Project design document form
(Version 10.1)

BASIC INFORMATION	
Title of the project activity	Landfill Gas Recovery and Flaring Project in the El Verde Landfill, León.
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	5
Completion date of the PDD	04/09/2018
Project participants	Promotora Ambiental S.A.B. de C.V First Climate (Switzerland) AG
Host Party	Mexico (Host)
Applied methodologies and standardized baselines	ACM0001 Version 18.0, “Flaring or use of landfill gas”
Sectoral scopes linked to the applied methodologies	Sectoral Scopes: 13.-Waste handling and disposal; and 1.-Energy industries (renewable-/ non-renewable sources)
Estimated amount of annual average GHG emission reductions	166,305 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The objective of El Verde Landfill Gas Project is to capture the landfill gas (LFG) and to flare and/or utilize it leading to GHG emissions reductions. The principal components of landfill gas (LFG) are methane (CH4) and carbon dioxide (CO2), both of which are greenhouse gases (GHG).

El Verde landfill is owned by Promotora Ambiental S.A.B. de C.V (hereinafter called PASA). PASA is a private waste collection and disposal firm that offers integral solutions in the management of industrial and municipal solid wastes. PASA has more than 20 years of experience and, currently, has activities in 27 landfills in Mexico.

The El Verde landfill was designed for municipal waste treatment with a total area of 60 ha. The landfill is divided in two macro cells, with a total area of approximately 51 ha planned for waste disposal. The remaining 9 ha include roads, buffer zone, and the administrative area. The proposed project activity covers the entire 60 ha, i.e. including future expansion as more waste is received. Currently, waste is disposed at Macrocell 2, with an approximate area of 26 hectares for waste disposal. The Macrocell 1, with 25 hectares for waste disposal, has been practically filled up during the first crediting period. The geographic location of the landfill is characterized by specific climatic conditions , classified as Mexican high altitude (in Spanish, “Mexicano de altura”), with an average annual precipitation of 654 mm and an annual average temperature of 19.6°C.

The landfill began accepting waste in June 2001. By the end of 2017, more than 7.7 million of tonnes of waste have been filled. Upon completion, maximum waste depth is expected to be about 35 meters. Currently, the landfill has been accepting waste at an average rate of about 1,515 tonnes per day, which equates to some 553,000 tonnes per year. In the coming years, projecting the yearly population increase rate of 1.5% , it is expected that the landfill site can accommodate some 20 million of tonnes of waste, with an expected closure date at the end of 2030. Please note that operational lifetime of the project may be extended beyond 2030 in case there is still space available for waste disposal. In such case, PASA would require additional permits, and any disposing activity would not be undertaken until such appropriate authorizations are available.

Prior to the start of the implementation of the project activity, there was no destruction of CH4 neither through LFG combustion nor energy generation. Therefore, the scenario existing prior to the implementation of the project activity was no methane collection or destruction leading to CH4 release into the atmosphere. The situation before the project implementation coincides with the baseline scenario.

The project activity was designed in two phases:

- Phase 1: The first phase includes the construction and operation of a landfill gas (LFG) collection and flare system. The purpose of LFG flaring is to safely dispose of the flammable constituents, particularly methane, and to control odour nuisance, health risks and adverse environmental impacts. This phase has involved the investment in a highly efficient landfill gas collection system and the required enclosed flaring equipment.

- Phase 2: Once the LFG flow is proven to be steady (in terms of volume and quality) for the electricity generation, a second project phase would be carried out and a reciprocating engine facility will be installed. This phase would imply the installation of generating equipment that would combust the methane of the LFG in order to produce electricity.

The El Verde Landfill Gas Project León is entering in its second crediting period and during the first crediting period, was operating under Phase 1. The installed equipment under Phase 1 of El Verde Landfill Gas Project is composed by a LFG Collection System and a LFG Flare System. In order to maximize LFG recovery rates, and thus GHG emission reductions, an active LFG Collection

System was installed covering the area of Macrocell 1. The system consists of a series of vertical extraction wells interconnected by header piping. The LFG is extracted from the landfill by a set of blowers to be initially flared in the LFG Flare System. Once LFG gas recovery is considered to be stationary and proper dimensioning can be conducted, project proponent would install the required LFG power generation equipment. During the first crediting period, LFG has been only flared. It is expected that in second crediting period LFG would be used mainly for power generation, with any excess of LFG being flared.

Besides climate change mitigation, the project would have important local environmental benefits. All the landfill gas is currently released to the atmosphere without any treatment. This implies a potential fire and explosion risk as well as bad odours. Moreover, landfill gas (LFG) contains trace amounts of volatile organic compounds, which are air pollutants. The capture and combustion of the LFG in the electricity generator and flare would greatly reduce all these risks and thereby contribute to sustainable development. The project would provide a significant opportunity for technology transfer, with design, equipment and installations complying with international standards with regard to quality, reliability, operational safety and environmental aspects. Moreover, the company will need some engineers and other specialists with experience in this area to advice the company while implementing the project. These professionals will also train local operators and engineers on operations and maintenance of the facilities. This kind of technology is still not widely applied in Mexico.

The contributions of the project to sustainable development are:

1) Reducing global climate change by destroying the CH_4 captured from the LFG.
2) Bringing the possibility for renewable energy generation capacity, offsetting the use of non-renewable resources (coal, oil, and gas); thereby displacing emissions of CO_2, a basic contributor to global warming.
3) Reducing possible health risks by destroying most of the non- CH_4 organic compounds, mainly volatile organic compounds (“VOCs”) and hazardous air pollutant (“HAPs”), that are present in LFG.
4) Reducing landfill odours by combusting the LFG and improving safety by reducing explosion and fire hazards from LFG accumulation.
5) Creating jobs associated with the design, construction, and operation of the LFG capture - much of the construction and development funding is to be spent locally for drilling, piping, construction, and operational personnel.
6) Bringing economic development near the landfill, by making the area around the project site a better and safer place to live and do business.

It is estimated that the project will reduce an annual average of 166,305 tCO_2e and a total GHG emission reductions of 1,164,132 tCO_2e for the second crediting period.

For clarification purposes, the proposed CDM project activity is not a CPA that has been excluded from a registered CDM PoA as a result of erroneous inclusion of CPAs.

A.2. Location of project activity

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A.2.1. Host Party

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Mexico.

A.2.2. Region/State/Province etc.

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Guanajuato State.

A.2.3. City/Town/Community etc.

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León de los Adamas City.

A.2.4. Physical/Geographical location

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El Verde landfill is located in León de Los Aldamas (also called León), about 15 kilometres northwest of the centre of the city. The address is Carretera León, Lagos de Morenos km 18.5, León City, Guanajuato State, Mexico. Guanajuato State is located in Central Mexico, about 350 kilometres northwest of Mexico City. León is located 45 kilometres northwest of the Del Bajío International Airport. The geographic coordinates of the project activity are N 21°10'14"; W 101°46'30".

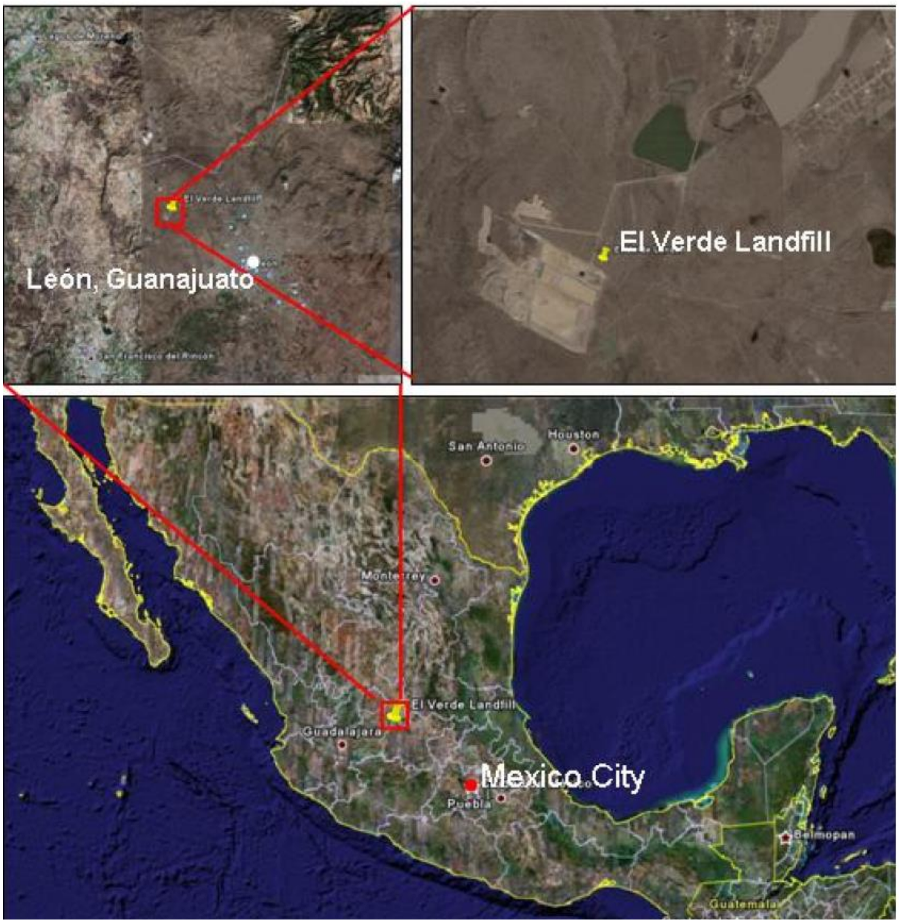

Figure 1 Location of El Verde landfill

A.3. Technologies/measures

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The objective of El Verde Landfill Gas Project is to capture the landfill gas (LFG) and to flare and/or utilize it leading to GHG emissions reductions. Prior to project implementation, there is no combustion of LFG, hence no methane destruction. The situation before the project implementation coincides with the baseline scenario. The project activity was designed in two phases:

- Phase 1: The first phase includes the construction and operation of a landfill gas (LFG) collection and flare system. The purpose of LFG flaring is to safely dispose of the flammable constituents, particularly methane, and to control odour nuisance, health risks

and adverse environmental impacts. This phase has involved the investment in a highly efficient landfill gas collection system and the required enclosed flaring equipment.

- Phase 2: Once the LFG flow is proven to be steady (in terms of volume and quality) for the electricity generation, a second project phase would be carried out and a reciprocating engine facility will be installed. This phase would imply the installation of generating equipment that would combust the methane of the LFG in order to produce electricity. It is expected that three (3) LFG Engines provided by GE Jenbacher (Model JGS 420 GS-L.L with capacity of 1.383 MW each will be installed in 2018 , providing a total capacity of 4.149 MW. An extra LFG Engine of the same characteristics is expected to be installed in 2023, although it will depend on the gas availability. The configuration to be employed by the project activity is still to be defined until the LFG flow is proven to be steady (in terms of volume and quality).

Under Phase 1, the LFG has been only flared during the first crediting period. The installed equipment of the project activity during the first crediting period is composed by a LFG Collection System and a LFG Flare System, under Phase 1. The LFG Collection System is composed by deep and shallow vertical wells installed in intermediate or closed areas of the El Verde Landfill site and interconnected by a piping network for serving the blower station with a specific diameter piping, suitable for the anticipated flow rates. A leachate pumping system and a condensate management system has also been installed. The LFG Flare System is composed by an enclosed ZTOF Biogas Flare which is equipped with all the monitoring equipment as per the methodology requirements including continuous exhaust gas monitoring, ensuring a minimum destruction efficiency of 98%.

The LFG Flare System of El Verde Landfill Gas Project was commissioned on 11/01/2010 and has been operating since then. The construction works for the LFG Collection System were completed on 27/02/2010. The project was fully operational by the date of registration on 27/10/2010. Since its registration date it has been implemented and monitored as per the monitoring plan of the PDD, with continuous operation.

Eventually, it is expected to install LFG Power Generation equipment under Phase 2. From then on, LFG would be used to generate electricity and only send the excess LFG to the flare. Thus all LFG will be combusted in one of these two ways and methane contained in LFG would be destroyed. The exact configuration and specifications of the Electricity generation System are still to be defined by the end supplier once the LFG flow is proven to be steady (in terms of volume and quality).

The technologies, systems and equipment involved in the project activity are listed in the following table:

Table 1. Technologies, systems and equipment involved in the project activity

Equipment	Description and Capacity	Operational date (Age)	Operational Lifetime[1]
LFG Collection System	• Deep and shallow vertical wells in intermediate or closed areas have been installed, trying not to interfere with landfill operation. Depending on future development plans, some horizontal wells might be installed to capture the gas in areas that continue to be filled; • A piping network has been installed to include connection to extraction wells for serving the blower station[2] with a specific diameter piping, suitable for the anticipated flow rates. Connection has been made to those extraction wells that have been constructed to final or intermediate grade, and to which the piping connection have a minimal impact on current filling operations. • A leachate pumping system and a condensate management system has also been installed. The LFG collection system has been designed to include self-draining condensate traps and condensate manholes with pumps where necessary.	27/02/2010 (7 years)	15 years
LFG Combustion System	• An Enclosed ZTOF Biogas Flare[3] which offers automated operation and is designed to destroy safely, with automatic temperature control, typical organic compounds generated by solid waste and other biogas processes. The flare system is controlled with a processor, or programmable logic controller (PLC), which receives and transmits signals with respect to operating conditions. If an unacceptable operating condition occurs, the control system discontinues flow of biogas or adjusts the operating parameters to correct the problem. Control of the Enclosed ZTOF Biogas Flare includes an initial purge cycle, automatic ignition sequence, and fail-safe controls. The Enclosed ZTOF Biogas Flare is equipped with all the monitoring equipment as per the methodology requirements including continuous exhaust gas monitoring.	11/01/2010 (7 years)	15 years
LFG Extraction System	• A skid assembly containing a panel rack with flare control panel, a moisture separator, and a blower station. • The blower station has been installed to create	01/01/2010 (7 years)	15 years

[1] Based on the industry standard "LFGE Project Development Handbook" of the EPA's Landfill Methane Outreach Program (LMOP) in its page 4-4 in Chapter 4 (http://www.epa.gov/lmop/documents/pdfs/pdh_chapter4.pdf).

[2] The PDD of the first crediting period assumed the installation of two blowers with 30 HP each whereas finally two blowers with 75 HP each were installed. The monitored value of on-site consumption of electricity provided by the grid attributable to the project activity ($EC_{PJ,y}$) considering the two blowers of 75 HP each is used for the calculation of the project emissions from electricity consumption by the project activity ($PE_{EC,y}$)

[3] The flare height installed in the project activity is more than 10 times the diameter. This makes it a high height flare. As per the tool "Project emissions from flaring" version 02.0.0, a low height flare is an enclosed flare for which the flame enclosure has a height between 10 and two times de diameter of the enclosure. Given that the project is not using a low height flare, the flare efficiency in the minute m shall not be adjusted by subtracting 0.1 from the default value of 90% for the efficiency of the flare. Therefore, a value of 90% will be used ex-ante for the project activity.

	negative pressure in the pipeline structures in order to send the landfill gas to the flaring system and considering future electricity generator flow demands.		
LFG Pre-treatment System[4]	• The pre-treatment will be composed at least by a chiller (to reduce humidity of LFG) and a cleaning system (to reduce particulates and compounds which can damage the engines).	Not operational yet.	15 years
Electricity generation System[5]	• It is expected that three (3) LFG Engines provided by GE Jenbacher (Model JGS 420 GS-L.L [6] with capacity of 1.383 MW (expected efficiency of 39.80% and load capacity of 627.49 Nm3/h of LFG @50% CH4) each will be installed in 2018[7], providing a total capacity of 4.149 MW. An extra LFG Engine of the same characteristics is expected to be installed in 2023, although it will depend on the gas availability. The configuration to be employed by the project activity is still to be defined until the LFG flow is proven to be steady (in terms of volume and quality). In any case, total nameplate capacity will be equal or below 10 MW.	Not operational yet.	15 years

[4] The exact configuration and specifications of the LFG Pre-treatment System are still to be defined by the end supplier based on the LFG analysis. The information provided regarding the LFG Pre-treatment System at the CDM-PDD level is for description purposes only and might change when the project reaches Phase 2 (power generation).

[5] The exact configuration and specifications of the Electricity generation System are still to be defined by the end supplier once the LFG flow is proven to be steady (in terms of volume and quality). The information provided regarding the Electricity generation System at the CDM-PDD level is for description purposes only and might change when the project reaches Phase 2 (power generation).

[6] The characteristics of the GE Jenbacher (Model JGS 420 GS-L.L) are provided to the DOE

[7] Operation of the project is not compromised by the exact date of installation of the Electricity generation System as the collected LFG is flared. The information provided regarding the dates at the CDM-PDD level is for description purposes only and might change when the project reaches Phase 2 (power generation).

The following diagram represents the technology applied in the project activity including the energy and mass flows and the monitoring variables with their location in the systems:

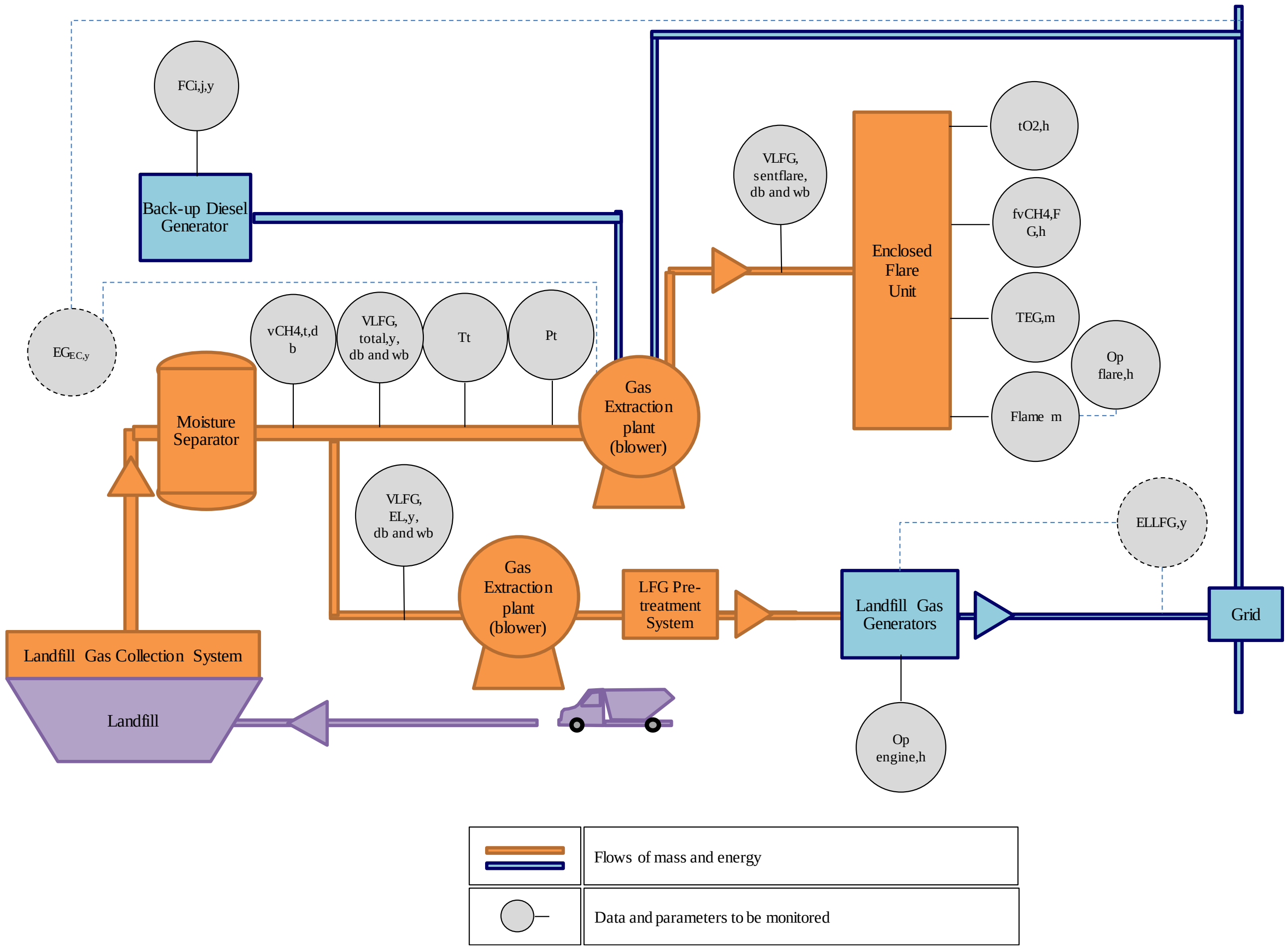

Figure 2. Process Diagram of the project activity including the monitoring equipment location

The main GHG emissions source in the baseline is methane (CH_4), from the decay of organic matter present in the waste, and these emissions will be reduced by the project activity. Project implementation will require some electricity consumption for operating the active landfill extraction system, pumps, etc. Thus the project will produce CO_2 emissions at the fossil-fired power plants supplying the landfill until the LFG capture has been established; in this moment landfill will use the LFG to produce electricity avoiding the electricity consumption from the grid. If it is possible, some electricity will be supplied to a municipality avoiding CO_2 emissions produced by fuel consumption of the grid.

The project would provide a significant opportunity for technology transfer, with design, equipment and installations complying with international standards with regard to quality, reliability, operational safety and environmental aspects. Moreover, the company will need some engineers and other specialists with experience in this area to advice the company while implementing the project. These professionals will also train local operators and engineers on operations and maintenance of the facilities. This kind of technology is still not widely applied in Mexico. Very few landfills have installed equipment for the collection and flare of landfill gas without the CDM incentive.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Mexico (host)	Promotora Ambiental S.A.B. de C.V	Yes
Switzerland	First Climate (Switzerland) AG	Yes

A.5. Public funding of project activity

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The project has not received any public funding from Parties included in Annex I of the UNFCCC.

A.6. History of project activity

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The proposed CDM project activity was registered as a CDM project activity on 2/10/2010. The current CDM-PDD is presented for the renewal of the crediting period.

A.7. Debundling

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Not applicable'

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

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The approved baseline and monitoring methodology used for the project activity is ACM0001, "Flaring or use of landfill gas"(version 18.0)[8]. In accordance with the methodology, the project makes use of the latest versions of the following tools:

- "Emissions from solid waste disposal sites" (version 08.0)[9]
- "Project emissions from flaring" (version 02.0.0)[10]
- "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)[11]
- "Tool to calculate the emission factor for an electricity system" (version 7.0)[12]
- "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)[13]
- "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (version 03.0)[14]
- "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" Version 03.0.1[15]

B.2. Applicability of methodologies and standardized baselines

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[8]https://cdm.unfccc.int/UserManagement/FileStorage/0X2IE6B1PJDLKMWN89AZGTFUHR3VYS

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

[10] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v1.pdf/history_view

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

[12] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v1.1.pdf/history_view

[13] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v1.pdf/history_view

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

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

The methodology ACM0001 "Flaring or use of landfill gas"(version 18.0) is applicable to project activities which:

(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;[16] and/or
    (iii) Supplying the LFG to consumers through a natural gas distribution network.
    (iv) Supplying compressed/liquefied LFG to consumers using trucks;
    (v) Supplying the LFG to consumers through a dedicated pipeline;
(d) Do not reduce the amount of organic waste that would be recycled in the absence of the project activity.

The following paragraphs describe how each of the applicability conditions of the methodology ACM0001 "Flaring or use of landfill gas"(version 18.0) are met by the project activity:

a) As explained in section A.3, the purpose of the project is to install a new LFG capture system in a the existing SWDS where no LFG capture system was installed prior to the implementation of the project activity; so the corresponding to the applicability criteria (a) set above is met by the project activity.
b) There was not an existing LFG capture system at the time of validation so no investment into such existing LFG capture system was made to increase the recovery rates and therefore applicability criteria (b) set above is not met by the project activity.
c) The project activity intend to flare the LFG and/or use the captured LFG as follows:
    (i) Generating electricity; The project activity is expected to generate electricity so the applicability criteria (c) (i) is applicable to the project activity.
    (ii) The project activity will not use the captured LFG to generate heat in a boiler, air heater nor kiln (brick firing only) so the applicability criteria (c) (ii) is not applicable to the project activity.
    (iii) The project activity will not supply the LFG to consumers through a natural gas distribution network so the applicability criteria (c) (iii) is not applicable to the project activity.
d) The waste entering to the landfill is not managed through recycling; it is landfilled as it arrives to the landfill. Therefore, the project will not have any effect on the waste entering to the landfill. In order to analyze the municipal solid waste management in a country basis, the document published by the Mexican Ministry of Environment (SEMARNAT by its original in Spanish) in 2010 named “Collection Centers Waste materials Directory from Mexico”[17] is a directory which includes information on materials collection and recycling centers identified throughout Mexico. As can be observed in the directory, there is no organic waste recycling center in the area at the time of validation where the project activity receives the waste which means that there is no recycling activity of organic waste.

[16] For claiming emission reductions for other heat generation equipment (including other products in kilns), project participants may submit a revision to this methodology.

[17] Ministry of Environment (SEMARNAT), Collection Centers Waste materials Directory from Mexico 2010, http://web2.semarnat.gob.mx/transparencia/transparenciafocalizada/residuos/Documents/directorio_residuos.pdf

Therefore, the implementation of the project activity will not reduce the amount of organic waste that would be recycled in the absence of the project activity because at the moment there is no facility which recycles organic waste. As a conclusion, the project activity will not reduce the amount of organic waste that would be recycled in the absence of the project activity so the project meets the applicability criteria (d).

Moreover, the methodology ACM0001 "Flaring or use of landfill gas" (Version 18.0) 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 procedure to identify the baseline scenario confirms that the most plausible baseline scenario as atmospheric release of the LFG or capture of LFG and destruction through flaring (a). Since the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is (a), the ACM0001 "Flaring or use of landfill gas" (Version 18.0) is applicable to the project activity as can be shown in Section B.4.

The following paragraphs describe how each of the applicability conditions of the tools required by the methodology ACM0001 "Flaring or use of landfill gas" (Version 18.0) are met by the project activity:

- The "Emissions from solid waste disposal sites" (version 08.0) is applicable under Application A, since the CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. “ACM0001: Flaring or use of landfill gas”). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex ante estimation of emissions in the project design document (CDM-PDD). The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS).The tool is not applicable to hazardous wastes, and at the project site there are no hazardous wastes thus the project activity meets the tool’s applicability conditions.

- The “Project emissions from flaring” (version 02.0.0) is used to determine $PE_{flare,y}$ as required by the ACM0001 "Flaring or use of landfill gas" (version 18.0).

- The “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0) is applicable for the purpose of calculating project emissions in case where a project activity consumes electricity from the grid (Scenario A of Section I of the Tool). For the project activity, since electricity will be sourced from the grid, then the tool is applicable.

- The "Tool to calculate the emission factor for an electricity system" (version 07.0) is applicable for calculating project and leakage emissions in case where a project activity consumes electricity from the grid or results in increase of consumption of electricity from the grid outside the project boundary. For the current project activity, since electricity will be sourced from the grid, then the tool is applicable.

- The "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applicable for the purpose to determine to determine the mass flow of greenhouse gases such CO2, CH4, N2O, SF6 or PFC. The mass flow of a particular greenhouse gas is calculated based on measurements of: (a) the total volume flow or mass flow of the gas stream, (b) the volumetric fraction of the gas in the gas stream and (c) the gas composition and water content. 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, which is the case of the present project activity, and then the tool is applicable.

- The “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” (version 03.0) is applicable for calculating the project CO2 emissions from the combustion of fossil fuels in cases where CO2 emissions from fossil fuel combustion are calculated based on the quantity of fuel combusted and its properties. For the current project activity, since the quantity of fuel combusted, and its properties are monitored, then the tool is applicable.

- The “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” Version 03.0.1, shall be used for the assessment of continued validity of the original baseline and its update when the renewal of the crediting period is conducted.

In conclusion, the project activity meets the situations and tools described above. The project activity is therefore compliant to the ACM0001 "Flaring or use of landfill gas" (Version 18.0) and the applicable tools.

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

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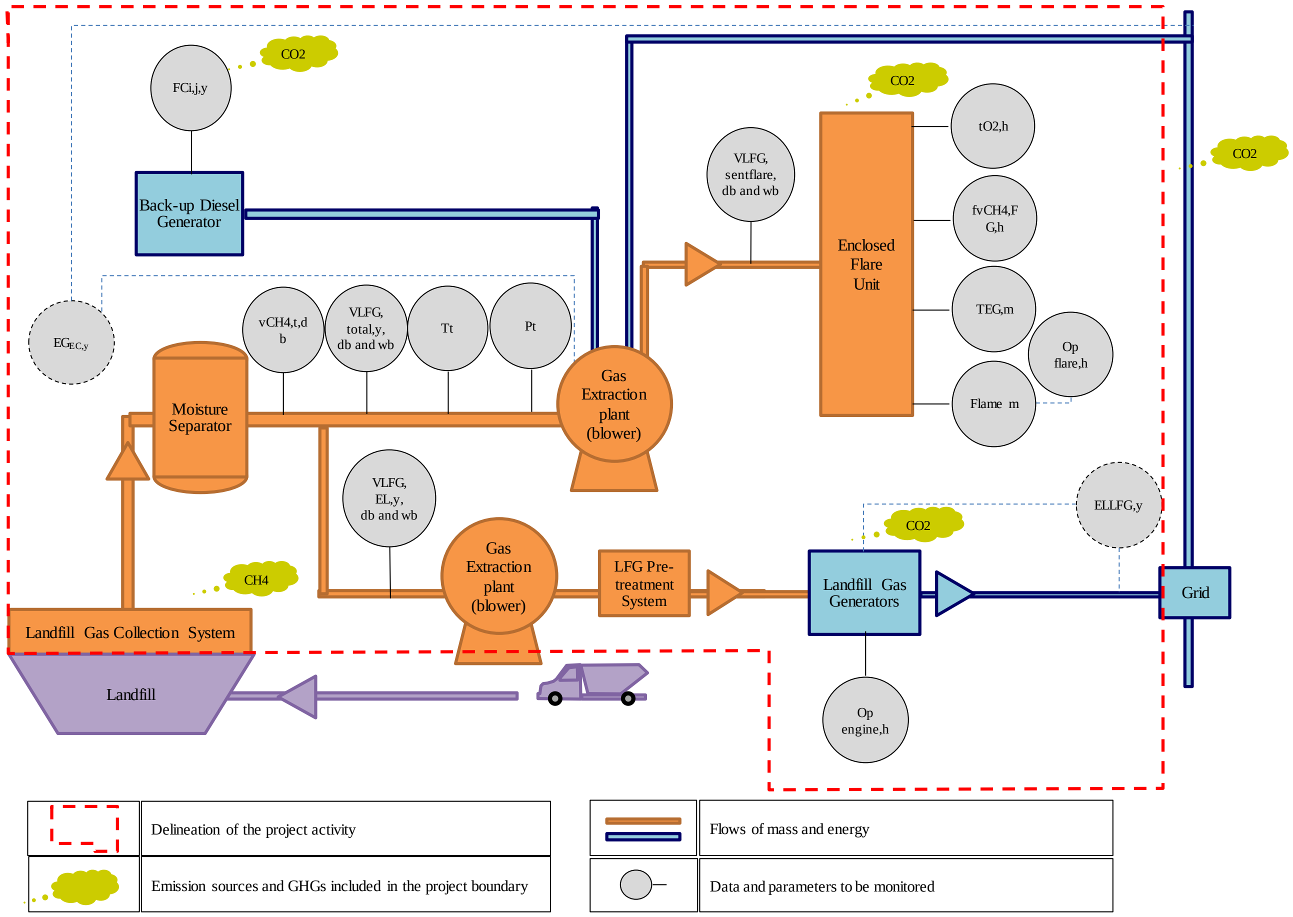
The sources and gases included in the project activity are indicated as follows:

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
		CO_2	No	N_2O emissions are small compared to CH_4 emissions from SWDS. This is conservative
		N_2O	No	CO_2 emissions from decomposition of organic waste are not accounted since the CO_2 is also released under the project activity
	Emissions from electricity generation	CO_2	Yes	Major emission source since 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
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

As per methodology ACM0001 "Flaring or use of landfill gas" (version 18.0), the project boundary of the project activity shall include the site where the LFG is captured and, as applicable:

- Sites where the LFG is flared or used (e.g. flare, power plant, boiler, air heater, glass melting furnace, kiln or natural gas distribution network);
- Captive power plant(s) (including emergency diesel generators) or power generation sources connected to the grid, which are supplying electricity to the project activity;
- 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; and
- 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.

In addition to the table of the sources and gases included in the project activity, a flow diagram of the project boundary, physically delineating the project activity is presented, based on the description provided in section A.3 above. The flow diagram presents the equipment, systems and flows of mass and energy described in that section. In particular, it is indicated in the diagram the emission sources and GHGs included in the project boundary and the data and parameters to be monitored taking into account the project boundary as per methodology ACM0001 "Flaring or use of landfill gas" (version 18.0), as follows:



B.4. Establishment and description of baseline scenario

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In accordance with paragraph 49 (a) of the modalities and procedures for a Clean Development Mechanism, the renewal of the crediting period of a registered CDM project activity shall only be granted if a designated operational entity (DOE) determines and informs the Executive Board that the original project baseline is still valid or has been updated taking account of new data where applicable. The "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" Version 03.0.1, shall be used for the assessment of continued validity of the original baseline and its update.

According to the *"Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" version 3.0.1,* the stepwise procedure was followed to assess the continued validity of the baseline and to update the baseline:

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

The "Procedures for the renewal of the crediting period of a registered CDM project activity"[18] approved by the CDM Executive Board requires assessing the impact of new relevant national and/or sectoral policies and circumstances on the baseline.

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

In assessing the continued validity of the baseline, a change in the relevant national and/or sectoral regulations between two crediting periods has to be examined at the start of the

[18] "Clean development mechanism project cycle procedure" (PCP) version 09.0

new crediting period. If at the start of the project activity, the project activity was not mandated by regulations, but at the start of the second or third crediting period regulations are in place that enforce the practice or norms or technologies that are used by the project activity, the new regulation (formulated after the registration of the project activity) has to be examined to determine if it applies to existing project or not.

At the start of the project activity, legislation in Mexico did not require landfills to collect nor utilize the gas generated hence it was not mandated by regulations. After the registration of the project activity, the Climate Change Law of 2012[19] states in article Number 3, Item II (Mitigation) literal b) that by 2018, the municipalities, in coordination with the Federative Entities and other administrative and financial institutions and with the technical support of the Secretariat of Social Development, will develop and construct the infrastructure for the management of solid waste disposal sites that does not emit methane to the atmosphere in urban centers of more than fifty thousand inhabitants, and when feasible, will implement the technology for the generation of electricity using methane gas. Considering that the Law is valid from 2018 and the start of the second crediting period of the project activity is from 27/10/2017, it is considered that the Law has no impact in the baseline scenario definition. Moreover, the legislation applies for new solid waste disposal sites which are still to be developed and constructed by 2018 hence it does not apply for existing landfills like the one in the project activity.

Therefore, El Verde León Landfill is not required to capture and flare LFG at the start of the second crediting period by any mandatory law. As a conclusion, currently in Mexico there are no laws or regulations mandating capture and flaring of landfill gas.

The fundamental elements of the baseline have not changed since the project was first registered, and the market structure, regulatory framework, and functioning remains the same. The current baseline complies with all relevant mandatory national and/or sectoral policies which have come into effect after the submission of the project activity for validation and are applicable at the time of requesting renewal of the crediting period.

Step 1.2: Assess the impact of circumstances

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

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

This sub-step should only be applied if the baseline scenario identified at the validation of the project activity was the continuation of use of the current equipment(s) without any investment and, the projects proponents or third party (or parties) would undertake an investment later due, for example, to the end of the technical lifetime of the equipment(s) before the end of the crediting period or the availability of a new technology. This step is not the case for the renewal of the crediting period.

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

There are some parameters, which were determined at the start of the first crediting period for an ex-ante estimation of GHG emission reductions which should be updated.

[19] Climate Change Law 2012 http://www.profepa.gob.mx/innovaportal/file/6583/1/ley_general_de_cambio_climatico.pdf .

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 "Flaring or use of landfill gas"(version 18.0). This update was applied in the context of the sectoral policies and circumstances that are applicable at the time of requesting for renewal of the crediting period, which have not changed as to affect the project. More details for the updated baseline emissions for the second crediting period can be seen in section B.6.

Step 2.2: Update the data and parameters

As mentioned in step 1.4 above, all of the parameters keep being valid for the second crediting period. More details can be seen in section B.6 and B.7 (updated monitoring parameters).

As per ACM0001 "Flaring or use of landfill gas" (Version 18.0), project participants may either apply the simplified procedures or the procedures using the “Combined tool to identify the baseline scenario and demonstrate additionality” to select the most plausible baseline scenario and demonstrate additionality. The project participant has chosen the “Simplified procedures to identify the baseline scenario and demonstrate additionality” as per section 5.3.1 of the ACM0001 "Flaring or use of landfill gas" (Version 18.0).

The simplified procedures are valid for three years from the date of entry into force of Version 15.0 of ACM0001 on 4 May 2017; before the end of this period, the CDM Executive Board will reassess the validity of these simplified procedures and extend or update them if needed. Any update of the simplified procedures does not affect the projects that request registration as a CDM project activity or a programme of activities by 4 May 2020 and apply the simplified procedures contained in Version 18.0 of ACM0001. As per paragraphs 22 and 23 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas" (Version 18.0), the establishment and description of the baseline scenario of the project activity is considered as follows:

- 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. The project activity belongs to the managed and controlled landfills in Mexico where passive collection and control of LFG for safety and odour concerns is practiced and LFG is partially or completely vented to the atmosphere. In the absence of the project activity, the current practice will be continued, defining the baseline scenario.
- 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 the “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” Version 03.0. The project activity will export all or part of the electricity generated and therefore, the baseline scenario will be electricity generation in existing and/or new grid-connected power plants.

B.5. Demonstration of additionality

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The table below is only applicable if the proposed project activity is a type of project activity which is deemed automatically additional, as defined by the applied approved methodology or standardized baseline.

Specify the methodology or standardized baseline that establish automatic additionality for the proposed project activity (including the version number and the specific paragraph, if applicable).	Paragraph 21 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas" (Version 18.0)
Describe how the proposed project activity meets the criteria for automatic additionality in the relevant methodology or standardized baselines.	As per paragraph 21 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas" (Version 18.0), the following types of project activities are deemed automatically additional, if prior to the implementation of the project activity the LFG was 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. Prior to the implementation of the project activity, the LFG was only vented and not utilized for energy generation. The project activity consists in flaring the LFG under Phase 1 and will be used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW under Phase 2. Since the project activity matches the type (a) and (c) in paragraph 21 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas" (Version 18.0), the project activity is deemed automatically additional.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$ **(26) equation of the ACM0001 Version 18.0**

Variable		Definition
ER_y	=	Emission reductions in year *y* (tCO2e/yr)
BE_y	=	Baseline emissions in year *y* (tCO2e/yr)
PE_y		Project emissions in year *y* (tCO2/yr)

B.6.1.1. Baseline emissions

Baseline emissions are determined according to equation 1 and comprise the following sources:

(a) Methane emissions from the SWDS in the absence of the project activity;

(b) Electricity generation using fossil fuels or supplied by the grid in the absence of the project activity;

(c) Heat generation using fossil fuels in the absence of the project activity; and

(d) Natural gas used from the natural gas network in the absence of the project activity.

To estimate the baseline scenario the ACM0001 V 18.0 uses:

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}$$ **(1) of the ACM0001 Version 18.0**

Where:

Variable		Definition
BE_y	=	Baseline emissions in year *y* (tCO_2e)
$BE_{CH4,y}$	=	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)

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

Baseline emissions of methane from the SWDS are determined as follows, based on the amount of methane that is captured under the project activity and the amount that would be captured and

destroyed in the baseline (such as due to regulations). In addition, the effect of methane oxidation that is present in the baseline and absent in the project is taken into account:[20]

$$BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y}\right) \times GWP_{CH4}$$ **(2) equation of the ACM0001 V 18.0**

Where:

Variable		Definition
BE_{CH4}	=	Baseline emissions of methane from the SWDS in year *y* (t CO_2e/yr)
OX_{top_layer}	=	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)
$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year *y* (t CH_4/yr)
GWP_{CH4}	=	Global warming potential of CH4 (t CO_2e/t CH_4)

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

During the crediting period, $F_{CH4,PJ,y}$ is determined as per methodology ACM0001 Version 18.0, considering the sum of the quantities of methane flared and used (as applicable) in power plant(s), boiler(s), air heater(s), kiln(s) and natural gas distribution network and/or to the trucks, as follows:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y}$$ **(3) equation of the ACM0001 V 18.0**

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

Since the project activity includes electricity generation but it does not includeheat generation nor use of landfill gas as natural gas, the equation (3) above can be simplified to:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$$ **Simplification of Equation (3) of ACM0001 (version 18.0)**

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

The working hours of the power plant(s) and flare(s) should be monitored, and no emission reduction should be claimed for methane destruction during non-working hours. This is taken into account by monitoring the hours that the equipment utilizing the LFG is operating in year *y* ($Op_{flare,h,y}$ and $Flame_m$). The ex-ante value of $Op_{flare,h,y}$ and $Flame_m$ is considered to be 8000 hours/year[21].

$F_{CH4,flared,y}$ is determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0. This is taken into account by monitoring the hours that the equipment utilizing the LFG is operating in year *y* ($Op_{j,h,y}$).The following requirements apply:

- The gaseous stream the tool shall be applied to the LFG delivery pipeline to each item of electricity generation or heat generation equipment *j*, or the natural gas distribution system. $F_{CH4,EL,y}$ and $F_{CH4,HG,y}$ y are then calculated as the sum of mass flows to each item of electricity generation or heat generation equipment *j*;
- CH_4 is the greenhouse gases for which the mass flow should be determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in the tool);
- The mass flow should be calculated on an hourly basis for each hour *h* in year *y*;
- The mass flow calculated for hour *h* is 0 if the equipment is not working in hour *h* ($Op_{j,h}$=not working), the hourly values are then summed to a yearly unit basis.

$F_{CH4,flared,y}$ is determined ex post as per the following procedures a) and b), respectively:

a) 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 flare(s) and any methane emissions from the flare(s), as follows:

$$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}}$$ **(4) equation of the ACM0001 V 18.0**

Variable		Definition
$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year y (t CH4/yr)
$F_{CH4,sent\_flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year y (t CH4/yr)
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year y (t CO2e/yr)
GWP_{CH4}	=	Global warming potential of CH4 (t CO2e/t CH4)

The amount of methane in the LFG which is destroyed by flaring in year y ($F_{CH4,sent\_flare,y}$) will be determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0, applying the requirements described above where the gaseous stream is the LFG delivered to the flare(s). The Option 2 of the mentioned "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0 under the name "Simplified calculation without measurement of the moisture content" will be applied as a simple and conservative approach to determine the absolute humidity of the gaseous stream of $F_{CH4,sent\_flare,y}$ by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. Since the gaseous stream flow will be measured on

[21] "Guidance for monitoring landfill gas engine emissions", published by the UK Environment Agency, which uses in its page 25 the following sentence in developing a calculation method "assuming the engines operate for 8,000 hours/year"

volume basis and the volumetric fraction of methane will be measured in dry basis, two options will be used in the project activity:

- Option A will be used in case of dry basis of the gas, demonstrating that the temperature of the gaseous stream (Tt) is less than 60ºC (333.15 K) at the flow measurement point (way b of Option A), and

- Option B will be used in case of wet basis of the gas, demonstrating that the temperature of the gaseous stream (Tt) is more than 60ºC (333.15 K) at the flow measurement point and by converting the measured volumetric flow from wet basis to dry basis.

To determine $F_{CH4,sent\_flare,y}$, the volumetric flow of landfill gas which is sent to flare will be measured on volume basis with a flowmeter which also measures the temperature of the gaseous stream (T_t). Depending on the temperature of the gaseous stream (T_t), the flowmeter will be measuring $V_{LFG,sent\_flare,y,db}$ (m^3 dry gas/h) or $V_{LFG,sent\_flare,y,wb}$ (m^3 wet gas/h) and Option A (T_t > 60ºC) or B (T_t < 60ºC) will be used accordantly. Therefore, the parameters $V_{LFG,sent\_flare,y,db}$ (m^3 dry gas/h) or $V_{LFG,sent\_flare,y,wb}$ (m^3 wet gas/h) will be measured at the same sample point.

Under normal operation conditions, the volumetric flow of landfill gas which is sent to flare will be monitored as $V_{LFG,sent\_flare,y,db}$ (m^3 dry gas/h) since the temperature of the landfill gas (Tt) will be less than 60ºC at the flow measurement point most of the time. The values applied ex ante for this volumetric flow are considered to be in dry basis following way b) of Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 3.0 since this is the expected basis of the gas under normal operating conditions. Under abnormal operating conditions, the same volumetric flow will be named as $V_{LFG,sent\_flare,y,wb}$ (m^3 wet gas/h) in case of wet basis of the gas, demonstrating that the temperature of the gaseous stream (Tt) is more than 60ºC at the flow measurement point following Options B of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 3.0, and by converting the measured volumetric flow from wet basis to dry basis for calculation purposes ex post.

The following paragraphs show the formulae which will be used to determine the absolute humidity of the gaseous streams applying the Option 2 "Simplified calculation without measurement of the moisture content" and to determine the flow and volumetric fraction of the gaseous stream applying the Option A and Option B as per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0:

- **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 using equation (4) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0 as follows:.

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

(4) equation of "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0

Where:

Variable		Definition
$m_{H2O,t,db,sat}$	=	Saturation absolute humidity in time interval *t* on a dry basis (kg H_2O/kg dry gas)
$p_{H20,t,Sat}$	=	Amount of methane in the LFG which is sent to the flare in year y (t CH_4/yr)
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 H2O (kg H2O/kmol H2O)
$MM_{t,db}$		Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas)

Parameter $MMt_{,db}$ is estimated using equation (3) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0 as follows:

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

(3) equation of "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0

Where:

Variable		Definition
$MM_{t,db}$	=	Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)
$v_{k,t,db}$	=	Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis (m^3 gas k/m^3 dry gas)
MM_k	=	Molecular mass of gas *k* (kg/kmol)
k	=	All gases, except H_2O, contained in the gaseous stream (e.g. N_2, CO_2, O_2, CO, H_2, CH_4, N_2O, NO, NO_2, SO_2, SF6 and PFCs). See available simplification below

The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (k) in the gaseous stream. However as a simplification, the volumetric fraction of only the gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. The simplification is not acceptable if it is differently specified in the underlying methodology.

Since the methodology ACM0001 version 18.0 states that the simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in the tool), only the volumetric fraction of methane (CH4) contained in the gaseous stream ($v_{CH4,t,db}$) will be measured because it is the greenhouse gas considered in the emission reduction calculation. Therefore, the difference to 100% will be considered as pure nitrogen.

- **Option A**

Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. 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/m3 dry gas; or

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

For the project activity, the way b) from above will be used so it will be demonstrated that the temperature of the gaseous stream (T_t) is less than 60ºC (333.15 K) at the flow measurement point. If it cannot be demonstrated that the gaseous stream is dry, then the flow measurement should be assumed to be on a wet basis and the corresponding option from Table 1 should be applied instead. For the project actibity Option B will be used.

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

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

(5) equation of "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0

With:

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

(6) equation of "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0

Where:

Variable		**Definition**
$F_{i,t}$	=	Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas/h)
$V_{t,db}$	=	Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m^3 dry gas/h)
$v_{i,t,db}$	=	Volumetric fraction of greenhouse gas *i* in the gaseous stream in a time interval *t* on a dry basis (m^3 gas *i*/m^3 dry gas)
$\rho_{i,t}$	=	Density of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas *i*/m^3 gas *i*)
P_t	=	Absolute pressure of the gaseous stream in time interval *t* (Pa)
MM_i	=	Molecular mass of greenhouse gas *i* (kg/kmol)
R_u	=	Universal ideal gases constant (Pa.m3/kmol.K)
T_t	=	Temperature of the gaseous stream in time interval *t* (K)

- **Option B**

The mass flow of greenhouse gas i ($F_{i,t}$) is determined using equations (5) and (6) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0. 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 using equation (7) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0 as follows:

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

(7) equation of "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0

Where:

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

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

The volumetric fraction of H_2O in time interval t on a dry basis ($v_{H2O,t,db}$) is estimated using equation (8) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0 as follows:

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

(8) equation of "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0

Where:

Variable		*Definition*
$v_{H2O,t,db}$	=	Volumetric fraction of H2O in the gaseous stream in time interval *t* on a dry basis (m^3 H2O/m^3 dry gas)
$m_{H2O,t,db}$		Absolute humidity in the gaseous stream in time interval *t* on a dry basis (kg H2O/kg dry gas)
$MM_{t,db}$		Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)
MM_{H2O}		Molecular mass of H2O (kg H2O/kmol H2O)

The absolute humidity of the gaseous stream ($m_{H2O,t,db}$) in the project activity is determined using Option 2 "Simplified calculation without measurement of the moisture content" as specified in the sections above and the molecular mass of the gaseous stream ($MM_{t,db}$) is determined using equation (3) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0.

For ex-ante purposes of $PE_{flare,y}$, the project uses an efficiency of 90% according to the default value of the *"Project emissions from flaring" (Version 02.0.0).*

The determination ex-post of $PE_{flare,y}$ will be conducted using the *"Project emissions from flaring" (Version 02.0.0)*. If LFG is flared through more than one flare, then $PEf_{lare,y}$ is the sum of the emissions for each flare determined separately. To determine the flare efficiency for minute m ex-post ($\eta_{flare,m}$) in the project activity, the project participant uses the case for enclosed flares (not defined as low height flares) choosing the "Option B: Measure the flare efficiency" under normal operational conditions. In case there is a malfunction or a delay in the installation of the measurement equipment to determine the flare efficiency, "Option A: Apply a default value for flare efficiency" for enclosed flares will be used by the project participant.

The following steps will be applied ex-post to calculate the methane destruction efficiency of the flare applying the "Project emissions from flaring" (Version 02.0.0)**:**

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

The "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0 shall be used to determine the following parameter:

Variable	***Description***
$F_{CH4,m}$	Mass flow of methane in the residual gaseous stream in the minute *m* (kg)

The mass flow of methane in the residual gaseous stream in the minute m (kg) ($F_{CH4,m}$) will be determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0, applying the requirements described above where the gaseous stream is the LFG delivered to the flare. The Option 2 of the mentioned "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0 under the name "Simplified calculation without measurement of the moisture content" will be applied as a simple and conservative approach to determine the absolute humidity of the gaseous stream of $F_{CH4,m}$, by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. Since the gaseous stream flow will be measured on volume basis and the volumetric fraction of methane will be measured in dry basis, two options will be used in the project activity:

- Option A will be used in case of dry basis of the gas, demonstrating that the temperature of the gaseous stream (T_t) is less than 60ºC (333.15 K) at the flow measurement point (way b of Option A), and

- Option B will be used in case of wet basis of the gas, demonstrating that the temperature of the gaseous stream (T_t) is more than 60ºC (333.15 K) at the flow measurement point and by converting the measured volumetric flow from wet basis to dry basis.

The following requirements apply:

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

STEP 2: Determination of flare efficiency

The flare efficiency depends on the efficiency of combustion in the flare and the time that the flare is operating. For determining the efficiency of combustion of enclosed flares there is the option to apply a default value or determine the efficiency based on monitored data. For open flares a default value must be applied. The time the flare is operating is determined by monitoring the flame using a flame detector and, for the case of enclosed flares, in addition the monitoring requirements provided by the manufacturer's specifications for operating conditions shall be met.

Open flare

In the case of open flares, the flare efficiency in the minute *m* (η*flare,m*) is 50% when the flame is detected in the minute *m* (Flamem), otherwise η*flare,m* is 0%.

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* (η*flare,m*) and shall document in the CDM-PDD which option is selected:

- Option A: Apply a default value for flare efficiency.

- Option B: Measure the flare efficiency.

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

Option A: Default value

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

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

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

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

Default value flare efficiency will be used to calculate the amount of methane destroyed by flaring ex ante as per Option A of "Project emissions from flaring" version 02.0.0. The flare height installed in the project activity will be more than 10 times the diameter. This makes it a high height flare. As per the tool "Project emissions from flaring" version 02.0.0, a low height flare is an enclosed flare for which the flame enclosure has a height between 10 and two times de diameter of the enclosure. Given that the project is not using a low height flare, the flare efficiency in the minute m shall not be adjusted by subtracting 0.1 from the default value of 90% for the efficiency of the flare. Therefore, a value of 90% will be used for the project activity to calculate the amount of methane destroyed by flaring ex ante.

Option B: Measured flare efficiency

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

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

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

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

In applying Option B, the project participants may choose to determine $\eta_{flare,calc,m}$ using either Option B.1 or Option B.2. Under Option B.1 the measurement is conducted by an accredited entity on a biannual basis and under Option B.2 the flare efficiency is measured in each minute.

Option B.1: Biannual measurement of the flare efficiency

For the determination ex post in the project activity, measured flare efficiency will be used to calculate the amount of methane destroyed by flaring ex post as per Option B.1 of "Project emissions from flaring" version 02.0.0. Under Option B.1, the measurement is conducted by an accredited entity on a biannual basis.

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

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

Tool equation (1)

Variable	***Description***
$\eta_{flare,calc,y}$	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: Measurement of flare efficiency in each minute

The flare efficiency ($\eta_{flare,calc,m}$) is determined based on monitoring the methane content in the exhaust gas, the residual gas, and the air used in the combustion process during the minute *m* in year *y,* as follows:

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

Tool equation (2)

Variable	***Description***
$\eta_{flare,calc,m}$	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.
Determine $F_{CH4,EG,m}$ according to Steps 2.1 - 2.4 below:

Step 2.1: Determine the methane mass flow in the exhaust gas on a dry basis

The mass flow of methane in the exhaust gas is determined based on the volumetric flow of the exhaust gas and the measured concentration of methane in the exhaust gas, as follows:

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

Tool equation (3)

Variable	***Description***
$F_{CH4,EG,m}$	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 (VEG,m)

Determine the average volume flow of the exhaust gas in minute *m* based on a stoichiometric calculation of the combustion process. This depends on the chemical composition of the residual gas, the amount of air supplied to combust it and the composition of the exhaust gas. It is calculated as follows:

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

Tool equation (4)

Variable	***Description***
$V_{EG,m}$	Volumetric flow of the exhaust gas 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 ($M_{RG,m}$)

Project participants may select to monitor the mass flow of the residual gas in minute *m* directly (see monitored parameter $M_{RG,m}$) or, according to the procedure given in this step, calculate $M_{RG,m}$ based on the volumetric flow and the density of the residual gas. The density of the residual gas is determined based on the volumetric fraction of all components in the gas.

$$M_{RG,m} = \rho_{RG,ref,m} \times V_{RG,m}$$

Tool equation (5)

Variable	***Description***
$M_{RG,m}$	Mass flow of the residual gas on a dry basis at reference conditions in 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

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

Tool equation (6)

Variable	***Description***
$\rho_{RG,ref,m}$	Density of the residual gas at reference conditions in minute *m* (kg/m^3)
P_{ref}	Atmospheric pressure at reference conditions (Pa)
Ru	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 MMRG,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 (N2). The same equation applies, irrespective of which option is selected.

$$MM_{RG,m} = \sum_i (v_{i,RG,m} \times MM_i)$$

Tool equation (7)

Variable	*Description*
$MM_{RG,m}$	Molecular mass of the residual gas in minute *m* (kg/kmol)
MMi	Molecular mass of residual gas component i (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*
i	Components of the residual gas. If Option (a) is selected to measure the volumetric fraction, then i = CH4, CO, CO2, O2, H2, H2S, NH3, N2 or if Option (b) is selected then *i* = CH4 and N2

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

$Q_{ECO2,EG,m}$ shall be determined as follows:

$$Q_{EG,m} = Q_{CO_2,EG,m} + Q_{O_2,EG,m} + Q_{N_2,EG,m}$$

Tool equation (8)

Variable	*Description*
$Q_{EG,m}$	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* (m3/kg residual gas)
$Q_{CO2,EG,m}$	Quantity of CO2 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)
$Q_{N2,EG,m}$	Quantity of N2 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)
$Q_{O2,EG,m}$	Quantity of O2 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)

with

$$Q_{O_2,EG,m} = n_{O2,EG,m} \times VM_{ref}$$

Tool equation (9)

Variable	*Description*
$Q_{O2,EG,m}$	Quantity of O2 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)
$n_{O2,EG,m}$	Quantity of O2 (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_{Mref}	Volume of one mole of any ideal gas at reference temperature and pressure (m3/kmol)

$$Q_{N2,EG,m} = VM_{ref} \times \left\{ \frac{MF_{N,RG,m}}{2 \times AM_N} + \left(\frac{1 - v_{O2,air}}{v_{O_2,air}} \right) \times \left[F_{O2,RG,m} + n_{O2,EG,m} \right] \right\}$$

Tool equation (10)

Variable	***Description***
$Q_{N2,EG,m}$	Quantity of N2 (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)
VM_{ref}	Volume of one mole of any ideal gas at reference temperature and pressure (m3/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 O2 in air
$F_{O2,RG,m}$	Stochiometric quantity of moles of O2 required for a complete oxidation of one kg residual gas in minute *m* (kmol/kg residual gas)
$n_{O2,EG,m}$	Quantity of O2 (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)

$$Q_{CO_2,EG,m} = \frac{MF_{C,RG,m}}{AM_C} \times VM_{ref}$$

Tool equation (11)

Variable	***Description***
$Q_{CO2,EG,m}$	Quantity of CO2 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)
$MF_{C,RG,m}$	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 (m3/kmol)

$$n_{O2,EG,m} = \frac{v_{O_2,EG,m}}{\left(1 - \left(v_{O_2,EG,m} / v_{O_2,air}\right)\right)} \cdot \left[\frac{MF_{C,RG,m}}{AM_C} + \frac{MF_{N,RG,m}}{2 \times AM_N} + \left(\frac{1 - v_{O_2,air}}{v_{O_2,air}} \right) \times F_{O2,RG,m} \right]$$

Tool equation (12)

Variable	***Description***
$n_{O2,EG,m}$	Quantity of O2 (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 O2 in the exhaust gas on a dry basis at reference conditions in the minute *m*
$v_{O2,air}$	Volumetric fraction of O2 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 O2 required for a complete oxidation of one kg residual gas in minute *m* (kmol/kg residual gas)

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

Tool equation (13)

Variable	***Description***
$F_{O2,RG,m}$	Stochiometric quantity of moles of O2 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)
$MF_{O,RG,m}$	Mass fraction of oxygen in the residual gas in the minute m
AM_O	Atomic mass of oxygen (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)

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 (N2). The same equation applies, irrespective of which option is selected.

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

Tool equation (14)

Variable	***Description***
$MF_{j,RG,m}$	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)
j	elements C, O, H and N
i	Component of residual gas. If Option (a) is selected to measure the volumetric fraction, then *i* = CH4, CO, CO2, O2, H2, H2S, NH3, N2 or if Option (b) is selected then *i*= CH4 and N2

Measured flare efficiency will be used to calculate the amount of methane destroyed by flaring ex post as per Option B of "Project emissions from flaring" version 02.0.0. Under Option B, the project participant has chosen to determine flare efficiency using Option B.2. Under Option B.2 the measurement is conducted by the measurement of flare efficiency in each minute.

The default value flare efficiency will be used to calculate the amount of methane destroyed by flaring ex ante as per Option A (1) of "Project emissions from flaring" version 02.0.0. For ex ante estimation of $F_{CH4,PJ,y}$, the estimate baseline emission of methane from the SWDS (according to equation 2) in order to estimate the emission reductions of the proposed project activity in the CDM-PDD are conducted following the "Emissions from solid waste disposal sites" (Version 08.0).

The flare height installed in the project activity is more than 10 times the diameter. This makes it a high height flare. As per the tool "Project emissions from flaring" version 02.0.0, a low height flare is an enclosed flare for which the flame enclosure has a height between 10 and two times de diameter of the enclosure. Given that the project is not using a low height flare, the flare efficiency in the minute m shall not be adjusted by subtracting 0.1 from the default value of 90% for the efficiency of the flare. Therefore, a value of 90% will be used ex-ante for the project activity.

STEP 3: Calculation of project emissions from flaring

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

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

Tool equation (15)

Variable	***Description***
$PE_{flare,y}$	Project emissions from flaring of the residual gas in year *y* (tCO2e)
GWP_{CH4}	Global warming potential of methane valid for the commitment period (tCO2e/tCH4)
$F_{CH4,RG,m}$	Mass flow of methane in the residual gas in the minute *m* (kg)
$\eta_{flare,m}$	Flare efficiency in minute m

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

The *ex-ante* estimation of the amount of methane that would have been destroyed/combusted during the year, in tonnes of methane ($F_{CH4,PJ,Y}$) has been carried using the latest version of the approved "Emissions from solid waste disposal sites" (Version 08.0), considering the following additional equation:

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

(5) equation of the ACM0001 V 18.0

Variable		**Definition**
$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (t CO_2e/yr)
η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

$BE_{CH4,SWDS,y}$ is determined using the methodological tool "Emissions from solid waste disposal sites" (Version 08.0). The following guidance should be taken into account when applying the tool:

- f_y in the tool shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for in equation 2 of this methodology;
- In the tool, *x* begins with the year that the SWDS started receiving wastes (e.g. the first year of SWDS operation); and
- Sampling to determine the fractions of different waste types is not necessary because the waste composition can be obtained from previous studies.

The methane generation from the landfill in the absence of the project activity at year *y* ($BE_{CH4,SWDS,y}$), is calculated as per the "Emissions from solid waste disposal sites" (Version 08.0), as follows:

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot \left(1-e^{-k_j}\right) \quad \textbf{(1)}$$

Where:

$BE_{CH4,SWDS,y}$	=	Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
Φ	=	Model correction factor to account for model uncertainties
f	=	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
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)
F	=	Fraction of methane in the SWDS gas (volume fraction)
DOC_f	=	Fraction of degradable organic carbon (DOC) that can decompose
MCF	=	Methane correction factor
$W_{j,x}$	=	Amount of organic type j prevented from disposal in the SWDS in the year x (tonnes)
DOC_j	=	Fraction of degradable organic carbon (by weight) in the waste type j
k_j	=	Decay rate for the waste type j
j	=	Waste type category (index)
x	=	Year since the landfill started receiving wastes [x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)] Note: this definition represents a correction of the Tool as given in ACM0001, V 18.0.
y		Year for which methane emissions are calculated

Since ACM0001, V 18.0 further clarifies that "*Sampling to determine the different waste types is not necessary; the waste composition can be obtained from previous studies*", this option has been used in for the project activity.

ACM0001, V 18.0 also states that the value to be applied for the parameter η_{PJ} can be chosen as follows: "*Technical specifications of the LFG capture system to be installed (if available) or a default value of 50 per cent*." This is taken into consideration through the utilization of a default capture efficiency value (50 per cent) for the calculation of the total of LFG generated.

At the renewal of the crediting period, the following data should be updated according to default values suggested in the most recently published IPCC Guidelines for National Greenhouse Gas Inventories:

- Oxidation factor (*OX*);

- Fraction of methane in the SWDS gas (*F*);
- Fraction of degradable organic carbon (*DOC*) that can decompose (DOC_f);
- Methane correction factor (*MCF*);
- Fraction of degradable organic carbon (by weight) in each waste type *j* (*DOCj*);
- Decay rate for the waste type *j* (k_j).

Respectively, if the most recent IPCC Guidelines suggest different categorization of waste types, solid waste disposal sites or climate conditions, these should be applied respectively.

Determining the amounts of waste types j disposed in the SWDS (Wj,x or Wj,i)

Since only one type of waste is disposed in the landfill site (in this case municipal solid waste) then $W_{j,x} = W_x$ and $W_{j,i} = W_i$ and the waste sampling is not required. For such reason, Application A of the Methodological Tool "Emissions from solid waste disposal sites." (Version 08.0) will be used in the project activity as follows:

Since the administration of the landfill had the specific information on historic information on amounts, composition and origin of the waste in SWDS administration documents, such data is used as a more reliable data

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

This step provides a procedure to determine the amount of methane that would have been captured and destroyed (by flaring) in the baseline due to regulatory or contractual requirements, or to address safety and odour concerns (collectively referred to as requirement in this step). The appropriate case should be identified and the corresponding instructions followed based on the four cases distinguished below:

Table 7: Cases for determining methane captured and destroyed 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

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

In this situation:

$$F_{CH4,BL,y} = 0$$ **(6) equation of the ACM0001 V 18.0**

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

In this situation:

$$F_{CH4,BL,y} = F_{CH4,BL,R,y}$$ **(7) equation of the ACM0001 V 18.0**

$F_{CH4,BL,R,y}$ 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 LFG that is required to be flared, the amount shall be calculated as follows:

$$F_{CH4,BL,R,y} = \rho_{reg,y} \times F_{CH4,PJ,capt,y}$$ **(8) equation of the ACM0001 V 18.0**

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* (t CH_4/yr)
$\rho_{reg,y}$	=	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* (t CH_4/yr)

Project participants may choose to calculate $F_{CH4,PJ,capt,y}$ by either of the two options:

Option 1: Calculate using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", applying the following requirements:

- The gaseous stream the tool shall be applied to is the LFG pipeline immediately downstream of the LFG capture system and before any split in the gaseous flow to different uses or flares;
- CH_4 is the greenhouse gases for which the mass flow should be determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in the tool); and
- The mass flow should be calculated on an hourly basis for each hour *h* in year *y*.

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 Step A.1, however not taking into account the working hours of the equipment.

c) 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:

$$F_{CH4,BL,R,y} = 0$$ **(9) equation of the ACM0001 V 18.0**

d) 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% is assumed:[22]

$$F_{CH4,BL,R,y} = 0.2 \times F_{CH4,PJ,capt,y}$$ **(10) equation of the ACM0001 V 18.0**

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

In this situation:

$$F_{CH4,BL,y} = F_{CH4,BL,sys,y}$$ **(11) equation of the ACM0001 V 18.0**

- 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:

$$F_{CH4,BL,sys,y} = F_{CH4,sent\_flare,y}$$ **(12) equation of the ACM0001 V 18.0**

Where:

$F_{CH4,BL,sys,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year *y* for the case of an existing LFG capture system (t CH_4/yr)

[22] This default value of 20% is based on assuming a situation in which: the efficiency of the LFG capture system in the project is 50%; the efficiency of the LFG capture system in the baseline is 20%; and, the amount captured in the baseline is flared using an open flare with a destruction efficiency of 50% (consistent with the default value provided in the "Tool to determine project emissions from flaring gases containing methane"). Project participants may propose and justify an alternative default value as a request for revision to this methodology.

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

$F_{CH4,sent\_flare,y}$ is determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" and applying the requirements described in Step A.1, 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:

$$F_{CH4,BL,sys,y} = F_{CH4,hist,y}$$ **(13) equation of the ACM0001 V 18.0**

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:

$$F_{CH4,hist,y} = \frac{F_{CH4,BL,x-1}}{F_{CH4,x-1}} \cdot F_{CH4,PJ,y}$$ **(14) equation of the ACM0001 V 18.0**

Where:

$F_{CH4,hist,y}$	=	Historical amount of methane in the LFG which is captured and destroyed (t CH_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 (t CH_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 (t CH_4/yr)
$F_{CH4,PJ,capt,y}$	=	Amount of methane in the LFG which is captured in the project activity in year *y* (t CH_4/yr)

$F_{CH4,x-1}$ shall be estimated using the methodological tool "Emissions from solid waste disposal sites" (Version 08.0). The guidance and requirements described in Step A.1.1 for applying the tool shall be followed. The year *y* in the tool is equivalent to the year prior to the implementation of the project activity.

- 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:

$$F_{CH4,BL,sys,y} = 0.2 \times F_{CH4,PJ,y}$$ **(15) equation of the ACM0001 V 18.0**

The 20% default factor is consistent with the default factor given in equation 10.

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

$F_{CH4,BL,y}$ shall be determined based on information in contract of regulation requirements and data related to the existing LFG capture system, as follows:

$$F_{CH4,BL,y} = \max\left\{F_{CH4,BL,R,y};\ \ F_{CH4,BL,sys,y}\right\}$$ **(16) equation of the ACM0001 V 18.0**

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* (t CH_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 (t CH_4/yr)

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

For the project activity, Case 3 “No requirement to destroy methane exists and a LFG capture system exists” is applicable. The environmental authority in Mexico does not request the landfill to burn a specified amount LFG. Considering this, the ratio of the destruction efficiency of the baseline system to the destruction efficiency of the system used in the project activity was estimated using the guidance of ACM0001 V 18.0. The procedure to determine the amount of methane that would have been captured and destroyed (by flaring) in the baseline due to regulatory or contractual requirements has been followed as per the Case 3. Therefore, in this situation:

$$F_{CH4,hist,y} = \frac{F_{CH4,BL,x-1}}{F_{CH4,x-1}} \cdot F_{CH4,PJ,y}$$

(14) equation of the ACM0001 V 18.0

The value of the parameter $F_{CH4,\ BL,\ x-1}$ has been determined as 0 since there is not an existing LFG capture system. Therefore $F_{CH4,BL,y}$ is considered as 0.

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

Since the project will generate electricity, the baseline emissions associated with electricity generation in year y ($BE_{EC,y}$) are calculated using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" Version 03.0. When applying the tool:

(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 ($EG_{PJ,y}$).

The equation (2) of the tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" Version 03.0 is used as follows:

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

Where:

- $EC_{\ BL,k,y}$ = Quantity of electricity that would be consumed by the baseline electricity consumer *k* in year *y* (MWh/yr)
- $EF_{EF,k,y}$ = Emission factor for electricity generation for source *k* in year *y* (t CO2/MWh)
- $TDL_{k,y}$ = Average technical transmission and distribution losses for providing electricity to source *k* in year *y*

.

Step C: Baseline emissions associated with heat generation ($BE_{HG,y}$)

Since the project will not generate heat, the baseline emissions associated with heat generation in year y ($BE_{HG,y}$) are 0.

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

Since the project will not use LFG in natural gas distribution, the baseline emissions associated with natural gas generation in year y ($BE_{NG,y}$) are 0.

B.6.1.2. Project emissions

To estimate the project emissions, the ACM0001 V 18.0, considers the emissions from consumption of electricity in the project case and the fact that possible CO2 emissions coming from other fuels than the recovered methane (contained in the landfill gas), should be accounted for as project emissions. The general equation for project emissions in the project activity is as follows:

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

Simplification of equation (22) of the ACM0001 V 18.0

Variable		Definition
$PE_{EC,y}$	=	Emissions from consumption of electricity due to the project activity in year *y* (t CO_2/yr). The project emissions from electricity consumption ($PE_{EC,y}$) will be calculated following the latest version of "*Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation*" Version 03.0
$PE_{FC,j,y}$	=	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year *y* (t CO_2/yr). The project emissions from fossil fuel combustion ($PE_{FC,j,y}$) will be calculated following the latest version of "*Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion*" Version 03.0

$PE_{EC,y}$ will be calculated using the "*Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"* Version 03.0, as follows:

The project emissions from consumption of electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, as follows:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad \textbf{(1)}$$

- **$PE_{EC,y}$** Are the project emissions from electricity consumption by the project activity during the year y (tCO_2 / yr)
- **$EC_{PJ,y}$** Is the quantity of electricity consumed by the project activity during the year y (MWh),
- **$EF_{EL,j,y}$** Is the emission factor for the grid in year y (tCO_2/MWh)
- **$TDL_{j,y}$** Are the 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.

When the project does not generate electricity in the first project stage, the assumption made was that the electricity needed for the operation of the project activity will be supplied by the national grid. When the project generates electricity, there is a net export of electricity to the grid (scenario A). For these reasons, the emissions coming from the electricity use are deducted from the overall emissions reductions (this means that only emissions reductions for the net electricity generation are claimed).

For scenario A: Electricity consumption from the grid option A1 was choose for the determination of the emission factors for electricity generation ($EF_{EL,j/k/l,y}$). The combined margin emission factor of the applicable electricity system is estimated using the procedures of the latest approved version of the. "*Tool to calculate the emission factor for an electricity system*"***V.7.0***. ($EF_{EL,j,y} = EF_{grid,CM,y}$).

$PE_{FC,y}$ will be calculated using the "*Tool to calculate project or leakage CO2 emissions from fossil fuel combustion"* Version 03.0., as follows:

CO2 emissions from fossil fuel combustion in process j are calculated based on the quantity of

fuels combusted and the CO2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad (1)$$

Where:

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

The CO_2 emission coefficient $COEF_{i,y}$ will be calculated using option B based on net calorific value and CO_2 emission factor of the fuel(s) type(s) used. Option A can not be applied because the necessary data is not available.
The type(s) of fossil fuel(s) to be used will depend on the choice of the developer (i.e. natural gas, fuel oil, diesel, etc.), and the corresponding emission factors will be taken from the IPCC default values, in case there is no data available.

B.6.1.3. Leakage

No leakage effects are accounted for under this methodology.

B.6.2. Data and parameters fixed ex ante

Data/Parameter	**OX_{top_layer}**
Data unit	Dimensionless
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Consistent with how oxidation is accounted for in the methodological tool “Emissions from solid waste disposal sites” (Version 08.0),
Value(s) applied	0.1
Choice of data or measurement methods and procedures	According to the “Emissions from solid waste disposal sites” (Version 08.0).
Purpose of data	Calculation of baseline emissions
Additional comment	Applicable to Step A.

Data/Parameter	**GWP_{CH4}**
Data unit	tCO_2e/tCH_4
Description	Global warming potential of CH_4
Source of data	IPCC
Value(s) applied	25
Choice of data or measurement methods and procedures	25 tCO_2e/tCH_4 as per Table 2.14 of the Fourth Assessment Report of the IPCC. Shall be updated according to any future COP/MOP decisions.
Purpose of data	Calculation of baseline emissions
Additional comment	As per COP Decision 4/CMP.7, *“for the second commitment period of the Kyoto Protocol, the global warming potentials used by Parties to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of the greenhouse gases listed in Annex A to the Kyoto Protocol shall be those listed in the column entitled “Global Warming Potential for Given Time Horizon” in table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon, taking into account the inherent and complicated uncertainties involved in global warming potential estimates”.* Therefore, GWP of methane has been considered as 25 (100-year time horizon) as per Table 2.14 of the Fourth Assessment Report of the IPCCC which can be found at: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14

Data/Parameter	**D_{CH4}**
Data unit	tCH_4/m^3CH_4
Description	Methane density
Source of data	IPCC
Value(s) applied	0.0007168
Choice of data or measurement methods and procedures	At standard T and P (0 degrees C and 1,013 bar)
Purpose of data	Calculation of baseline emissions
Additional comment	Not applicable..

Data/Parameter	**$BE_{CH4, SWDS,y}$**
Data unit	tCO_2e
Description	Methane generation from the landfill in the absence of the project activity at year y
Source of data	Calculated as per the "*Emissions from solid waste disposal sites*" – *(Version 08.0)*
Value(s) applied	see table below
Choice of data or measurement methods and procedures	As per the *"Emissions from solid waste disposal sites" (Version 08.0),*
Purpose of data	Calculation of baseline emissions
Additional comment	Used for ex-ante estimation of the amount of methane that would have been destroyed/combusted during the year

Period Year	**$BE_{CH4,SWDS,y}$ (t CO_2e)**
2017	288,921
2018	301,401
2019	313,421
2020	325,039
2021	336,309
2022	347,274
2023	357,976
Total	**2,270,341**

Data/Parameter	φ
Data unit	-
Description	Model correction factor to account for model uncertainties
Source of data	As per the "Emissions from solid waste disposal sites" (Version 08.0)
Value(s) applied	0.75
Choice of data or measurement methods and procedures	see table below
Purpose of data	Calculation of baseline emissions
Additional comment	Not applicable

	Humid/wet conditions	Dry conditions
Application A	0.75	0.75
Application B	0.85	0.80

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	According to the "Emissions from solid waste disposal sites" –(Version 08.0)
Purpose of data	Calculation of baseline emissions
Additional comment	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC.

Data/Parameter	**f**
Data unit	-
Description	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data	According to the “Emissions from solid waste disposal sites” (Version 08.0)
Value(s) applied	0
Choice of data or measurement methods and procedures	All the methane generated was directly vented to the atmosphere prior to the project activity. Upon the implementation of the project activity, methane captured will be flared and/or used for electricity.
Purpose of data	Calculation of baseline emissions
Additional comment	Not applicable

Data/Parameter	η_{PJ}
Data unit	-
Description	Efficiency of the LFG capture system that will be installed in the project activity
Source of data	As per ACM0001 / Version 18.0 "Flaring or use of landfill gas"
Value(s) applied	50%
Choice of data or measurement methods and procedures	The efficiency of the planned LFG collection, flaring, and utilization system is estimated applying the default value proposed in ACM0001 / Version 18.0 "Flaring or use of landfill gas"
Purpose of data	Calculation of baseline emissions
Additional comment	The efficiency of the planned LFG collection, flaring, and utilization system is taken into account for the ex ante estimation of emission reductions.

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	As per the “*Emissions from solid waste disposal sites".(Version 08.0)*
Value(s) applied	0.1
Choice of data or measurement methods and procedures	According to the “Emissions from solid waste disposal sites” (Version 08.0).
Purpose of data	Calculation of baseline emissions
Additional comment	Not applicable

Data/Parameter	**MCF**
Data unit	-
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.8
Choice of data or measurement methods and procedures	According to the “Emissions from solid waste disposal sites” (Version 08.0), this value is to be applied to the landfill as it is “for unmanaged solid waste disposal sites - deep and/or with high water table. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters and/or high water table at near ground level. For the project activity, high water table levels have been experienced.
Purpose of data	Calculation of baseline emissions
Additional comment	Not applicable

<table>
<tr><th>Data/Parameter</th><th>DOC_j</th></tr>
<tr><td>Data unit</td><td>-</td></tr>
<tr><td>Description</td><td>Fraction of degradable organic carbon (by weight) in 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, Tables 2.4 and 2.5)</td></tr>
<tr><td>Value(s) applied</td><td><table>
<tr><th>Waste type j</th><th>DOC_j (%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, bevarages 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>In accordance with “Emissions from solid waste disposal sites” (Version 08.0)</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>The values applied are for wet waste.</td></tr>
</table>

Data/Parameter	**DOC_f**
Data unit	-
Description	Fraction of degradable organic carbon (DOC) that can decompose
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or measurement methods and procedures	According to the “Emissions from solid waste disposal sites” (Version 08.0)
Purpose of data	Calculation of baseline emissions
Additional comment	Not applicable

<table>
<tr><th>Data/Parameter</th><th>k_j</th></tr>
<tr><td>Data unit</td><td>-</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 Nationall 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> 1000mm)</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, beverages and tobacco (other than sludge)</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>The El Verde Landfill is located in Guanajuato (Mexico), which has a mean annual temperature (MAT) of 19.6ºC and mean annual precipitation (MAP) of 654 mm. Data on potential evapotranspiration (PET) is 3. Therefore, the site is based in a Boreal and Temperate in dry climatic conditions (MAT<20ºC) and dry precipitations (MAP<1000 mm)</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>The conditions of the LFS have sourced at: http://worldweather.wmo.int/en/city.html?cityId=1287</td></tr>
</table>

Data/Parameter	$EF_{EL,j,y} = EF_{grid, CM, y} = EF_{EL,k,y}$
Data unit	tCO2/MWh
Description	Emission factor
Source of data	Calculated as per the ”Tool to calculate the emission factor for an electricity system” Version 7.0.
Value(s) applied	0.458
Choice of data or measurement methods and procedures	Value obtained as per SEMARNAT guidance (http://www.semarnat.gob.mx/sites/default/files/documentos/cicc/aviso_factor_de_emision_electrico_2015.pdf)
Purpose of data	Calculation of baseline emissions and Calculation of project emissions
Additional comment	The value will be kept fixed for the entire crediting period.

Data/Parameter	$\eta_{flare,m}$
Data unit	%
Description	Flare Efficiency in the minute m
Source of data	As per “Project emissions from flaring” (Version 02.0.0)
Value(s) applied	0.9
Choice of data or measurement methods and procedures	Measured flare efficiency will be used to calculate the amount of methane destroyed by flaring ex post as per Option B.1 of “Project emissions from flaring” version 02.0.0. Under Option B, the project participant has chosen to determine flare efficiency using Option B.2. Under Option B.2, the measurement will be conducted by the measurement of flare efficiency in each minute
Purpose of data	Calculation of Baseline emissions
Additional comment	The default value flare efficiency will be used to calculate the amount of methane destroyed by flaring ex ante as per Option A (1) of “Project emissions from flaring” version 02.0.0. For ex ante estimation of $F_{CH4,PJ,y}$, the estimate baseline emission of methane from the SWDS (according to equation 2) in order to estimate the emission reductions of the proposed project activity in the CDM-PDD are conducted following the "Emissions from solid waste disposal sites" (Version 08.0). The flare height installed in the project activity is more than 10 times the diameter. This makes it a high height flare. As per the tool “Project emissions from flaring” version 02.0.0, a low height flare is an enclosed flare for which the flame enclosure has a height between 10 and two times de diameter of the enclosure. Given that the project is not using a low height flare, the flare efficiency in the minute m shall not be adjusted by subtracting 0.1 from the default value of 90% for the efficiency of the flare. Therefore, a value of 90% will be used ex-ante for the project activity.

Data/Parameter	-
Data unit	Dimensionless
Description	Fraction of LFG that is required to be flared due to a requirement in year y
Source of data	This parameter is a default value ex ante as per ACM0001 / Version 18.0, Step A2, Case 2 c), eq. 9
Value(s) applied	0
Choice of data or measurement methods and procedures	For the project activity, the Case 2 “Requirement to destroy methane exists and no existing LFG capture system” under situation c) “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” is applicable because the legislation applicable at the submission for validation of the project activity 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 and without existing LFG capture system. ACM0001 / Version 18.0, Step A2, Case 2 c), eq. 9 is applied.
Purpose of data	Calculation of Baseline emissions
Additional comment	Used to calculate $F_{CH4,BL,y}$, which is part of the calculation of $BE_{CH4,y}$

Data/Parameter	TDL_y
Data unit	%
Description	Average technical transmission and distribution losses in the grid in year y.
Source of data	Default value of average technical transmission and distribution losses will be used.
Value(s) applied	20.0%
Choice of data or measurement methods and procedures	Not applicable
Purpose of data	Calculation of baseline emissions and Calculation of project emissions
Additional comment	Determined ex ante.

B.6.3. Ex ante calculation of emission reductions

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B.6.3.1. Ex ante calculation of Baseline emissions

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

Baseline emissions of methane from the SWDS are determined based on the amount of methane that is captured under the project activity and the amount that would be captured and destroyed in the baseline (such as due to regulations). In addition, the effect of methane oxidation that is present in the baseline and absent in the project is taken into account. As a result, the following table below contains the $BE_{CH4,y}$values obtained from the application of the equation (2) for the ACM0001 Version 18.0:

Table 2. Annual calculation for $BE_{CH4,y}$

Period			BE_{CH4} (tonnes of CO2)
Period Year	**Start Date**	**End Date**	
1	27/10/2017	26/10/2018	134,259
2	27/10/2018	26/10/2019	139,690
3	27/10/2019	26/10/2020	145,337
4	27/10/2020	26/10/2021	150,021
5	27/10/2021	26/10/2022	154,967
6	27/10/2022	26/10/2023	159,790
7	27/10/2023	26/10/2024	164,962
Total			**1,049,026**
Annual average			**149,861**

The above results have been calculated from the following values:

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

An *ex ante* estimate of $F_{CH4,PJ,y}$ is required to estimate baseline emission of methane from the SWDS (according to equation 2) in order to estimate the emission reductions of the proposed project activity in the CDM-PDD. $BE_{CH4,SWDS,y}$ is determined using the methodological tool “Emissions from solid waste disposal sites” (Version 08.0). The methane emissions avoided during the year from preventing waste disposal at the solid waste disposal in the site have been calculated as follows applying the inputs values specified in Appendix 4. The next table contains the $F_{CH4,PJ,y}$ values obtained from the application of the equation (5) of the ACM0001 Version 18.0:

Table 3. Annual calculation for $F_{CH4,PJ,y}$

Period			$F_{CH4,PJ,y}$ (tonnes of CH_4)
Period Year	Start Date	End Date	
1	27/10/2017	26/10/2018	5,967
2	27/10/2018	26/10/2019	6,208
3	27/10/2019	26/10/2020	6,459
4	27/10/2020	26/10/2021	6,668
5	27/10/2021	26/10/2022	6,887
6	27/10/2022	26/10/2023	7,102
7	27/10/2023	26/10/2024	7,332
Total			**46,623**
Annual average			**6,660**

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

The baseline emissions associated with electricity generation in year *y* ($BE_{EC,y}$) have been calculated using the "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" Version 03.0 considering the electricity capacity to be installed. The following table summarizes the results:

Table 4 Annual calculation for $BE_{EC,y}$

Period			$BE_{EC,y}$ (tonnes of CO2)
Period Year	Start Date	End Date	
1	27/10/2017	26/10/2018	0
2	27/10/2018	26/10/2019	18,242
3	27/10/2019	26/10/2020	18,242
4	27/10/2020	26/10/2021	18,242
5	27/10/2021	26/10/2022	18,242
6	27/10/2022	26/10/2023	18,242
7	27/10/2023	26/10/2024	24,323
Total			**115,533**
Annual average			**16,505**

The above results are based on the results below:

Table 5. Annual calculation for $EC_{BL,k,y}$

Period			$EC_{BL,k,y}$ (MWh)
Period Year	Start Date	End Date	
1	27/10/2017	26/10/2018	0
2	27/10/2018	26/10/2019	33,192
3	27/10/2019	26/10/2020	33,192
4	27/10/2020	26/10/2021	33,192
5	27/10/2021	26/10/2022	33,192
6	27/10/2022	26/10/2023	33,192
7	27/10/2023	26/10/2024	44,256
Total			**210,216**
Annual average			**30,031**

Step C: Baseline emissions associated with heat generation ($BE_{HG,y}$)

Since the project will not generate heat, the baseline emissions associated with heat generation in year y ($BE_{HG,y}$) are 0.

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

Since the project will not use LFG in natural gas distribution, the baseline emissions associated with natural gas generation in year y ($BE_{NG,y}$) are 0.

Finally, the following tables below contains the BE_y values obtained from the application of the equation (1) for the ACM0001 Version 18.0:

Table 6. Annual calculation for $BE_{,y}$

Period			$BE_{,y}$ (tCO2e)
Period Year	**Start Date**	**End Date**	
1	27/10/2017	26/10/2018	134,259
2	27/10/2018	26/10/2019	157,932
3	27/10/2019	26/10/2020	163,579
4	27/10/2020	26/10/2021	168,264
5	27/10/2021	26/10/2022	173,209
6	27/10/2022	26/10/2023	178,033
7	27/10/2023	26/10/2024	189,286
Total			**1,164,562**
Annual average			**166,366**

B.6.3.2. Ex ante calculation of Project emissions

Project emissions are calculated as follows:

The project emissions from consumption of electricity by the project activity ($PE_{EC,y}$) shall be calculated using the “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” Version 03.0. When applying the tool, the following results have been found:

Table 7. Annual calculation for $PE_{EC,y}$

Period			$PE_{EC,y}$ (tCO2)
Period Year	**Start Date**	**End Date**	
1	27/10/2017	26/10/2018	61
2	27/10/2018	26/10/2019	61
3	27/10/2019	26/10/2020	61
4	27/10/2020	26/10/2021	61
5	27/10/2021	26/10/2022	61
6	27/10/2022	26/10/2023	61
7	27/10/2023	26/10/2024	61
Total			**427**
Annual average			**61**

The project emissions from fossil fuel combustion for purposes other than electricity generation ($PE_{FC,y}$) shall be calculated using the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” Version 03.0. No project emissions from fossil fuel have been considered ex-ante so the following results have been found when applying the tool:

Table 8. Annual calculation for $PE_{FC,y}$

Period			$PE_{FC,y}$ (tCO2)
Period Year	Start Date	End Date	
1	27/10/2017	26/10/2018	0
2	27/10/2018	26/10/2019	0
3	27/10/2019	26/10/2020	0
4	27/10/2020	26/10/2021	0
5	27/10/2021	26/10/2022	0
6	27/10/2022	26/10/2023	0
7	27/10/2023	26/10/2024	0
Total			**0**
Annual average			**0**

The project emissions in the project activity are calculated as per equation (21) of the ACM0001 Version 18.0, with the following results:

Table 9. Annual calculation for PE,y

Period			$PE_{,y}$ (tCO2)
Period Year	Start Date	End Date	
1	27/10/2017	26/10/2018	61
2	27/10/2018	26/10/2019	61
3	27/10/2019	26/10/2020	61
4	27/10/2020	26/10/2021	61
5	27/10/2021	26/10/2022	61
6	27/10/2022	26/10/2023	61
7	27/10/2023	26/10/2024	61
Total			**427**
Annual average			**61**

B.6.3.3. Ex ante calculation of Leakage

No leakage effects are accounted for under this methodology.

B.6.3.4. Ex ante calculation of Emission reductions

The emissions reductions expected from the project activity are calculated as per equation (26) of the ACM0001 Version 18.0, with the results shown in the following point B.6.4.

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

Year	Baseline emissions ($t CO_2e$)	Project emissions ($t CO_2e$)	Leakage ($t CO_2e$)	Emission reductions ($t CO_2e$)
1	134,259	61	0	134,198
2	157,932	61	0	157,871
3	163,579	61	0	163,518
4	168,264	61	0	168,202
5	173,209	61	0	173,148
6	178,033	61	0	177,971
7	189,286	61	0	189,224
Total	**1,164,562**	**427**	**0**	**1,164,132**
Total number of crediting years	7 years			
Annual average over the crediting period	**166,366**	**61**	**0**	**166,305**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

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	-
Measurement methods and procedures	Project participants should refer to the original design of the landfill to ensure that any practice to increase methane generation have been occurring prior to the implementation of the project activity. Any change in the management of the SWDS after the implementation of the project activity should be justified by referring to technical or regulatory specifications.
Monitoring frequency	Annually
QA/QC procedures	This section has been left in blank on purpose.
Purpose of data	Not required for calculations.
Additional comment	This section has been left in blank on purpose.

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	Information of the host country's regulatory requirements relating to LFG, contractual requirements, or requirements to address safety and odour concerns. For ex ante calculations, a default value of 0 has been chosen as per ACM0001 / Version 18.0, Step A2, Case 2 c), eq. 9.
Value(s) applied	0
Measurement methods and procedures	For the project activity, the Case 2 "Requirement to destroy methane exists and no existing LFG capture system" under situation c) "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" is applicable because the legislation applicable at the submission for validation of the project activity 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 and without existing LFG capture system. ACM0001 / Version 18.0, Step A2, Case 2 c), eq. 9 is applied.
Monitoring frequency	Annually
QA/QC procedures	This section has been left in blank on purpose.
Purpose of data	Calculation of Baseline emissions.
Additional comment	Applicable to Case 2 of section 5.4.1.3. Used to calculate $F_{CH4,BL,y}$, which is part of the calculation of $BE_{CH4,y}$

Data/Parameter	**$V_{LFG,total,y,db}$[23]**
Data unit	m³ dry gas/h
Description	Volumetric flow of total landfill gas which is sent to flare and used for electricity generation in year y on a dry basis
Source of data	Measured by a flow meter
Value(s) applied	see table below
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 required. The measurement method will be based in the thermal principle of the thermal mass flowmeter. The readings will be gathered automatically by an automatic data collection system. The accuracy of the measurement equipment will be 1% full scale. The responsible person/entity for the measurement will be the project participant. The calibration will be carried out yearly or at the frequency required by the manufacturer following the recommended procedures.
Monitoring frequency	Continuous.

Value(s) applied:

Year Period	**$V_{LFG,total,y,db} = LFG_{total,y}$**
1	16,649,155
2	17,322,628
3	18,022,892
4	18,603,823
5	19,217,089
6	19,815,259
7	20,456,658

[23] The values applied ex ante for this parameter have been considered to be in dry basis so values in wet basis have not been used in the calculation.

QA/QC procedures	Periodic calibration against a primary device will be conducted. Calibration and frequency of calibration is according to manufacturer's specifications.
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter will be monitored in Options A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0. No separate monitoring of temperature and pressure is necessary since flowmeters that automatically express LFG volumes in normalized cubic meters will be used.

Data/Parameter	**$V_{LFG,sent\_flare,y,db}$**[24]
Data unit	m^3 dry gas/h
Description	Volumetric flow of landfill gas which is sent to flare in year y on a dry basis
Source of data	Measured by a flow meter
Value(s) applied	see table below

Year Period	$V_{LFG,sent\_flare,y,db} = LFG_{flare,y}$
1	16,649,155
2	2,262,980
3	2,963,243
4	3,544,175
5	4,157,441
6	4,755,611
7	377,128

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 required. The measurement method will be based in the thermal principle of the thermal mass flowmeter. The readings will be gathered automatically by an automatic data collection system. The accuracy of the measurement equipment will be 1% full scale. The responsible person/entity for the measurement will be the project participant. The calibration will be carried out yearly or at the frequency required by the manufacturer following the recommended procedures.
Monitoring frequency	Continuous
QA/QC procedures	Periodic calibration against a primary device will be conducted. Calibration and frequency of calibration is according to manufacturer's specifications.
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter will be monitored in Options A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 3.0. No separate monitoring of temperature and pressure is necessary since flowmeters that automatically express LFG volumes in normalized cubic meters will be used.

Data/Parameter	**$V_{LFG,EL,y,db}$**[25]

[24] The values applied ex ante for this parameter have been considered to be in dry basis so values in wet basis have not been used in the calculation.

[25] The values applied ex ante for this parameter have been considered to be in dry basis so values in wet basis have not been used in the calculation.

Data unit	m³ dry gas/h
Description	Volumetric flow of landfill gas which is used for electricity generation in year y on a dry basis
Source of data	Measured by a flow meter
Value(s) applied	**Year Period** / $V_{LFG,EL,y,db} = LFG_{electricity,y}$: **1**: 0 **2**: 15,059,648 **3**: 15,059,648 **4**: 15,059,648 **5**: 15,059,648 **6**: 15,059,648 **7**: 20,079,531
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 required. The measurement method will be based in the thermal principle of the thermal mass flowmeter. The readings will be gathered automatically by an automatic data collection system. The accuracy of the measurement equipment will be 1% full scale. The responsible person/entity for the measurement will be the project participant. The calibration will be carried out yearly or at the frequency required by the manufacturer following the recommended procedures.
Monitoring frequency	Continuous
QA/QC procedures	Periodic calibration against a primary device will be conducted. Calibration and frequency of calibration is according to manufacturer's specifications.
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter will be monitored in Options A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0. No separate monitoring of temperature and pressure is necessary since flowmeters that automatically express LFG volumes in normalized cubic meters will be used.

Data/Parameter	$t_{O2,h}$
Data unit	%
Description	Volumetric fraction of O2 in the exhaust gas of the flare in the hour *h*.
Source of data	Continuous gas analyser
Value(s) applied	No value was estimated, 90% of flare efficiency is considered for ex-ante estimations in this CDM-PDD.
Measurement methods and procedures	Oxygen concentration in the exhaust gas will be measured at least once per hour using a continuous gas analyser, and data records will be kept during the crediting period and two years after. Data will be aggregated daily/monthly/yearly.
Monitoring frequency	Measured at least once per hour using a continuous gas analyser. The accuracy of the meter will be ± 0.2 to 1% Full Scale. Its calibration frequency would be 12 months. Extractive sampling analysers with water and particulates removal devices are to be used. The point of measurement (sampling point) is in the upper section of the flare (80% of total flare height). Sampling is conducted with appropriate sampling probes adequate to high temperatures level (e.g. inconel probes).

QA/QC procedures	Analyser will be periodically calibrated according to the manufacturer's recommendation. A zero check and typical value check by comparison with a standard certified gas has been conducted.
Purpose of data	Calculation of project emissions
Additional comment	This parameter will be monitored considering that an enclosed flare will be used and the option of continuous monitoring of the flare efficiency is to be used under normal operating conditions. In case of malfunction or delayed installation of the continuous gas analyser, 90% of flare efficiency will be used.

Data/Parameter	**$fv_{CH4,FG,h}$**
Data unit	Mg/m^3
Description	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour h
Source of data	Continuous gas analyser
Value(s) applied	No value was estimated, 90% of flare efficiency is considered for ex-ante estimations in this CDM-PDD.
Measurement methods and procedures	Methane concentration in the exhaust gas will be measured at least once per hour using a continuous gas analyser, and data records will be kept during the crediting period and two years after. Data will be aggregated daily/monthly/yearly.
Monitoring frequency	Measured at least once per hour using a continuous gas analyser. The accuracy of the meter will be ± 0.2 to 1% Full Scale. Its calibration frequency would be 12 months. Extractive sampling analysers with water and particulates removal devices are to be used. The point of measurement (sampling point) is in the upper section of the flare (80% of total flare height). Sampling is conducted with appropriate sampling probes adequate to high temperatures level (e.g. inconel probes).
QA/QC procedures	Analyser will be periodically calibrated according to the manufacturer's recommendation. A zero check and typical value check by comparison with a standard certified gas has been conducted.
Purpose of data	Calculation of project emissions
Additional comment	This parameter will be monitored considering that an enclosed flare will be used and the option of continuous monitoring of the flare efficiency is to be used under normal operating conditions. In case of malfunction or delayed installation of the continuous gas analyser, 90% of flare efficiency will be used.

Data/Parameter	**$Maintenance_y$**
Data unit	Calendar dates
Description	Maintenance events completed in year y
Source of data	Project participants
Value(s) applied	Not used in the calculations ex-ante.
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
Additional comment	Monitoring of this parameter is required for the case of enclosed flares and the project participant selects Option B to determine flare efficiency. These dates are required so that they can be compared to the maintenance schedule to check that maintenance events were completed within the minimum time between maintenance events specified by the manufacturer (SPEC,flare)

Data/Parameter	**T_t**
Data unit	K
Description	Temperature of the gaseous stream in time interval t
Source of data	Measured by a flow meter
Value(s) applied	For ex-ante determination, gaseous stream flow temperature being below 60ºC is adopted.
Measurement methods and procedures	Continuous measurement. Data will be recorded electronically, and will be kept during the crediting period and two years after. The measurement method will be based in the thermal principle of the thermal mass flowmeter, which can also measure the temperature of the gaseous stream. The readings will be gathered automatically by an automatic data collection system. The accuracy of the measurement equipment will be 1% full scale. The responsible person/entity for the measurement will be the project participant. The calibration will be carried out yearly or at the frequency required by the manufacturer following the recommended procedures.
Monitoring frequency	Data will also be aggregated monthly/yearly
QA/QC procedures	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy
Purpose of data	Calculation of baseline emissions
Additional comment	As per the last version of the "Tool to determine the mass flow of a GHG in a gaseous stream" (Version 02.0.0), Option 2 (Simplified calculation without measurement of the moisture content) will be used to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. The applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted and therefore, 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	Measured by a pressure meter
Value(s) applied	For ex-ante determination, gaseous stream flow temperature being below 60ºC is adopted and the value of P_t has been considered as the $P_{H2O,Sat}$

Measurement methods and procedures	Continuous measurement. Data will be recorded electronically, and will be kept during the crediting period and two years after. The readings will be gathered automatically by an automatic data collection system. Depending on the equipment used, the pressure of the gaseous stream might need to be calculated as the sum of the atmospheric pressure and the gauge pressure. The accuracy of the measurement equipment will be 1% full scale. The responsible person/entity for the measurement will be the project participant. The calibration will be carried out yearly or at the frequency required by the manufacturer following the recommended procedures.
Monitoring frequency	Data will also be aggregated monthly/yearly
QA/QC procedures	Pressure meters should be subject to a regular maintenance and testing regime to ensure accuracy
Purpose of data	Calculation of baseline emissions
Additional comment	As per the last version of the "Tool to determine the mass flow of a GHG in a gaseous stream" (Version 02.0.0), Option 2 (Simplified calculation without measurement of the moisture content) will be used to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. The applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted and therefore, this parameter must be monitored continuously to calculate saturation absolute humidity ($m_{H2O,t,db,sat}$)

Data/Parameter	$v_{CH4,t,db}$
Data unit	m³ CH4/m³ dry gas
Description	Volumetric fraction of CH4 in a time interval t on a dry basis
Source of data	Measured continuously by the project participant using certified equipment
Value(s) applied	50%
Measurement methods and procedures	Continuous gas analyser operating in dry-basis. Volumetric flow measurement should always refer to the actual pressure and temperature. The measurement method will be based in the NDIR (Non Dispersed Infrared) method of the continuous gas analyzer. The readings will be gathered automatically by an automatic data collection system. The accuracy of the measurement equipment will be 2% full scale. The responsible person/entity for the measurement will be the project participant. The calibration will be carried out yearly or at the frequency required by the manufacturer following the recommended procedures.
Monitoring frequency	Continuous
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N2) 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

Additional comment	This parameter will be monitored in Options A and B of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 3.0. Its calibration frequency would be as per manufacturer instructions. The meter has been installed in this first phase of the project activity in the main line between the flare and the booster.

Data/Parameter	**$EC_{BL,k,y}$**
Data unit	MWh
Description	Net quantity of electricity generated using LFG
Source of data	Calculated from the balance of electricity produced (EG_y) substracting the electricity imported (EI_y), both measured by electricity meter
Value(s) applied	<table><tr><th>Year Period</th><th>$EC_{BL,k,y}$</th></tr><tr><td>1</td><td>0</td></tr><tr><td>2</td><td>33,192</td></tr><tr><td>3</td><td>33,192</td></tr><tr><td>4</td><td>33,192</td></tr><tr><td>5</td><td>33,192</td></tr><tr><td>6</td><td>33,192</td></tr><tr><td>7</td><td>44,256</td></tr></table>
Measurement methods and procedures	Electricity meter will be used to measure **$EC_{BL,k,y}$**. The measurement method will be based in the principle that the electricity reading is the power accumulated over a period divided by the duration of such period. The readings will be gathered automatically by an electricity meter and the project participant will be receiving the corresponding bills, which will be used as the monitoring data source. The accuracy of the measurement equipment will be 1% of maximum reading. The responsible person/entity for the measurement will be the project participant. The calibration will be carried out yearly or at the frequency required by the electricity company. The net quantity of electricity generated using LFG (**$EC_{BL,k,y}$**) will be calculated by the difference between the gross quantity of electricity generated using LFG ($EL_{LFG,y}$), which will be monitored and the mount of electricity consumed by the project activity (**$EG_{EC,y}$**).
Monitoring frequency	It will be calculated from continuous measurement using electricity meters.
QA/QC procedures	Data will be measured continuously, recorded electronically, and data will be kept during the crediting period and two years after. Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy.
Purpose of data	Calculation of project emissions
Additional comment	Required to estimate the emission reductions from electricity generation from LFG.

Data/Parameter	**$EG_{EC,y}$**
Data unit	MWh
Description	Amount of electricity consumed by the project activity in year y
Source of data	Measured by electricity meter

Value(s) applied	**Year Period** / $EG_{EC,y}$[26]: **1** – 111; **2** – 111; **3** – 111; **4** – 111; **5** – 111; **6** – 111; **7** – 111
Measurement methods and procedures	Electricity meter will be used to measure $EG_{EC,y}$. The measurement method will be based in the principle that the electricity reading is the power accumulated over a period divided by the duration of such period. The readings will be gathered automatically by an electricity meter and the project participant will be receiving the corresponding bills, which will be used as the monitoring data source.. The accuracy of the measurement equipment will be 1% of maximum reading. The responsible person/entity for the measurement will be the project participant. The calibration will be carried out yearly or at the frequency required by the electricity company.
Monitoring frequency	It will be calculated from continuous measurement using electricity meters.
QA/QC procedures	Data will be measured continuously, recorded electronically, and data will be kept during the crediting period and two years after. Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy.
Purpose of data	Calculation of project emissions
Additional comment	Required to estimate the project emission from electricity utilization. Ex-ante values based on measured data 4th Monitoring Period, from 01/01/2014 to 31/07/2016. See "ER_Summary_4thMP_Leon_v2_Final"

Data/Parameter	$\mathbf{Op_{engine,h}}$
Data unit	-
Description	Operation of the engine that consumes the LFG
Source of data	The project participant uses an exante operational time of 8,000 h/year as a conservative assumption considering that the equipment will require maintenance works. The maintenance works would lead to downtimes equating to approximately 760 h/year.
Value(s) applied	For ex ante determination, $Op_{engine,h}$ has been considered to be 1 for 8,000 h/year.
Measurement methods and procedures	For the engine using the LFG, the plant is operating in hour h by monitoring the product generated by the engine (i.e Net quantity of electricity generated using LFG). The method to determine the operation of the engine that consumes the LFG would be: • $Op_{engine,h}$=0 when no net quantity of electricity is generated using LFG in the hour h. • $Op_{engine,h}$=1 when net quantity of electricity is generated using LFG in the hour h.

[26] Ex-ante values based on measured data 4th Monitoring Period, from 01/01/2014 to 31/07/2016. See "ER_Summary_4thMP_Leon_v2_Final"

Monitoring frequency	Hourly
QA/QC procedures	Not applicable
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for at least two years after the end of the crediting period.

Data/Parameter	**$Op_{flare,h}$**
Data unit	-
Description	Operation of the flare that consumes the LFG
Source of data	The project participant uses an exante operational time of 8,000 h/year as a conservative assumption considering that the equipment will require maintenance works. The maintenance works would lead to downtimes equating to approximately 760 h/year.
Value(s) applied	For ex ante determination, $Op_{flare,h}$ has been considered to be 1 for 8,000 h/year.
Measurement methods and procedures	For the enclosed flare using the LFG, the plant is operating in hour h by monitoring, at least, the flame detection system. The flame detection system is used to ensure that the equipment is in operation since the control system of the equipment ensures that the enclosed flare will stop if no flame is detected. The method to determine the operation of the enclosed flare using the LFG would be: • $Op_{flare,h}$ =0 when flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); • $Op_{flare,h}$=1 when flame is detected continuously in hour h (instantaneous measurements are made at least every minute).
Monitoring frequency	Hourly
QA/QC procedures	Not applicable
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for at least two years after the end of the crediting period.

Data/Parameter	**$Flame_m$**
Data unit	Flame on or Flame off
Description	Flame detection of flare in the minute m
Source of data	The project participant uses an ex ante operational time of 8,000 h/year as a conservative assumption considering that the equipment will require maintenance works. The maintenance works would lead to downtimes equating to approximately 760 h/year.
Value(s) applied	For ex ante determination, $Flame_m$ has been considered to be on for 8,000 h/year.
Measurement methods and procedures	Measured using a Ultra Violet detector or Infra-Red or both. The flame detection system is used to ensure that the equipment is in operation since the control system of the equipment ensures that the enclosed flare will stop if no flame is detected. The method to determine wether the flame is on or off would be: • Flame off: when flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); • Flame on: when flame is detected continuously in hour h (instantaneous measurements are made at least every minute).
Monitoring frequency	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off.

QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for at least two years after the end of the crediting period.

Data/Parameter	**$PE_{EC,y}$**
Data unit	tCO2
Description	Project emissions from electricity consumption by the project activity during the year *y*
Source of data	Calculated as per the "Tool to calculate baseline, project and or leakage emissions from electricity consumption".
Value(s) applied	<table><tr><th>Year Period</th><th>$PE_{EC,y}$</th></tr><tr><td>**1**</td><td>61</td></tr><tr><td>**2**</td><td>61</td></tr><tr><td>**3**</td><td>61</td></tr><tr><td>**4**</td><td>61</td></tr><tr><td>**5**</td><td>61</td></tr><tr><td>**6**</td><td>61</td></tr><tr><td>**7**</td><td>61</td></tr></table>
Measurement methods and procedures	The calculation procedures and methods will be defined according to the case presented during the crediting period for the project activity, according to one of the following possible scenarios: a) Electricity consumption from the grid; or b) Electricity consumption from (an) off-grid captive power plant(s); or c) Electricity consumption from the grid and (a) captive power plant(s).
Monitoring frequency	It will be measured at continuously.
QA/QC procedures	As per the latest version of the "Tool to calculate baseline, project and or leakage emissions from electricity consumption".
Purpose of data	Calculation of project emissions
Additional comment	For ex-ante purposes, it was followed case a) in order to estimate project emissions from electricity consumption from the grid.

Data/Parameter	**$FC_{i,j,y}$**
Data unit	Mass or volume unit per year (e.g. ton/yr or m3/yr)
Description	Quantity of fuel type i combusted in process j during the year y
Source of data	Onsite measurements
Value(s) applied	<table><tr><th>Year Period</th><th>$FC_{i,j,y}$</th></tr><tr><td>**1**</td><td>0</td></tr><tr><td>**2**</td><td>0</td></tr><tr><td>**3**</td><td>0</td></tr><tr><td>**4**</td><td>0</td></tr><tr><td>**5**</td><td>0</td></tr><tr><td>**6**</td><td>0</td></tr><tr><td>**7**</td><td>0</td></tr></table>

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	It will be measured at 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
Additional comment	For ex-ante purposes, since the fuel will be used mainly for the diesel backup generator, the value applied for the parameter is 0 because the consumption of fossil fuel is not considered as the normal operational conditions of the project activity.

Data/Parameter	$T_{EG,m}$
Data unit	°C
Description	Temperature in the exhaust gas of the enclosed flare in minute m
Source of data	On-site measurements
Value(s) applied	No value was estimated.
Measurement methods and procedures	Measure the temperature of the exhaust gas in the flare by appropriate temperature measurement equipment (i.e thermocouple). 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 although there might be several monitoring ports to measure the different temperatures along the flare stack.. The measurement method will be based in the thermoelectric principle of the thermocouple. The readings will be gathered automatically by an automatic data collection system. The accuracy of the measurement equipment will be 1.1ºC. The responsible person/entity for the measurement will be the project participant. The calibration or replacement will be carried out yearly or at the frequency required by the manufacturer following the recommended procedures.
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	Not used in the calculations
Additional comment	Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. These events should be noted in the site records along with any corrective action that was implemented to correct the issue. Monitoring of this parameter is applicable in case of enclosed flares. Measurements are required to determine if manufacturer's flare specifications for operating temperature are met.

B.7.2. Sampling plan

>>

Since data and parameters monitored in section B.7.1 above are not to be determined by a sampling approach, no description of the sampling plan in accordance with the "Standard for sampling and surveys for CDM project activities and programme of activities" is required.

B.7.3. Other elements of monitoring plan

>>

The following point describes the operational and management structure that the project operator will implement in order to monitor emission reductions achieved by the project activity.

a) Data generation: The data generation for the El Verde Landfill Gas Project is using both Automatic Continuous and Manual Periodic (Daily) Data Gathering System.

b) Data aggregation: The data is aggregated monthly in a Monthly Report which is presented to the Board of Promotora Ambiental S.A.B. de C.V (PASA) as per internal procedures.

c) Data recording: The data which is gathered automatically is recorded in monthly spreadsheets while the data gathered manually is recorded both in paper forms and in spreadsheets. Promotora Ambiental S.A.B. de C.V (PASA) has an in-house back-up system to record the data during the crediting period.

d) ER calculation and reporting: The gathered data is used to calculate the Emission Reductions (ER) as per the applicable methodologies and the registered PDD and these are reported in the CDM-MR. Previous to this process, a QA/QC procedure is used with the aim of disregard any raw data in the same time interval which do not accomplish the operational conditions.

Once the data is collected, it is aggregated in a monthly basis to report the expected CER generation to PASA´s Board. Once data is archived in back-up system of the facility, all data is sent to the CDM Consultant to conduct the ER calculations and the preparation of the Monitoring Report (CDM-MR).

e) **Organizational structure, roles and responsibilities:** The Field Technician is the responsible to conduct the day-to-day operation of equipment and collects data under the Manual Periodic Data Gathering System. The Monitoring and Biogas Manager supervises all CDM activities such as data collection, aggregation and recording and reports to the Landfill Sites, Biogas and Energy Manager who supervises the project activity. Finally, the CDM Consultant is responsible for the CERs calculations and elaborates the Monitoring Report.

f) The responsibilities and authorities for monitoring and reporting: The following list simplifies the responsibilities allocated of each role during the monitoring period:

- Field Technician
  - ✓ Checks day-to-day operation of equipment.
  - ✓ Conduct the required maintenance as per predefined schedule.

- ✓ Executes the calibration of equipment with procedures and frequency established. Collects data under the Manual Periodic Data Gathering System in paper registries and transfers to electronic registries.

- Automatic Continuous Data Gathering System provider
  - ✓ Aggregates the raw data gathered by the Automatic Continuous Data Gathering System.
  - ✓ Transmits raw data gathered in a monthly basis through Excel file to PASA.
  - ✓ Provides support to back-up the automatic raw data.

- Monitoring and Biogas Manager
  - ✓ Supervises the general operations.
  - ✓ Supervises all CDM activities such as data collection, aggregation and recording.
  - ✓ Supervision of Automatic Continuous Data Gathering System.
  - ✓ Ensures that data is collected as per the registered PDD.
  - ✓ Manages the calibration of equipment with procedures and frequency established.
  - ✓ Ensures proper Back-Up of the Raw Data and CDM Documentation.
  - ✓ Sends Raw Data to CDM Consultant.

- Landfill Sites, Biogas and Energy Manager
  - ✓ Supervises the project activity.
  - ✓ Takes major decisions when required (equipment repair/replacement, improvements, etc).

- CDM Consultant (ClimaLoop)
  - ✓ Performs the CERs calculations;
  - ✓ Performs internal audits of the project;
  - ✓ Elaborates the Monitoring Report;
  - ✓ Supports the project during the verification site visits.

g) **Emergency procedures for the monitoring system:** The emergency procedures for the monitoring system in the El Verde Landfill Gas Project consist in daily checks of the project activity equipment and meters. If any problem occurs, the responsible personnel take the required action to solve the problem. If a malfunction on meters or equipment occurs, no CERs are claimed for the corresponding period.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>
27/10/2010

C.2. Expected operational lifetime of project activity

>>
21y-0m

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
Renewable. Second crediting period.

C.3.2. Start date of crediting period

>>

C.3.3. Duration of crediting period

>>
7 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
Landfill gas collection, treatment and flaring/utilization of LFG are measures to improve the environmental management of waste in landfills and no significant negative impacts are expected. The detailed design and engineering of the proposed project will be conducted by PASA to provide the following environmental benefits:

- The project implementation would provide a number of local environmental benefits in addition to climate change mitigation:

- Destruction of non-methane hydrocarbons (NMHC) that contribute to photochemical smog in the local area. Moreover, volatile organic compounds are burnt in high-temperature flare, specially designed for this purpose;

- Destruction of air pollutants, such as hydrogen sulphide, that are sometimes present in landfill gas in trace quantities;

- Reduced fire and explosion risk through improved management of landfill gas.

- Reduced odour as landfill gas is captured and flared;

- Avoidance of methane leaking through the landfill cover. LFG displaces oxygen in the soil, thereby harming the roots of plants. Plants on the landfill surface protect the cover soil from erosion.

Erosion can lead to rainwater intrusion into the landfill and a consequent increase in leachate quantities. Erosion of the surface soil makes it more difficult for plants to grow. Plants promote transpiration of water, thereby minimizing both leachate and rainwater runoff.

Note that LFG combustion would produce small amounts of nitrogen oxides (NOx), particulate matter and carbon monoxide (CO), as would be the case in the kitchen stove or any other device burning natural gas.

The emissions of such gases are not regulated in Mexico. Nevertheless, the project would use an enclosed flare specially designed to reduce these emissions to levels below that of an open flame. Note, however, that since the main fuel is methane, the emissions of particulate matter would be minimal. On the other hand a LFG flare is specially designed to operate at high temperature in order to burn the volatile organic compounds.

The landfill already has the permit necessary to operate the landfill as well as the proposed project activity, as follows:

- Authorization MIA-026-3357/2000 of December 10th, 2000. Guanajuato State Environment, Authority - Institute of Ecology (Instituto de Ecología del Gobierno del Estado de Guanajuato). This Authorization also states that the Environmental Impact Assessment presented during the landfill conception and construction complies with the laws in force for LFG capture and use.

- Concession contract SPM/CRS/01/2000 between PASA the Public Service of Cleaning, Use and Final Disposal of Municipal Waste of León, Guanajuato (Servicio Público y de Limpia, Aprovechamiento y Disposición Final de los Residuos Municipales de León, Guanajuato).

The proposed project would not require a modification of the current Enviromental Impact Assessment (issued on December 20, 2000 by the Guanajuato Ecology Institute, MIA-026-3357/2000), as is stated in the document no. PAYDS-DS-902-2007 emited by the Sustainable Development Ministry of Leon Government.

At present, the project operator (PASA) expects to initially flare the LFG. The project proponent recognizes that the current permits do not include power generation. ***If at some point PASA decides to generate electricity, it will solicit all necessary permits prior to electricity generation.***

D.2. Environmental impact assessment

>>
No significant negative impacts are expected, as discussed in section D.1.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>
On 03/10/2007, letters were sent by José Eleazar López Araiza Alday, General Director or Environmetal Protection of Guanajuato with return receipt in order to invite persons to attend the 1st stakeholders presentation meeting. A total of 58 people were invited to attend the meeting from different sectors.

On 23/01/2009, letters were sent by Eleazar López Araiza Alday, General Director or Environmetal Protection of Guanajuato with return receipt in order to invite persons to attend the 2nd stakeholders presentation meeting. A total of 39 people were invited to attend the meeting from different sectors.

The sectors invited are listed below:

- (14) Non-governmental organizations and/or consultancies and academic sector
- (25) Local and Federal government
- (3) Private sector
- (15) Additional persons, representing the surrounding communities

The 1st public event was held on 16/10/2007 at the Guanajuato Room in Hotel La Nueva Estancia in León, Guanajuato State, Mexico. This event was also open to the public in general, permitting an opportunity for all persons and institutions that feel affected by the project to provide their input to the proposed project activity.

The 2nd public event was held on 30/01/2009 at the events room of the greenhouse of the Park “Los Cárcamos” León, Guanajuato State, Mexico. This event was also open to the public in general, permitting an opportunity for all persons and institutions to provide their input.

The following table lists all the people that attended the 1st meeting and /or submitted any comment (not including PASA’s personnel):

Table 10. People that attended the 1st stakeholder meeting of El Verde Landfill Project

Name	Charge	Company/Institution
Laura Maldonado Chavez	Chief of Environmental Managemen	SEMARNAT
Blanca E. Moreno Valles	Director	Control and Management of Solid Waste
Dora Alicia Garcia Cruz	President of Settler Committee	Paseo De Los Laureles Committee
Angelica Ramirez Estrada	General Secretary	Paseo De Los Laureles Committee
Hector Reyes O		UMVALEON
Ivonne Marquez	General Attendant	Invited
Yinyer Bastidas	Housewife	Invited
Carlos Aaron Avila Plascencia	Fixed Sources Department	Institute of Ecology
Belen Ramirez Hernandez		Environmental Education
Jose Refugio Rocha Elias	Area Chief	Paydes, Environmental Education
Sergio Moreno T		León Town Hall
Gabriela Torral Vivero	General Director	La Palabra Magazine
Luz Adriana Rocha	Promoter	Environmental Education
Monica Aspeitia Gonzalez		Environmental Education
Cinthya G		A.M.
Cecilia Pimentel		Education and Environmental Management

Raul Tapia		Hermanos Tapia Ecologist Group
Alejandro Perez	Press Coordinator	Secretary of Sustainable
Luz Cristina Moreno	Coordinator of Control and Administration	Environment Protection and Solid Waste
Alicia Zuñiga	Technical Coordinator	PA Y DS
Maria Eugenia Gonzalez		PA Y DS
Ivan Jose M		S.E.C Y D
Iris Bañuelos		Televisa-Carpeta Information
Juan Carlos Samarrina Perez	Coordinator of Environmenta Fulfillment	Control and Management of Solid Waste
Teresa Gonzalez Rodriguez	Environmental Director	Improvement and Environmental Assessment
J. Refugio	Information Chief	El Heraldo
Lorena Perez		Televisa
Noe Garcia		A.M.
Fernando Avila Gonzalez	Advisor	H. Town Hall
Luis Efren Ramos		Tv4
Estefania Flores		Tv4
Maria Elena Duran Padilla	General Coordinator	Public Security of Civil Protection
Andres Contreras S	Director of the Industrial Engineering Faculty	Leon University
Karla Gonzalez De La		PA Y DS
Martha Alicia Perez	Coordinator	UNIVA
J. Jesus Gaytan F	Director of Civil Engineering	Leon University
Juan Antonio R		Monterrey Technician
Santiago Vargas	Director of Environmental Regulatior and	PA Y DS
Valeria Vivero	Support of Technical Direction	SEDESU
Jose De Jesus Vazquez G	Representative of Lagunillas	
Jose Alejandro Martinez P		PA Y DS
Ricardo Froylan Garcia B	Enlace De La Juventud	Angel A. C. Group
Fabiola Moreno Villegas		Environmental Education
Ivonne Garcia Lira	Coordinator of Sustainable Education Institutions	Environmental Education, Environmental Secretariat
Jesus Montoya		A.M.
Ricardo Ramirez H	Promoter	Environmental Education
Angelica Ramos		
Federico Pimentel	General Coordinator of Environemtal Management	PA, León Guanajuato Municipality
Hector Nava M	Projects Coordinator	S.O.P
Simon Pablo Gonzalez	Technical Secretary	General Director of Environmental Protection
R. Barrera		Televisa
Elba Valdivia	Chief of Environmental Assessment	Improvement and Environmental Impact, Environmental Protection
Salvador Lara Garcia	Coordinator of Emissions to Atmosphere	Improvement and Environmental Impact
Luis Miguel Lopez		Newspaper A.M.
Carlos Magdaleno	Director	NAFINSA
Fernando Araiza M	Public Coordinator	Angel A.C., Clase Ciudadana AC
Paulina Ramirez	Reporter	Multimedios TV
Alberto Gonzalez	Camera Man of Newscast	Multimedios
Gabriel Villagrana Garcia	Advisor	H. Town Hall
Jose Eleazar Lopez	General Director	Sedesu
Sergio Navarro	Advisor	H. Town Hall

Juan Jose Medina	Director of Municipal Education Development	Secretary of Education, Culture and Sports
Monserrat Castañeda	Reporter	AM newspaper

The following table lists all the people that attended the 1st meeting and /or submitted any comment (not including PASA's personnel):

Table 11. People that attended the 2nd stakeholder meeting of El Verde Landfill Project

Name	Company/Institution
Belen Ramirez Hernandez	Environmental Protection
Edgar Villanueva	Univa
Gustavo Arguello	Environmental Protection
Simon Pablo Gonzalez	Environmental Protection
Fabiola Moreno Villegas	Environmental Protection
Cecilia Pimentel	Environmental Protection
Teresa Gonzalez Rodriguez	Environmental Protection
Angeles Abracon	Gen Industrial
Raul Osuna	Gen Industrial
Martha Fuentes	Gen Ambiental
Marcos Llamas	Social Comunication, Municpality President
Jose Refugio Rocha Elias	Environmental Protection
Dagaberto Paez	Lic. Sergio Navarro Representation
Juan Gerardo Morales	Gen Landfill
Lilia Veronica Ramirez	Environmental Protection
Juan Macias Contreras	Environmental Protection
Carla Gonzales De La Mora	Environmental Protection
Veronica Cornejo	Gen Industrial
Alicia Zuñiga	Rda Environmental Protection
Jorge Lopez	Environmental Protection
Ivonne Garcia Lira	Environmental Protection
Elba Valdivia	Environmental Protection
Panfilo Santos Martinez	Coordinatior Of Education, Culture And Recreation Of Municipality
Alfonso Martinez	Pasa
Lourdes Fernandez	Mgm International
Jose De Jesus Vazquez	Member Of Lagunillas Municipality
Maria De La Luz Martinez Martinez	Financial Of The Municipality
Jose Alejandro Martinez	Environmental Education Municipality
Laura Maldonado Chavez	Environmental Protection
Angelica Ramirez Estrada	General Secretariat, Municipality
Monica Aspeitia Gonzalez	Consultant
Federico Pimentel	Environmental Protection
Blanca E. Moreno Valles	Waste Sustainable Management, Municipality
Maria Eugenia Hernandez	Environmental Protection
Jose Santiago Vargas	Environmental Protection
Juliana Banda	Environmental Protection
Raul Tapia Flores	Advisor
J. Carlos Samarriego	Environmental Protection
Miguel Gastelun	Pasa
Hector Nava Muguiro	Public Construction Local Municipality
Julio Rodriguez	Gen Landfill
Fernando Aranza	Case Ciudadano Ac
Ignacio Aviña Franco	Environmental Education Municipality
Renata Perez	Environmental Protection
Jose Lopez Araiza	Environmental Protection

Support material of the 1st meeting:
- PowerPoint presentation of the project
- Brochure with the Executive Summary of the project
- Invitations

Support material of the 2nd meeting:

- PowerPoint presentation of the project
- Invitations

During the meeting, questionnaires were distributed to the people in order to stimulate comments on the project.

PROMOTORA AMBIENTAL	**El Verde Landfill Gas Recovery Project**	mgm INTERNATIONAL

YOUR OPINION IS IMPORTANT TO US

Please, answer the following questions and include all the pertinent comments in the columns on the right.	
Question	**Answer/Comment/Opinion**
With reference to climate change, the Kyoto Protocol and the Clean Development Mechanism, briefly express your opinion on the "El Verde Landfill Gas Recovery Project".	
Would you recommend private companies, government authorities and other organizations to develop projects of this nature: the capture and flaring and/or use of landfill gas as a contribution to the sustainable development?	
Do you believe "El Verde Landfill Gas Recovery Project" will contribute to the social, economic and environmental development (Sustainable Development) of the region and Mexico?	
Are there any additional comments you would like to make?	
Please, write your personal data: o Name and Last name: o Institution/Organization that you represent: o Position: o E-mail: o Telephone: Signature:	

Please, return this survey at the end of the meeting or send it back to the following addresses. Do not hesitate to consult us if you have any doubts. Thank you very much.

PROMOTORA AMBIENTAL S.A.
Julio César Martínez (1st meeting), Alfonso Martínez (2nd meeting)
jrodriguez@gen.tv, amartinezmu@gen.tv
Fax:

MGM INTERNATIONAL
Casiopea Ramírez (1st meeting) Lourdes Fernández (2nd meeting)
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E.2. Summary of comments received

>>

In general, the comments obtained regarding to the project presentation were positive. Some remarkable aspects mentioned were the contribution of this type of projects for improving waste management and reducing odours, benefiting the surrounding communities. Most of the participants expressed their interest in replicating these greenhouse gas emission reduction projects in Mexico and to receive more information about projects that reduce GHG emissions. The project contribution to greenhouse gases mitigations was clearly understood.

During the second meeting, the comments obtained regarding to the project presentation were positive. The stakeholders were interested in the price of the CERs and how the CERs are estimated and which factors affects the estimations.

E.3. Consideration of comments received

>>

During the questions and answers session in the event held, participants expressed concern about several issues. Below we provide a list of the questions raised and answers given by PASA's representatives:

Q.- For how long will the landfill continue to produce gas using the waste that already exists?

A.- Maximum gas production is reached during the first 3 or 4 years after a cell is closed. Since this landfill is currently operating, it is estimated that it will continue to produce good levels for 15 to 20 years.

Q.- What will happen as a result of the law that obliges the administration of the León Municipality to manage separated wastes?

A.- The specific conditions for this type of projects do not exist here, due to the education level of people and the lack of infrastructure. The important thing about this project is that no gases will be released as in the current scenario; however, the Municipality needs private funds to finance this initiative.

Q.- Is it worth to spend millions to flare the gas or is it better to focus economic efforts on generating a model for the management of organic waste?

A.- The project focuses on the existing scenario; the problem is that the management of organic waste costs about 5-10 times more. In Mexico, the organizations do not have an incentive to pay this cost right now to not pay it in the future; the simplest thing to do, in the next 5 years, is to continue with the current method to collect waste and to maintain it in the landfill. The conversion of the system is good from the environmental point of view, but it involves a risk for PASA's business. The Kyoto Protocol will remain valid for another 5 years, so the project will be covered for that period.

Q.- If there exist previous studies, why not invest in electric generation from the beginning?

A.- Although there are studies, it is necessary to analyze wells and monitor the gas to be sure about the measurements; generally, the EPA models are used, but the Protocol says that measurements must be carried out.

Q.- If Mexico is obliged to reduce emissions in 2012, how will the market be managed?

A.- This issue is being currently discussed since Mexico contributes with very low emissions. The United Nations program related to Latin America and the Caribbean is focused on stopping deforestation and involves a voluntary carbon market. Probably, a similar mechanism will continue to operate.

Q.- What do gas flares generate?

A.- They do not generate electricity, only Carbon Credits. It is just a very efficient monitored flaring.

Q.- Does PASA have agreements with universities for the investigation of Bioenergy generation?

A.- Yes, PASA has an agreement with the Universidad de Nuevo León and the Fundación Mundo Sustentable (Sustainable World Foundation) will develop a course on climate change with an area of investigation.

Q.- Can a pilot compost project be implemented per colony in order to not spend so much money?

A.- A compost project per colony (neighborhood) is not recommended, it is better to transport the already separated waste to a single location. Currently, León already has separation programs and education is being provided in schools and colonies. Leon is now interested in making the most of waste. In the Mochis, PASA has an integral service where it collects municipal waste and transports it to a separation plant, where compost is produced and commercialized.

Q.- Which are the local environmental benefits that the project will generate?

A.- The odur will be reduce as the same as fire risk. The lecheate evaporation will reduce the risk of underwater contamination. PASA is inviting to the engineering students to make their professional practices in the Landfill to get experience to develop future Mexican projects.

Q.- Does the validator will be agreed with the current emissions estimations?

A.- The CERs estimations of the PDD are theorical based in a approved CDM methodology, the PDD complies with this methodology and the validator will review it, and give his expert opinion.

Q.- How you estimate the price of the CERs?

A.- The CERs price has been changing during the last year, it depends on the offer and demand. There are some web pages as Point Carbon web page that gives an idea of the current price of the CERs.

SECTION F. Approval and authorization

>>

The letters of approval from Parties for the project activity were available at the time of submitting the PDD to the DOE for validation.

Appendix 1. Contact information of project participants

Organization name	Promotora Ambiental S.A.B. de C.V
Country	Mexico
Address	Blvd. Antonio L. Rodríguez 1884 Torre 1 Piso 8 Monterrey Col. Santa María 64650
Telephone	+52 (81) 1366-4600
Fax	
E-mail	rlopezlo@pasa.mx
Website	www.pasa.mx
Contact person	Ricardo Lopez

Organization name	First Climate (Switzerland) AG
Country	Switzerland
Address	Brandschenkestrasse 51 8002 Zurich
Telephone	+ 41 (0) 44 298 2800
Fax	
E-mail	urs.brodmann@firstclimate.com
Website	https://www.firstclimate.com/
Contact person	Urs Brodmann

Appendix 2. Affirmation regarding public funding

There is no public funding from Parties included in Annex 1 for the proposed project activity.

Appendix 3. Applicability of methodologies and standardized baselines

Please refer to section B.2.

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

The following inputs have been used in the ex ante calculation of emission reductions:

Physical parameters				
Parameters	Unit	Value	Explanantion	Source
$\Phi_{default}$	-	0,75	Model correction factor to account for model uncertainitites	According to the "Emissions from solid waste disposal sites (Version 08.0)", page 9
f	%	0,0	Fraction of CH4 catpured to the SWDS	Considered 0 since the Tool - Annex 13 also considers an Adjustment Factor
GWPCH4	tCO2e/tCH4	25	Global Warming Potential	According to the "Emissions from solid waste disposal sites" (Version 08.0), page 2
OX	-	0,1	Oxidation factor	According to the "• "Emissions from solid waste disposal sites" (version 07.0) page 3, considering the material utilized for covering the landfill (at the clousure)
F	%	0,5	Fraction of CH4 in the SWDS gas	According to the "Emissions from solid waste disposal sites" (Version 08.0), page 2
DOC_f	%	0,5	Fraction of degradable organic carbon that can decompose	According to the "Emissions from solid waste disposal sites" (Version 08.0), page 3
$MCF_{default}$	-	0,8	Methane Correction Factor	According to the "Emissions from solid waste disposal sites" (Version 08.0) page 4, considering the management of the landfill
r_{CH4}	tonnes/m^3	0,0007168	Density CH4	According to the "Emissions from solid waste disposal sites" (Version 08.0), page 9 (density of methane at normal conditions)
OX_{top_layer}	-	0,1	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline	Consistent with how oxidation is accounted for in the methodological tool "Emissions from solid waste disposal sites" (Version 08.0)
CH4 (%v/v)	%	50%	CH4 concentration	To be monitored (this value as a default per PDD calculations)

Electrical considerations				
Parameters	Unit	Value	Explanantion	Source
EFgrid,y	tCO2e/MWh	0,4580	Grid Emission Factor	As per SEMARNAT guidance (http://www.semarnat.gob.mx/sites/default/files/documentos/cicc/aviso_factor_de_emision_e
TDLy	ratio	20,00%	Technical losses in the grid	Default value
Working times				
Parameters	Unit	Value	Explanantion	Source
helec	h/year	8.000	Hours of generators	Project developer
hbl	h/year	8.000	Hours of blowers	Project developer
hth	h/year	0	Hours of thermal consumption	NA
Other parameters				
Parameters	Unit	Value	Explanantion	Source
$PE_{FC,j,y}$	tCO2e/year	0	Emissions from heat consumption by the project activity	Project evaluator
CH_{4LHV}	KJ/mol	890	Methane LHV	IPCC
FCi,j,y	m3/year	0,0000	Fuel consumption	Project developer
NCVi,y	GJ/ m3	26,3000	Weighted average net calorific value of the fuel type i (LPG)	Values from the fuel supplier will be used.
EFCO2i,y `	tCO2/GJ	0,0656	Weighted average CO2 emission factor of fuel type i (LPG)	Values from the fuel supplier will be used.
Site characteristics				
Parameters	Unit	Value	Explanantion	Source
MAT	ºC	19,6	Mean Average Temperature	http://worldweather.wmo.int/en/city.html?cityId=1287
MAP	mm/year	654	Mean average Precipitation	http://worldweather.wmo.int/en/city.html?cityId=1287
PET	mm^3/mm^2	3	Potential evapotranspiration	http://www.fao.org/geonetwork/srv/fr/graphover.show?id=12739&fname=aridity_index.gif&access=public
Waste basis	-	wet	Waste basis (wet / dry)	Project developer

Equipment Details				
Parameters	Unit	Value	Explanantion	Source
η_{PJ}	%	0,50	GCE of the equipment installed	Default value as per page 10/23 of ACM0001 / Version 18.0 "Flaring or use of landfill gas"
$EC_{PJ,y}$	MWh/yr	111,5	Electricity Consumption, yearly	Based on measured data 4th Monitoring Period, from 01/01/2014 to 31/07/2016. See "ER_Summary_4thMP_Leon_v2_Final"
ηflare,m	%	0,9	Flare Efficiency in the minute m	Default value according to the tool "Project emissions from flaring" version 02.0.0
CEG	MW	1,383	Capacity of Each Generator	Model JGS 420 GS-L.L from GE Jenbacher
GE	%	39,80%	Generator efficiency	Model JGS 420 GS-L.L from GE Jenbacher
FLGE	m3/h	627,49	Flow LFG each generator	Calculated
Tcn	m3/h	0	Thermal Consumption	NA
ε_{boiler}	%	0	Boiler efficiency	NA

Year	Waste Input from data (tonnes)	Acumulated	Source
Total	22,981,384	22,981,384	
2002	466,860	466,860	LF Information
2003	445,276	912,135	LF Information
2004	481,745	1,393,880	LF Information
2005	474,763	1,868,643	LF Information
2006	473,501	2,342,143	LF Information
2007	485,080	2,827,223	LF Information
2008	464,226	3,291,449	LF Information
2009	467,422	3,758,871	LF Information
2010	460,966	4,219,837	LF Information
2011	445,123	4,664,960	LF Information
2012	451,293	5,116,253	LF Information
2013	470,264	5,586,517	LF Information
2014	493,950	6,080,466	LF Information
2015	525,991	6,606,457	LF Information
2016	544,790	7,151,247	LF Information
2017	552,853	7,704,100	LF Information
2018	561,146	8,265,246	LF Information Calculation
2019	569,563	8,834,809	LF Information Calculation
2020	578,107	9,412,916	LF Information Calculation
2021	586,778	9,999,695	LF Information Calculation
2022	595,580	10,595,275	LF Information Calculation
2023	604,514	11,199,788	LF Information Calculation
2024	613,581	11,813,370	LF Information Calculation
2025	622,785	12,436,155	LF Information Calculation
2026	632,127	13,068,282	LF Information Calculation
2027	641,609	13,709,891	LF Information Calculation
2028	651,233	14,361,124	LF Information Calculation
2029	661,001	15,022,125	LF Information Calculation
2030	670,917	15,693,042	LF Information Calculation
2031	680,980	16,374,022	LF Information Calculation
2032	691,195	17,065,217	LF Information Calculation
2033	701,563	17,766,780	LF Information Calculation
2034	712,086	18,478,866	LF Information Calculation
2035	722,768	19,201,634	LF Information Calculation
2036	733,609	19,935,243	LF Information Calculation

Composition	Waste composition
Glass, plastic, metal, other inert waste	26.56%
Pulp, paper, cardboard (other sludge)	22.63%
Textiles	13.52%
Wood and wood products	1.52%
Garden, yard and park waste	6.28%
Food, food waste, beverages and tobacco (other than sludge)	29.47%

Appendix 5. Further background information on monitoring plan

Please refer to section B.7.

Appendix 6. Summary report of comments received from local stakeholders

Please refer to Section E.

Appendix 7. Summary of post-registration changes

No post registration changes are needed to be summarized.

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Document information

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

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

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