,y}$ or $EG_{PJ,facility,I,y}$]
Measurement methods and procedures	Use electricity meters installed at the grid interface for electricity export to grid and for supply to captive consumers use electricity meters installed at the entrance of the electricity consuming facility. In case of grid and net electricity generation: This parameter should be either monitored using bi-directional energy meter or calculated as difference between (a) the quantity of electricity supplied by the project plant/unit to the grid; and (b) the quantity of electricity the project plant/unit from the grid. If it is calculated, then the following parameters shall be measured: (a) The quantity of electricity supplied by the project plant/unit to the grid; and (b) The quantity of electricity delivered to the project plant/unit from the grid
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	[See observation in TOOL05]
Purpose of data	Calculation of baseline emissions and/or project emissions.
Additional comment	[See observation in TOOL05]

TOOL06 – Project emissions from flaring

Data/Parameter	$F_{CH4,EG,t}$
Data unit	kg
Description	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period t
Source of data	Measurements undertaken by a third party accredited entity
Value(s) applied	[$F_{CH4,EG,t}$]
Measurement methods and procedures	Measure the mass flow of methane in the exhaust gas according to an appropriate national or international standard e.g. UKs Technical Guidance LFTGN05. The time period t over which the mass flow is measured must be at least one hour. The average flow rate to the flare during the time period t must be greater than the average flow rate observed for the previous six months.
Monitoring frequency	Biannual
QA/QC procedures	According to the standard applied
Purpose of data	Calculation of project emissions from flaring ($PE_{flare,y}$)
Additional comment	Monitoring of this parameter is required in the case of enclosed flares and if the project participants select Option B.1 to determine flare efficiency

Data/Parameter	**$T_{EG,m}$**
Data unit	°C
Description	Temperature in the exhaust gas of the enclosed flare in minute m
Source of data	CPA implementer
Value(s) applied	[$T_{EG,m}$]
Measurement methods and procedures	Measure the temperature of the exhaust gas in the flare by an appropriate temperature measurement equipment. Measurements outside the operational temperature specified by the manufacturer may indicate that the flare is not functioning correctly and may require maintenance. Flare manufacturers must provide suitable monitoring ports for the monitoring of the temperature of the flare. These would normally be expected to be in the middle third of the flare. Where more than one temperature port is fitted to the flare, the flare manufacturer must provide written instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the operation of the flare according to manufacturers specifications for temperature
Monitoring frequency	Once per minute
QA/QC procedures	Temperature measurement equipment should be replaced or calibrated in accordance with their maintenance schedule
Purpose of data	Calculation of project emissions from flaring ($PE_{flare,y}$)
Additional comment	Applicable to enclosed flares.

Data/Parameter	**$v_{i,RG,m}$**
Data unit	-
Description	Volumetric fraction of component i in the residual gas on a dry basis in the minute m where i = CH_4, CO, CO_2, O_2, H_2, H_2S, NH_4, N_2
Source of data	Measurements by project participants using a continuous gas analyser
Value(s) applied	[$v_{i,RG,m}$]
Measurement methods and procedures	Measurement may be made on either dry or wet basis. If value is made on a wet basis, then it shall be converted to dry basis for reporting
Monitoring frequency	Continuously. Values to be averaged on a minute basis
QA/QC procedures	Analysers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas
Purpose of data	Calculation of project emissions from flaring ($PE_{flare,y}$)
Additional comment	As a simplified approach, project participants may only measure the content CH_4, CO and CO_2 of the residual gas and consider the remaining part as N_2. Monitoring of this parameter is only applicable in case of enclosed flares and continuous monitoring of the flare efficiency

Data/Parameter	**$V_{RG,m}$**
Data unit	m^3
Description	Volumetric flow of the residual gas on a dry basis at reference conditions in the minute m
Source of data	Measurements by project participants using a flow meter
Value(s) applied	[$V_{RG,m}$]
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital)
Monitoring frequency	Continuously. Values to be averaged on a minute basis.
QA/QC procedures	Flow meters are to be periodically calibrated according to the manufacturer's recommendation.
Purpose of data	Calculation of project emissions from flaring ($PE_{flare,y}$)
Additional comment	Monitoring of this parameter is applicable in case of enclosed flares and continuous monitoring of the flare efficiency and if project participant selects to calculate $V_{RG,m}$ instead of monitoring directly. Monitoring of this parameter may also be necessary for confirming that the manufacturer's specifications for flow rate/heat flux are met. In this case the flow rate should be measured in a m^3 /h basis.

Data/Parameter	**$M_{RG,m}$**
Data unit	kg
Description	Mass flow of the residual gas on a dry basis at reference conditions in the minute m
Source of data	-
Value(s) applied	[$M_{RG,m}$]
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital)
Monitoring frequency	Continuous, values to be averaged on a minute basis
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	Calculation of project emissions from flaring ($PE_{flare,y}$)
Additional comment	Monitoring of this parameter is applicable in case of enclosed flares and continuous monitoring of the flare efficiency and if project participant selects to monitor $M_{RG,m}$ directly, instead of calculating. Monitoring of this parameter may also be necessary for confirming that the manufacturer's specifications for flow rate/heat flux are met. In this case the flow rate should be measured in a kg/h basis

Data/Parameter	$\mathbf{v_{O2,EG,m}}$
Data unit	-
Description	Volumetric fraction of O_2 in the exhaust gas on a dry basis at reference conditions in the minute m
Source of data	Measurements by project participants using a continuous gas analyser
Value(s) applied	[$v_{O2,EG,m}$]
Measurement methods and procedures	Extractive sampling analysers with water and particulates removal devices or in situ analysers for wet basis determination. The point of measurement (sampling point) shall be in the upper section of the flare (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperatures level (e.g. inconel probes)
Monitoring frequency	Continuously. Values to be averaged on a minute basis
QA/QC procedures	Analysers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard gas
Purpose of data	Calculation of project emissions from flaring ($PE_{flare,y}$)
Additional comment	Monitoring of this parameter is only applicable in case of enclosed flares and continuous monitoring of the flare efficiency.

Data/Parameter	$\mathbf{FC_{CH4,EG,m}}$
Data unit	mg/m^3
Description	Concentration of methane in the exhaust gas of the flare on a dry basis at reference conditions in the minute m
Source of data	Measurements by project participants using a continuous gas analyse
Value(s) applied	[$fc_{CH4,EG,m}$]
Measurement methods and procedures	Extractive sampling analysers with water and particulates removal devices or in situ analyser for wet basis determination. The point of measurement (sampling point) shall be in the upper section of the flare in order that the sampling is of the gas after consumption has taken place (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperatures level (e.g. inconel probes).
Monitoring frequency	Continuously. Values to be averaged on a minute basis
QA/QC procedures	Analysers must be periodically calibrated according to manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard gas
Purpose of data	Calculation of project emissions from flaring ($PE_{flare,y}$)
Additional comment	Monitoring of this parameter is only applicable in case of enclosed flares and continuous monitoring of the flare efficiency. Measurement instruments may read ppmv or % values. To convert from ppmv to mg/m^3 simply multiply by 0.716. 1% equals 10 000 ppmv

Data/Parameter	**$Flame_m$**
Data unit	Flame on or Flame off
Description	Flame detection of flare in the minute m
Source of data	CPA implementer
Value(s) applied	[$Flame_m$]
Measurement methods and procedures	Measure using a fixed installation optical flame detector: Ultra Violet detector or Infra-Red or both.
Monitoring frequency	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off.
QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations
Purpose of data	Calculation of project emissions from flaring ($PE_{flare,y}$)
Additional comment	Applicable to all flares

Data/Parameter	**$Maintenance_y$**
Data unit	Calendar dates
Description	Maintenance events completed in year y
Source of data	CPA implementer
Value(s) applied	[$Maintenance_y$]
Measurement methods and procedures	Record the date that maintenance events were completed in year y. Records of maintenance logs must include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced, or needing to be replaced, source of replacement parts, serial numbers and calibration certificates
Monitoring frequency	Annual
QA/QC procedures	Records must be kept in a maintenance log for two years beyond the life of the flare.
Purpose of data	Calculation of project emissions from flaring ($PE_{flare,y}$)
Additional comment	Monitoring of this parameter is required for the case of enclosed flares and the project participant selects Option B to determine flare efficiency. These dates are required so that they can be compared to the maintenance schedule to check that maintenance events were completed within the minimum time between maintenance events specified by the manufacturer ($SPEC_{flare}$)

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

Data/Parameter	$V_{t,wb}$
Data unit	m³ wet gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a wet basis
Source of data	[source of data]
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the CPA-[XX landfill name].
Measurement methods and procedures	Volumetric flow measurement should always refer to the actual pressure and temperature. Instruments with recordable electronic signal (analogical or digital) are assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events for the LFG flow meter(s) will be performed by using a reference primary device provided by a third party independent accredited calibration laboratory. Calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice.
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	This parameter will be monitored in Options B or C of TOOL08

Data/Parameter	$V_{t,db}$
Data unit	m³ dry gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data	[source of data]
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the CPA-[XX landfill name].
Measurement methods and procedures	Volumetric flow measurement should always refer to the actual pressure and temperature. Calculated based on the wet basis flow measurement plus water concentration measurement
Monitoring frequency	Continuous if not specified in the underlying methodology
QA/QC procedures	Periodic calibration events for the LFG flow meter(s) will be performed by using a reference primary device provided by a third party independent accredited calibration laboratory. Calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice.
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	This parameter will be monitored in Options A of TOOL08.

Data/Parameter	$v_{i,t,db}$
Data unit	m³ gas i/m³ dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Source of data	[source of data]
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the CPA-[XX landfill name].
Measurement methods and procedures	Continuous gas analyser operating in dry-basis. Volumetric flow measurement should always refer to the actual pressure and temperature.
Monitoring frequency	Continuous if not specified in the underlying methodology
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	This parameter will be monitored in Option B of TOOL08 and may be monitored in Options A or D.

Data/Parameter	$v_{i,t,wb}$
Data unit	m³ gas i/m³ wet gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a wet basis
Source of data	[source of data]
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the CPA-[XX landfill name].
Measurement methods and procedures	Calculated based on the dry basis analysis plus water concentration measurement or continuous in-situ analyzers if not specified in the underlying methodology.
Monitoring frequency	Continuous if not specified in the underlying methodology
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	This parameter will be monitored in Option C of TOOL08 and may be monitored in Options A and D

Data/Parameter	$M_{t,db}$
Data unit	kg/h
Description	Mass flow of the gaseous stream in time interval t on a dry basis
Source of data	[source of data]
Value(s) applied	[$M_{t,db}$]
Measurement methods and procedures	Calculated based on the wet basis flow measurement plus water concentration measurement
Monitoring frequency	Continuous if not specified in the underlying methodology
QA/QC procedures	Calibration and frequency of calibration is according to manufacturer’s specifications
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	This parameter will be monitored in Option D of TOOL08

Data/Parameter	**$C_{H2O,t,db,n}$**
Data unit	mg H_2O/m^3 dry gas
Description	Moisture content of the gaseous stream at normal conditions, in time interval t
Source of data	[source of data]
Value(s) applied	[$C_{H2O,t,db,n}$]
Measurement methods and procedures	Measurements according to the USEPA CF42 method 4 – Gravimetric determination of water content. Discrete measurement procedure.
Monitoring frequency	The mean value among three consecutive measurements performed in the same day (at least 2 hours each) shall be considered. Measurements should coincide with the Annual Surveillance Test (associated with requirements of the EN 14181 standard) or the calibration of the flow meter for the gaseous stream.
QA/QC procedures	According to the USEPA CF42 method 4
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	Monitoring is required if Option 1 described in the “Determination of the absolute humidity of the gaseous stream” section of the TOOL08 is applied, or as one of the ways of proving that the gaseous stream is dry (necessary for Options A or D)

Data/Parameter	**T_t**
Data unit	K
Description	Temperature of the gaseous stream in time interval t
Source of data	[source of data]
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the CPA-[XX landfill name].
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required. Examples include thermocouples, thermo resistance, etc.
Monitoring frequency	Continuous unless differently specified in the underlying methodology
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer’s specifications
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, this parameter must be monitored continuously to assure the applicability condition is met.

Data/Parameter	P_t
Data unit	Pa
Description	Pressure of the gaseous stream in time interval t
Source of data	[source of data]
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the CPA-[XX landfill name].
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required. Examples include pressure transducers, etc.
Monitoring frequency	Continuous unless differently specified in the underlying methodology
QA/QC procedures	Periodic calibration against a primary device will be performed by using a reference primary device and records of calibration procedures will be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) will be calibrated monthly.
Purpose of data	Calculation of baseline emissions and/or project 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).

Data/Parameter	$p_{H20,t,Sat}$
Data unit	Pa
Description	Saturation pressure of H_2O at temperature T_t in time interval t
Source of data	[source of data]
Value(s) applied	[$p_{H20,t,Sat}$]
Measurement methods and procedures	This parameter is solely a function of the gaseous stream temperature Tt and can be found at reference [1] for a total pressure equal to 101,325 Pa
Monitoring frequency	-
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	[1] Fundamentals of Classical Thermodynamics; Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4º Edition 1994, John Wiley & Sons, Inc.

Data/Parameter	**$v_{k,t,db}$**
Data unit	m³ gas k/m³ dry gas
Description	Volumetric fraction of gas k in the gaseous stream in time interval t on a dry basis
Source of data	[source of data]
Value(s) applied	[$v_{k,t,db}$]
Measurement methods and procedures	Continuous gas analyser operating in dry-basis
Monitoring frequency	Continuous if not specified in the underlying methodology/tool
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	-

Data/Parameter	**$v_{k,t,wb}$**
Data unit	m³ gas k/m³ wet gas
Description	Volumetric fraction of gas k in the gaseous stream in time interval t on a wet basis
Source of data	[source of data]
Value(s) applied	[$v_{k,t,wb}$]
Measurement methods and procedures	Calculated based on the dry basis analysis plus water concentration measurement or continuous in-situ analyzers if not specified in the underlying methodology/tool.
Monitoring frequency	Continuous if not specified in the underlying methodology
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Purpose of data	Calculation of baseline emissions and/or project emissions
Additional comment	-

Data/Parameter	**Status of biogas destruction device**
Data unit	-
Description	Operational status of biogas destruction devices
Source of data	[source of data]
Value(s) applied	[status of biogas destruction device]
Measurement methods and procedures	Monitoring and documenting may be undertaken by recording the energy production from methane captured or the operation of the flare by means of a flame detector to demonstrate the actual destruction of methane, unless a different method is specified in the underlying methodology/tool. Emission reductions will not accrue for periods in which the destruction device is not operational.
Monitoring frequency	Continuous if not specified in the underlying methodology/tool
QA/QC procedures	-
Purpose of data	Calculation of project emissions from flaring ($PE_{flare,y}$)
Additional comment	For Flame detector devices refer to TOOL06.

TOOL12 – Project and leakage emissions from transportation of freight

Data/Parameter	**$D_{f.m}$**
Data unit	Kilometre
Description	Return trip distance between the origin and destination of freight transportation activity f in monitoring period m
Source of data	Records of vehicle operator or records by the CPA implementer
Value(s) applied	[$D_{f,m}$]
Measurement methods and procedures	Determined once for each freight transportation activity f for a reference trip using the vehicle odometer or any other appropriate sources (e.g. on-line sources)
Monitoring frequency	To be updated whenever the distance changes.
QA/QC procedures	-
Purpose of data	Calculation of project emissions from distribution of compressed/liquefied LFG using trucks ($PE_{TR,m}$).
Additional comment	Applicable to option B of TOOL12.

Data/Parameter	**$FR_{f,m}$**
Data unit	Tonnes
Description	Total mass of freight transported in freight transportation activity f in monitoring period m
Source of data	Records by the CPA implementer or records by truck operators
Value(s) applied	[$FR_{f,m}$]
Measurement methods and procedures	According to TOOL12.
Monitoring frequency	Continuously
QA/QC procedures	-
Purpose of data	Calculation of project emissions from distribution of compressed/liquefied LFG using trucks ($PE_{TR,m}$).
Additional comment	Applicable to Option B of TOOL12.

*If applicable, include parameters indicated in TOOL03 in case of option A of TOOL12.

TOOL07 – Tool to calculate the emission factor for an electricity system

Data/Parameter	**$EF_{grid,OM,y} = EF_{grid,OM\text{-}DD,y}$**
Data unit	Operating margin CO_2 emission factor in year y
Description	tCO_2/MWh
Source of data	The Brazilian DNA
Value(s) applied	[$EF_{grid,OM,y}$]
Measurement methods and procedures	Option c) dispatch data analysis OM, which does not allow ex-ante data vintage.
Monitoring frequency	Hourly
QA/QC procedures	Official source of data.
Purpose of data	Calculation of baseline emissions associated with electricity generation ($BE_{EC,y}$)
Additional comment	Data from [latest year for which data is available] year is considered for ex-ante estimation.

I.7.2. Sampling plan

Not applicable. The proposed CPA does not apply sampling methods.

I.7.3. Other elements of monitoring plan

General monitoring:
The following instruments/equipment will be used to monitor required data along the operation of CPA-[XX landfill name] (depending on the applied measurement options and calculation approaches - to be chosen ex-post).

Instrument or Source of data	Measurement option	Parameter	Description
Appropriate volumetric or mass flow meter(s)	Option a) TOOL08	$V_{t,db}$	Volumetric flow of LFG in time interval t on a dry basis (in m^3 dry gas/h) used for the determination of $F_{CH4,BL,R,y}$ $F_{CH4,NG\text{-}cons,y}$, $F_{CH4,NG\ TR,y}$, $F_{CH4,NG,y}$, $M_{RG,m}$ and $V_{RG,m}$.
	Option b) or c) of TOOL08	$V_{t,wb}$	Volumetric flow of LFG in time interval *t* on a wet basis (in m^3 wet gas/h) used for the determination of $F_{CH4,BL,R,y}$ $F_{CH4,NG\text{-}cons,y}$, $F_{CH4,NG\ TR,y}$, $F_{CH4,NG,y}$, $M_{RG,m}$ and $V_{RG,m}$.
	Option d) of TOOL18	$M_{t,db}$	Mass flow of LFG in time interval *t* on a dry basis (in kg/h) used for the determination of $F_{CH4,BL,R,y}$ $F_{CH4,NG\text{-}cons,y}$, $F_{CH4,NG\ TR,y}$, $F_{CH4,NG,y}$, $M_{RG,m}$ and $V_{RG,m}$.
Appropriate gas analyzer(s) or similar equipment	Option B.2 of TOOL06 Option 1 of TOOL08	$v_{i,RG,m}$ = $v_{k,t,db}$/$v_{k,t,dw}$	Volumetric fraction of component *i* / k in the residual gas in the minute m (i = CH_4, CO, CO_2, O_2, H_2, H_2S, NH_4, N_2). As a simplified approach, the CME and/or CPA implementer may only measure the content CH_4, CO and CO_2 of the residual gas and consider the remaining part as N_2.
CH_4 content gas analyser unit(s)	Applicable to all CPAs	$v_{i,t,db/wb}$	Volumetric fraction of methane on the LFG send to flares and/or each processing element of the biogas upgrading facility and/or each delivery pipeline supplying upgraded LFG to consumer(s) (through natural gas distribution network or by using trucks or through a combination of both of these LFG transportation options) in a time interval *t* on a dry basis (in m^3 CH_4/m^3 dry or wet gas) used for the determination of $F_{CH4,BL,R,y}$, $_{CH4,NG\text{-}cons,y}$, $F_{CH4,NG,TR,y}$, $F_{CH4,NG,y}$, $fc_{CH4,EG,m}$, $v_{i,RG,m}$ and $F_{CH4,EG,t}$ (enclosed flares).
Optical flame detector (using ultra violet (UV) or infra-red technology or both)	Applicable to all flares	$Flame_m$	Flame detection of flare in the minute *m* (Flame "*on*" or Flame "*off*").
Flame detector devices	-	Status of biogas destruction device	Operational status of biogas destruction devices (flares).
LFG pressure sensor(s)	Applicable to all measurement options of TOOL08	P_t	Pressure of the LFG send to flare(s) and/or each processing element of the biogas upgrading facility and/or each delivery pipeline supplying upgraded LFG to consumer(s) (through natural gas distribution network or by using trucks or through a combination of both of these LFG transportation options) in time interval *t* (in Pa or mbar).
LFG temperature sensor(s)	Applicable to all measurement options of TOOL08	$T_{t} = T_{EG,m}$	Temperature of the LFG send to the flare(s) and/or each processing element of the biogas upgrading facility and/or each delivery pipeline supplying upgraded LFG to consumer(s) (through natural gas distribution network or by using trucks or through a combination of both of these LFG transportation options) in time interval t (in K or ºC).
Not based on measurements. Literature data.	Option 2 of TOOL08	$p_{H20,t,Sat}$	Saturation pressure of H_2O at temperature Tt,j in time interval *t* . This parameter is solely a function of the LFG temperature Tt and can be found at referenced literature.
Average results from measurements according	Option 1, and A and D of	$C_{H2O,t,db,n}$	Moisture content of the gaseous stream at normal conditions, in time interval t.

Instrument or Source of data	Measurement option	Parameter	Description
to the USEPA CF42 method 4	TOOL08		
Appropriate gas analyzer(s) or any other similar equipment	Option B.2 of TOOL06	$v_{O2,EG,m}$	Volumetric fraction of O_2 in the exhaust gas on a dry basis at reference conditions in the minute *m.* Applicable in case of enclosed flares and continuous monitoring of the flare efficiency.
Electricity meter(s)	CPAs with electricity consumption – TOOL05	$EC_{PJ,j,y}$; $EC_{LE,I,y}$	Quantity of electricity consumed by the project electricity consumption source j in year y / Net increase in electricity consumption of source i in year y as a result of leakage.
Electricity meter(s)	Option B1 of TOOL05	$EG_{PJ,grid,y}$ or $EG_{PJ,facility,I,y}$ or $EC_{BL,k,y}$	Amount of electricity generated and supplied by the CPA-[XX landfill name] in year y (in MWh).
Mass or volume meters, any other applicable equipment. Invoices may be used (if applicable)	Option B of TOOL05	$FC_{n,i,t}$	Quantity of fossil fuel type i fired in the captive power plant n in the time period t (mass or volume unit).
Electricity meter(s). Invoices may be used (if applicable)	Option B1 of TOOL05	$EG_{n,t}$	Quantity of electricity generated in captive diesel backup generator(s) during the year *y* (in MWh).
Not based on measurements. The Brazilian DNA (official source of data)	Option c) of TOOL07	$EF_{grid,OM,y} = EF_{grid,OM-DD,y}$	Operation margin CO_2 emission factor in year *y* (tCO_2/MWh). Dispatch data analysis method based on data from the Brazilian DNA.
Not based on measurements.	Option a) from step 6 of TOOL07	$EF_{grid,CM,y}$	Combined margin emission factor for the grid in year y (tCO_2/MWh).
Mass or volume meters, any other applicable equipment. Invoices may be used (if applicable)	CPAs with electricity consumption – TOOL03	$FC_{i,j,y}$	Quantity of fossil fuel type *i* combusted in process *j* during the year *y* (where process *j* corresponds to purpose other than electricity generation).
Invoices from supplier or any applicable equipment from the CPA implementer	Option A of TOOL03	$w_{C,i,y}$	Weighted average mass fraction of carbon in fuel type i in year y.
Invoices from supplier or any applicable equipment from the CPA implementer	Option A of TOOL03	$\rho_{i,y}$	Weighted average density of fuel type i in year y.
Invoices from supplier, national or IPCC default data.	Option B of TOOL03 Option B.1 of TOOL05	$NCV_{i,y} = NCV_{i,t}$	Net calorific value of fossil fuel in year y. Different fossil fuel *i* may be consumed at a CPA level for: - Transportation of upgraded LFG to consumer(s) entirely or partially by using trucks; - Purpose other than electricity generation and/or transportation of upgraded LFG.
Not based on measurements. Invoices from supplier, national or IPCC default data.	Option B of TOOL03 Option B.1 of TOOL05	$EF_{CO2,I,y} = EF_{CO2,i,t}$	CO_2 emission factor of fossil fuel type *i* in year *y*. Different fossil fuel *i* may be consumed at a CPA level for: - Transportation of upgraded LFG to consumer(s) entirely or partially by using trucks; - Purpose other than electricity generation and/or transportation of upgraded LFG.
Records from vehicle operator(s) based on distance meter(s) (e.g. vehicle hodometer) or via online services	Option B of TOOL12	$D_{f,m}$	Return trip distance between the origin and destination of freight transportation activity *f* in monitoring period *m.* Determined once for each freight transportation activity *f* for a reference trip using the vehicle odometer or any other appropriate sources (e.g. on-line sources)
CPA implementer and/or CME or records by truck operators	Option B of TOOL12	$FR_{f,m}$	Total mass of freight transported in freight transportation activity *f* in monitoring period *m.*
Default value from TOO05, official source of data, distribution and transmission utilities	Calculated or application of default value	$TDL_{grid,y}$ / $TDL_{captive,y}$	Use of recent, accurate and reliable data available within the host country or selection of the applicable default value as per TOOL05. Data shall not be older than 5 years.

Instrument or Source of data	Measurement option	Parameter	Description
Not based on measurements. Design of the landfill, technical specifications, local or national regulations, etc	Applicable to all CPAs	Mgmt of SWDS	The design and operational conditions of the [Landfill name] landfill will be annually monitored applicable sources.
Meter, equipment electronics or system	Applicable to all CPAs	$Op_{j,h}$	Operation of the equipment that consumes LFG: electricity generators, flares and/or each delivery pipeline with upgraded LFG supply to consumer(s) (natural gas distribution network, dedicated pipeline or by using trucks or through a combination of both of these LFG transportation options).
Not based on measurements. Official source of data	Case 2 of ACM0001	$\rho_{reg,y}$	Fraction of LFG that is required to be flared due to a requirement in year y.
CPA implementer and/or CME	Option B of TOOL06	$Maint_y$	Maintenance events completed in year *y* (calendar dates) for each flare. Records of maintenance logs will include all aspects of the maintenance.
Documents available by the CPA implementer at the first issuance.	For simplified procedures to baseline scenario and additionality	CAPEX and OPEX	Total investment to implement the project and total cost to operate the project (currency). Section 5.3.1 of ACM0001.
Documents available by the CPA implementer at the first issuance.	For simplified procedures to baseline scenario and additionality	Tariff of electricity exported	Tariff of the electricity exported (currency). Section 5.3.1 of ACM0001.

As part of the operation of the CPA-[XX landfill name], all continuously measured LFG destruction related parameters as well as measurements related to the exhaust gas of the flare(s) (temperature in the exhaust gas of the flare(s) and eventually other parameters related to flare operational conditions will all be recorded electronically via an appropriate data logger / data acquisition system (to be located within the site boundary). The data logger / data acquisition system will have the capability to record all data in a safe and reliable manner (thus ensuring the required data reliability and validity). Data recording and reporting frequency for these parameters will be at least everyone minute.

Records of electricity consumed by the CPA-[XX landfill name] will also be recorded electronically via an appropriate data logger / data control / data acquisition system (to be located within the site boundary). Data from related grid-sourced electricity purchase invoices and/or historical reports (issued by local electricity transmission/commercialization company) will also be used as cross-checking. Moreover, if applicable, records of electricity generated by the backup captive off-grid electricity generator(s) (fuelled by diesel) may also be regularly recorded (depending on the approach applied for the determination of project emissions from consumption of electricity source by such backup electricity generator(s)).

If applicable, records of quantity of fossil fuel eventually consumed by the CPA-[XX landfill name] will be aggregated manually or automatically (depending on the specifications of related measurement instrument to be applied). Accumulated related measurement records will be reported at with an at least every-month frequency. Data from related eventual fossil fuel purchasing receipts or invoices (to be issued by local distributor/supplier for the consumed fossil fuel) will also be used as cross-checking if applicable.

By the use of appropriate software application, recorded monitoring data will be regularly retrieved, aggregated and reported in order to be considered in the context of calculations of emission reduction achieved by the CPA-[XX landfill name].

Monitoring records available in the data logger/data acquisition system might be regularly retrieved remotely by modem or directly on site. If automatic data logging by the logger / data acquisition system fails, measurement data might be recorded manually (whenever it is possible). If data is not properly recorded or cannot be retrieved, no emissions reductions will be claimed for the period encompassing such data recording/reporting failure.

All monitoring data will be recorded and backed-up in a central database. As per the applicable monitoring procedure, data records will be summarized into emission reduction calculations prior to each periodic CDM verification. All data recorded by the data logger / data acquisition system will be made available to the Designated Operational Entities (DOEs) responsible for each periodic verification for the CPA-[XX landfill name]. This will ensure that data integrity and reliability for related monitoring data.

As per the monitoring procedure to be adopted by the CPA implementer and/or CME, access to monitoring data will be restricted and controlled. All monitoring records will be kept archived until at least two years after the last issuance of CER's for the CPA-[XX landfill name], whichever occurs later.

It will be the responsibility of the appointed monitoring team manager to ensure that all monitoring data is properly measured and recorded as part of operation of the CPA-[XX landfill name].

Technical specifications for monitoring instruments/equipment (e.g. manufacturer, model, serial numbers, accuracy, etc.) will be detailed in the Monitoring Reports for each periodic verification.

Maintenance and calibration for monitoring instruments/equipment and CPA's equipment/components in general:

All maintenance service and routines will include all preventive and corrective actions necessary for ensuring good functioning of all project related equipment, such as:

- Visual control of the equipment state and real-time check of displayed parameters,
- Cleaning up the equipment and the sensors,
- Lubrication and greasing,
- Replacement or overhauling of defective parts (including regular welding service in the HDPE pipelines and manifolds).

Calibration events in monitoring instruments/equipment will be periodically and appropriately performed as per applicable frequency, procedures and methods established or recommended by instrument/ equipment manufacturer, applicable national/international standards and/or best practice, as available.

General malfunction of equipment: if monitoring instruments/equipment or CPA's equipment/components present failure or malfunction, applicable repair or replacement actions will be carried out. Spare units for some of the monitoring instruments/equipment may be kept on site.

Operational and management structure for the CPA-[XX landfill name]:
An appropriate operational and management structure will be made available as part of the operation of the CPA-[XX landfill name].

The CPA's operational and management structure will rely on trained staff (incl. contractors) with responsibilities clearly defined. All collaborators and employees involved with operation of the CP and/or monitoring will be trained internally and/or externally. Training efforts may include inter alia:

a) General competence development about LFG generation and collection;
b) Review of equipment operational principles and captors;
c) Maintenance and calibration requirements for project's related equipment;
d) Procedures for monitoring data gathering and handling;
e) Emergency and safety procedures;
f) General competence development about LFG combustion in high temperature enclosed flares

The monitoring plan will be implemented by reflecting the best practice in terms of monitoring efforts for LFG collection and destruction/utilization project based initiatives under de CDM.

Monitoring of the management of the landfill: As required by ACM0001, the design and operational conditions of the [landfill name] landfill during the duration of the CPA-[XX landfill name] will be monitored on the basis of different sources, including inter alia:
- Original design of the [landfill name] landfill;

- Technical specifications for the management of the [landfill name] landfill;
- Applicable local or national regulations

Original operational design of the [landfill name] landfill should be confirmed not to be modified in order to ensure that no practice to increase methane generation at the landfill have been occurring, when compared to the landfill management and operation condition prior to implementation of the CPA-[XX landfill name]. As required by ACM0001, any change in the management of the landfill after the implementation of the CPA-[XX landfill name] should be justified by referring to technical or regulatory specifications and impacts of such changes in the determination of baseline emissions should in this case be taken into account appropriately. Such monitoring requirement will be used for the determination/confirmation of baseline emissions and/or confirmation of the CPA's implementation as described in the CPA-DD (in terms of operation and management conditions of the landfill from which LFG is combusted).

Further monitoring details are included under details for parameter "Management of SWDS".

SECTION J. Crediting period type and duration

Type of crediting period: renewable

Length of crediting period: 7 years – 0 months.

SECTION K. Eligibility criteria for inclusion of CPAs

The eligibility conditions for inclusion of the proposed CPA are further detailed below following the CDM Project Standard for Programme of Activities (v2.0).

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion
1	Geographical boundaries of CPAs consistent with the geographical boundary of the PoA.	The solid waste disposal site (SWDS) where the waste is disposed shall be clearly identified and only municipal solid waste (MSW) shall be considered (no hazardous wastes at the project site).	The proposed CPA is located under the geographical coordinates presented in section H.3 according to: [geographical coordinates of the CPA as per one of following documents: - Environmental studies and/or licenses; - Other documents, e.g.: engineering studies, etc.]
2	Conditions to avoid double counting of GHG emission reductions or net anthropogenic GHG removals, such as unique identifications of product and end-user locations (e.g. programme logo).	The CME has established a management system/procedure to avoid double counting as presented in section B. Also, a record keeping system for each CPA under the PoA is maintained.	Please refer to section B of this PoA-DD regarding the CME management system.
3	Conditions to confirm that CPAs are neither registered as CDM project activities included in another registered PoAs, nor the project activities that have been deregistered.	The CPA shall not lead to double counting of emission reduction as this CPA and shall not be part of any of the following categories: (1) Standalone CDM project activity; (2) Bundled CDM project activity; (3) Another registered PoA.	Signature of a letter of intent (LoI) from the CPA implementer prior to the start date of the CPA in order to confirm both their voluntary participation to the proposed PoA coordinated by Caixa Econômica Federal, and that the project under the CPA is neither registered as an

<table>
<tr><th>No.</th><th>Eligibility criterion - Category</th><th>Eligibility criterion - Required condition</th><th>Supporting evidence for inclusion</th></tr>
<tr><td></td><td></td><td></td><td>individual CDM project activity nor included as part of another registered PoA or that have been deregistered].</td></tr>
<tr><td>4</td><td>Specification of the technology/measure, such as the level and type of service, as well as performance specification based on, inter alia, testing/certification.</td><td>The site hosting the CPA shall be a licensed Municipal or Regional sanitary landfill located in the host country Brazil. While there are no restrictions in terms of size of the SWDS hosting the CPA neither in terms of the amount of MSW disposed, the management of the SWDS in the CPA shall not be changed in order to increase methane generation when compared to the situation prior to the implementation of the CPA. Furthermore, the SWDS shall receive municipal solid waste only.</td><td>The CPA proponent is responsible for operating and monitoring the CPA as per the CDM rules valid for large-scale projects as CPAs and guidelines provided by Caixa Econômica Federal.

[Several documents can be used to demonstrate compliance with this eligibility criteria including the following documents, but not limited to:
- Environmental license;
- Engineering studies;
- Monitoring documents;
- Other documents, e.g. quality and/or environmental attesting certification.]</td></tr>
<tr><td>5</td><td>Conditions to check the start dates of CPAs through documentary evidence.</td><td>The identification of the starting date of the proposed CPA shall be according to the CDM Glossary of Terms and is after the starting date of the PoA, i.e. 22/09/2010, when the PoA-DD was first published for global stakeholder consultation (start of the validation process).</td><td>The CPA starting date is [DD/MM/YYYY] as presented in [start date confirmation through one of the following documents:
- Contract between the CPA developer and a third party related to the implementation or construction of the CPA (EPC, etc.);
- Purchase order(s) of equipment
- /technology or any other significant expenditure;
- Any other relevant document,
- e.g.: order or notice to proceed]</td></tr>
<tr><td>6</td><td>Conditions to ensure compliance with the applicability of the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents.</td><td>The proposed CPA shall follow all the applicability conditions of ACM0001 as discussed in section I.2. Also, the CPA shall be according to the baseline scenario identified in ACM0001 and presented in section I.5.

The identification of the baseline scenario is to be performed at an individual/specific CPA level following section I.5.

The CPA encompasses one of the following scenario:<table><tr><th>#</th><th>Displ. Of a GHG intensive service</th><th>LFG release in the baseline</th><th>LFG release in the baseline</th></tr><tr><td>1.1</td><td>No. LFG flared</td><td>Partial</td><td>Yes</td></tr></table></td><td>The baseline scenario for emissions of methane consists of the [partial or total] release of LFG into the atmosphere, by assuming amount or share of methane that would have been captured and destroyed in the absence of the CPA due to regulatory or contractual requirements and/or to address safety and odour concerns, or for other reasons.
Regarding the project scenario, LFG is [flared and used for electricity generation and/or LFG supply to consumers)]. Also, the amount of organic waste that would be recycled in the absence of the CPA is not reduced.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Eligibility criterion - Category</th><th>Eligibility criterion - Required condition</th><th>Supporting evidence for inclusion</th></tr>
<tr><td></td><td></td><td><table>
<tr><td>1.2</td><td></td><td>Total</td><td>Yes</td></tr>
<tr><td>2.1</td><td rowspan="2">Yes, electricity generation</td><td>Partial</td><td>Yes</td></tr>
<tr><td>2.2</td><td>Total</td><td>Yes</td></tr>
<tr><td>3.1</td><td rowspan="2">Yes, supply to consumers.</td><td>Partial</td><td>Yes</td></tr>
<tr><td>3.2</td><td>Total</td><td>Yes</td></tr>
<tr><td>4.1</td><td rowspan="2">Yes, electricity gen. + supply to consumers.</td><td>Partial</td><td>Yes</td></tr>
<tr><td>4.2</td><td>Total</td><td>Yes</td></tr>
</table></td><td>Therefore, the CPA applies scenario [1.1/1.2/2.1/2.2/3.1/3.2/4.1/4.2].</td></tr>
<tr><td>7</td><td>Conditions to ensure that CPAs meet the requirements for the demonstration of additionality following the requirements contained in the additionality section of the applied methodology.
If investment analysis is used for the demonstration of additionality, the CPA-DD shall include a) input parameters used in the investment analysis together with a description of how the values for these parameters are obtained for each CPA or b) define technical and economic criteria with a range of values for each input parameter.</td><td>The proposed CPA shall be a large scale project type and not involve combination of other methodologies than ACM0001.

The identification of the baseline scenario and additionality shall be performed at an individual/specific CPA level by following one of the applicable procedures established in section I.5.</td><td>The identification of the baseline scenario to the proposed CPA is presented in section I.5 and it passes the additionality test as discussed in the same section.</td></tr>
<tr><td>8</td><td>Conditions to ensure the compliance with other requirements of the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents.</td><td>The proposed CPA shall follow ACM0001 and referred tool presented in section I.1, as well as CDM-PS-PoA, CDM-PCP-PoA and CDM-VVS-PoA.</td><td>This CPA-DD.</td></tr>
<tr><td>9</td><td>The PoA-specific requirements stipulated by the CME including any conditions related to undertaking local stakeholder consultations and environmental impact analysis.</td><td>The local stakeholder consultation and the environmental impact analysis shall be performed at CPA level by following the Host Country requirements. Requirements from the Brazilian DNA shall be considered.
Also, the site hosting the CPA must be a licensed Municipal or Regional sanitary landfill located in the host country Brazil.</td><td>The project implementer has agreed to follow stakeholder consultation requirements as per Brazil’s DNA, and as outlined in Section F of this document.
[The local stakeholder process consultation is presented in section F as can be checked in the following documents, but not limited to:
- Invitation letters sent to stakeholders;
- Comments received during the</td></tr>
</table>

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion
			stakeholder process; - Photos or minutes of meeting with stakeholders (if applicable); - Other related documents. Regarding environmental impact, the following documents can be used to confirm compliance, but not limited to: - Environmental studies and/or licenses; - Other documents, e.g. quality and/or environmental attesting certification.]
10	Conditions to provide an affirmation that funding from Annex I parties, if any, does not result in a diversion of official development assistance.	The CPA implementer shall confirm that the proposed CPA does not result in a diversion of Official Development Assistance from an Annex I country. In the case the implementation of the CPA requires a loan, the CPA proponent must have confirmation from the financial institution providing the loan for the CPA, where future carbon revenues have been presented for the loan evaluation and are a partial guarantee to repay the loan. In case of funding from Annex I Parties, demonstration of non-diversion of official development assistance (ODA) is to be provided.	[Financing contract or signed declaration from the CPA implementer can be used as supporting evidence demonstrating that the CPA does not deviate from an ODA]
11	Target group (e.g. domestic/commercial/industrial, rural/urban, grid-connected/off-grid), and where applicable, distribution mechanisms (e.g. direct installation).	Not applicable. The CPA shall not involve a target group.	Not applicable.
12	If the generic CPA applies sampling for the determination of parameter values for calculating GHG emission reductions or net anthropogenic GHG removals, conditions related to sampling requirements for the PoA in accordance with the “Standard: Sampling and surveys for CDM project activities and programme of activities”	Not applicable. The proposed CPA shall not applying sampling. Parameters will be monitored at CPA level according to section I.7.	Not applicable.

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion
13	If the generic CPA is small-scale or microscale, conditions to ensure that CPAs that will be included meet the small-scale or microscale thresholds and remain within those thresholds throughout the crediting period of the CPAs. However, if the generic CPA consists solely of units that qualify as “microscale CDM units” as defined in the “Methodological tool: Demonstration of additionality of microscale project activities”, these conditions are not required	Not applicable. The PoA considers a large scale methodology (ACM0001).	Not applicable.
14	If the generic CPA is small-scale or microscale, conditions for the debundling check based on the “Methodological tool: Assessment of debundling for small-scale project activities”. However, if the generic CPA consists solely of units that qualify as “microscale CDM units”, these conditions are not required.	Not applicable. The PoA considers a large scale methodology (ACM0001).	Not applicable.

Appendix 1. Contact information of coordinating/managing entity and project participants

Coordinating/managing entity and/or project participants	☒ Coordinating/managing entity ☐ Project participant
Organization name	Caixa Econômica Federal
Country	Brazil
Address	SBS quadra 4 lotes 3/4, Ed Matriz 1, 5º andar, 70092-900, Brasilia-DF, Brazil
Telephone	+55 61 3206-4911
Fax	+55 61 3206-9404
E-mail	susan@caixa.gov.br
Website	http://www.caixa.gov.br/
Contact person	Mr. Fabricio Lebeis

Coordinating/managing entity and/or project participants	☐ Coordinating/managing entity ☒ Project participant
Organization name	International Bank for Reconstruction and Development acting as the Trustee of the Carbon Partnership Facility
Country	Spain
Address	1818 H St., NW, 20433 Washington, DC, the United States of America
Telephone	+1 202 473-8003
Fax	+1 202 522-7432
E-mail	ibrd-carbonfinance@worldbank.org
Website	https://www.worldbank.org/
Contact person	Mr. Daniel Radack

Coordinating/managing entity and/or project participants	☐ Coordinating/managing entity ☒ Project participant
Organization name	Kingdom of Spain – Ministry for the Ecological Transition & Ministry of Economy and Business
Country	Spain
Address	C/Alcala 92, 28009, Madrid, Spain
Telephone	+34 91 436-1546
Fax	+34 91 436-1547
E-mail	and@miteco.es
Website	http://www.mineco.gob.es/
Contact person	Ms. Valvanera Ulargui Aparicio

Coordinating/managing entity and/or project participants	☐ Coordinating/managing entity ☒ Project participant
Organization name	Norwegian Ministry of Climate and Environment
Country	Norway
Address	Kongens gate 20, 0030 Oslo, Norway 0030 Oslo Norway
Telephone	+ 47 4020-4170
Fax	-

E-mail	anne-smeby.evjen@kld.dep.no
Website	https://www.regjeringen.no/en/dep/kld/id668/
Contact person	Ms. Anne Smeby Evjen

Coordinating/managing entity and/or project participants	☐ Coordinating/managing entity ☒ Project participant
Organization name	Swedish Energy Agency
Country	Sweden
Address	Kungsgatan 43, Eskilstuna 63104, Eskilstuna, Sweden
Telephone	+46 0 16 544-2212
Fax	-
E-mail	backoffice@energimyndigheten.se
Website	https://www.energimyndigheten.se/en/
Contact person	Mr. Ola Hansen

Appendix 2. Affirmation regarding public funding

There is no public funding involved in the programme of activities.

Appendix 3. Applicability of methodologies and standardized baselines

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

According to ACM0001, the following baseline alternatives shall be considered while identifying the baseline scenario: (i) destruction of LFG, (ii) electricity generation and (iii) supply of LFG to a gas natural distribution network and/or dedicated pipeline and/or distribution of compressed/liquefied using trucks.

In the case of heat generation, it is not part of CPA-[XX landfill name] as it does not encompass the use of LFG for heating or thermal purposes (i.e. use of collected LFG as gaseous fuel in boiler, air heater, glass melting furnace(s) and/or kiln). Therefore, scenarios H1 through H7 from ACM0001 are not considered in the baseline identification analysis.

a) 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;
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.

b) LFG use

- 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;

- LFG supply

For the supply of LFG to a natural gas distribution network and/or dedicated pipeline and/or distribution of compressed/liquefied using trucks, the baseline is assumed to be the supply with natural gas.

According to §288 and §291 the CDM Project Standard for Programme of Activities (v2.0):

> *"To demonstrate the validity of the original baseline or its update, the coordinating/managing entity is not required to re-assess the baseline scenario. Instead, the coordinating/managing entity shall assess the modalities to calculate GHG emission reductions or net anthropogenic GHG removals that would have resulted from that scenario (…)*
>
> *If data and parameters used for determining the original baseline, that were determined ex ante and not monitored during the PoA period, are no longer valid, the coordinating/managing entity shall update such data and parameters in accordance with the "Methodological tool: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".*

Therefore, steps of the methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (TOOL11) were applied as follows:

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

In Brazil, 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. Therefore, the baseline scenario remains the same since the PoA validation and registration[29].

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[30]. 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. No new policy or regulation was approved in the solid waste sector since then.

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[31], 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[32]. However, these initiatives are applied to household consumers. No new initiatives were created for the energetic use of LFG.

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[29] The PoA was registered on 05/12/2012.

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

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

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

Based on information above, the baseline scenario for the PoA did not change at the time of this renewal of the crediting period. 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.

Regarding the baseline emissions, no significant changes were identified in this renewal of crediting period as the PoA applied ACM0001 (v18.0) and no significant changes were identified from version 18.0 to the currently use version (v19.0). The only update is regarding the CO_2 emission factor of the build margin (EFBM). According to TOOL07, while applying option 1 of the tool (ex-ante data vintage), "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". Therefore, the EFBM changed from 0.2963 tCO_2/MWh in 2014 to 0.1370 tCO_2/MWh in 2018.

Furthermore, TOOL07 establishes that weights for the operating margin (w_{OM}) and build margin (w_{BM}) shall be 0.25 and 0.75, respectively, for the second crediting period instead of the 0.5 for each parameter.

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 PoA, 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. Also, there are no new fuels or raw materials involved in the PoA.

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 PoA consists of the implementation of a forced extraction system to collect LFG, which is used to generate electricity and/or LFG supply to consumers. In the absence of the PoA, the LFG would continue to be emitted to the atmosphere (partially or total) and LFG would not be used for energetic purposes. In case of investment into an existing LFG capture system, the remaining technical lifetime of the equipment shall be assessed at the CPA level.

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

According to TOOL11, 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 project and cannot be updated because the historical situation does not exist anymore as a result of the CDM project activity.

Circumstances related to the CO_2 emission factor of the grid have changed due to the update of the EFBM and change of operating and build margin weights as required by TOOL07. Data was revised in this PoA-DD accordingly. Detailed **description of** methods used to calculate emission reductions is presented in section I.6.

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

Step 2.1. Update the current baseline

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

This update was applied in the context of the sectorial policies and circumstances that are applicable at the time of requesting for renewal of the crediting period, which has not changed and has not impacted the PoA. Detailed description on how baseline emissions were determined for this second crediting period is presented in section I.6.

Step 2.2. Update the data and parameters
All parameters regarding the baseline emissions calculation have been updated for the second crediting period. Further information can be seen in section I.6.

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

This section is intentionally left blank. For details please refer to section I.6 above.

Appendix 5. Further background information on monitoring plan

This section is intentionally left blank. For details please refer to section I.7 above.

Appendix 6. Summary report of comments received from local stakeholders

This section is intentionally left blank. The local stakeholder consultation (LSC) shall be conducted at the CPA level. For details please refer to section F above.

Appendix 7. Summary of post-registration changes

The version firstly registered of the PoA-DD is 6.0 dated 18/01/2012. During the first crediting period of the PoA, two permanent changes were conducted as follows:

1. PoA-DD v7.1, dated 19/11/2013

a) Permanent changes from the registered monitoring plan
   - Inclusion of the possibility to use default value from TOOL06 if required data to calculate flaring efficiency is not available at the time of the verification.
   - Revision to include TDL_y (average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site) as a fixed parameter (not monitored).
   - Inclusion of “other flare operation parameters” as a monitored parameter.

2. PoA-DD v7.6 dated, 24/11/2018

a) Permanent changes in the programme design
   - Revision in the programme design by applying the updated version of ACM0001 (v18.0), which scope includes supply of upgraded LFG to consumer(s) using trucks or through a combination of supply via natural gas distribution network and trucks, as the previous version of ACM0001 which the PoA was registered (v11.0) did not include supply of LFG by trucks.
   - Revision to include the following options/alternatives valid for CPA design scenarios: (i) electricity generated by backup captive off-grid electricity generator(s) fuelled by diesel to meet electricity demand (ii) consumption of fossil fuel (for purpose other than generation of electricity and/or transportation of upgraded LFG).

b) Permanent changes from the registered monitoring plan

- Revision of the applied monitoring and GHG calculation approaches for determining the baseline and project emissions as per approaches and provisions of ACM0001 (version 18.0) and applied methodological tools. By reflecting the changes in the programme design, the permanent change from the registered monitoring plan applicable for the 8 new generic CPA-DDs includes addition of provisions for accounting (a) associated baseline and project emissions due to displacement of natural gas by consumer(s) with upgraded LFG (supplied through natural gas distribution network or by using trucks or through a combination of both of these LFG transportation options) + (b) project emissions due to consumption of electricity sourced by backup captive off-grid electricity generator(s) fueled by diesel + (c) project emissions due to consumption of fossil fuel (for purpose other than generation of electricity and/or transportation of upgraded LFG).

c) Corrections (in information made available in the PoA-DD that do not affect the programme design):
- General text revisions and improvements of PoA design description, including full compliance with currently applicable requirements for completing the latest version of the CDM-PoA-DD form at that time (version 08.1);
- Text revisions to comply with applicable requirements of the baseline and monitoring methodology under version 18.0 of ACM0001, including the eligibility criteria for CPAs inclusion (section K).

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Document information

Version	*Date*	*Description*
09.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for programmes of activities" (CDM-EB93-A07-STAN); • Make editorial improvements.
08.1	28 June 2017	Revision to: • Remove a duplicated instruction; • Make editorial improvement.
08.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for programmes of activities" and with the PDD and CPA-DD forms; • Make editorial improvement.
07.0	25 May 2017	Revision to: • Ensure consistency with the "CDM project standard for programmes of activities" (CDM-EB93-A07-STAN) (version 01.0); • Incorporate the "Programme design document form for small-scale CDM programmes of activities" (CDM-SSC-PoA-DD-FORM); • Make editorial improvement.
06.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
05.0	9 March 2015	Revision to: • Include provisions related to choice of start date of PoA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Add exception for generic CPA where technology is under positive lists; • Make editorial improvement.
04.1	5 August 2014	Editorial revision to correct the document information table.
04.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM programme of activities (these instructions supersede the Guideline: Completing the programme design document form for CDM programme of activities (Version 04.0)); • 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 PoA in B.4 and Appendix 1; • Add general instructions on post-registration changes in paragraphs 2 and 3 of general instructions and Appendix 6; • Change the reference number from F-CDM-PoA-DD to CDM-PoA-DD-FORM; • Make editorial improvement.
03.0	3 December 2012	EB 70 Revision to reflect changes to the *Guideline: Completing the programme design document form for CDM programmes of activities* (EB 70, Annex 6).

Version	*Date*	*Description*
02.0	13 March 2012	EB 66 Revision required to ensure consistency with the "Guidelines for completing the programme design document form for CDM programmes of activities" (EB 66, annex 12).
01.0	27 July 2007	EB 33, Annex 41 Initial publication.

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