Project design document form
(Version 11.0)

BASIC INFORMATION	
Title of the project activity	Modelo del Callao Landfill Gas Capture and Flaring System
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	7
Completion date of the PDD	29/09/2020
Project participants	PETRAMAS S.A.C.
Host Party	Peru
Applied methodologies and standardized baselines	ACM0001 Version 19.0, "Flaring or use of landfill gas"
Sectoral scopes	Sectoral Scopes: 13.-Waste handling and disposal; and 1.-Energy industries (renewable-/ non-renewable sources)
Estimated amount of annual average GHG emission reductions	344,880 tCO_2e

Eliminado: 6

Eliminado: 01/06/2015

Eliminado: ACM0001 Version 11, "Approved Consolidated Baseline Methodology for Landfill Gas Project Activities"

Eliminado: 61,024

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The objective of the "Modelo del Callao Landfill Gas Capture and Flaring System" (the project activity) 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).

Modelo del Callao landfill has an area of 54 hectares (ha) and receives around 3,500 tonnes (t) of municipal solid waste (MSW) daily from Callao and the district of San Martin de Porras, amongst others. It is expected that the amount of MSW could be incremented according to markets conditions of the MSW management sector. Modelo del Callao landfill is anticipated to remain open at least until 2030 reaching an accumulated amount of municipal solid waste of 13,115,618 tones by year 2030. The landfill used to be an open dump managed by Callao's municipal company, ESLIMP. After 26 years of operations, on 10 November 2003, it was awarded as a concession to PETRAMAS S.A.C. (the Project Developer). The concession was regarded as a solution for converting the open dump into a landfill, and encompasses the management and final disposal of the MSW. The 30-year concession clearly establishes that the rights to the LFG belong to PETRAMAS S.A.C. Modelo del Callao landfill is in compliance with all Peruvian regulations for Solid Waste Management (SWM) activities[1].

PETRAMAS S.A.C. is a Peruvian private company that has provided since 1996 services of collection, transport and final waste disposal to several municipalities and businesses within the city of Lima. The company owns a large fleet of garbage trucks and two landfills; namely, Huaycoloro and Modelo del Callao. Huaycoloro landfill is located to the east of Lima and is the biggest landfill in Peru, managing more than half of Lima's MSW. There is a registered CDM project at the Huaycoloro landfill, which is currently developing the LFG recovery and flaring/utilization system financed by CDM revenues.

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.

During the first crediting period, the "Modelo del Callao Landfill Gas Capture and Flaring System" was developed as a landfill gas (LFG) collection and flaring project but the project has increased its was input and in its second crediting period will be developed 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

[1] Modelo del Callao's landfill activity is regulated by Legislative Decree No. 1278, which approves the Law on Solid Waste Management published on 23/12/2016, which replaces General Law of Solid Residues (Law No. 27314)

Eliminado: The Modelo del Callao Landfill Gas Capture and Flaring System (the Project) is being developed by PETRAMAS S.A.C. (the Project Developer) as a landfill gas (LFG) collection and flaring project. It is located in Peru, close to the right bank of the Chillon River at kilometer (km) 19 on the highway to the district of Ventanilla, in the province of Callao.

Eliminado: The

Eliminado: If the proposed CDM project activity on the landfill yields profits, these will be shared with the municipality of Callao.

Eliminado: The Project aims to reduce methane (CH4) emissions by flaring LFG. Destruction of CH4 in this manner is expected to result in a substantial net reduction of greenhouse gas (GHG) emissions, calculated ex-ante on a conservative basis at 427,168 tons of carbon dioxide equivalent (tCO2e) over the first 7 years, or an average of 61,024 tCO2e annually during this period. ¶
¶
Modelo del Callao landfill is in compliance with all Peruvian regulations for Solid Waste Management (SWM) activities. Modelo del Callao landfill is anticipated to remain open at least until 2030. Modelo del Callao landfill is currently filling at a rate of approximately 1,250 tons per day (t/d), and is expected to reach an accumulated amount of municipal solid waste of 13,115,618 tones by year 2030[2]

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 “Modelo del Callao Landfill Gas Capture and Flaring System” is entering in its second crediting period and during the first crediting period, was operating only under Phase 1. The installed equipment under Phase 1 of the project activity 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. 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. It is expected that in second crediting period LFG would be used mainly for power generation, with any excess of LFG being flared.

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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 Peru.

The contributions of the project to sustainable development are:

1) Reducing global climate change by destroying the CH4 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 CO2, a basic contributor to global warming.
3) Reducing possible health risks by destroying most of the non- CH4 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 344,880 tCO2e and a total GHG emission reductions of 2,414,163 tCO2e for the second crediting period.

Eliminado: ¶
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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

The project activity will implement in the Disctric of Ventanilla Province of Callao, located in the Republic of Peru. The Project is located close to the right bank of the Chillon River at km 19 on the highway to the district of Ventanilla, province of Callao. The landfill has an area of 55 ha.

The coordinates of the Project are: Latitude -11.933383 South. Longitude -77.123583 West.

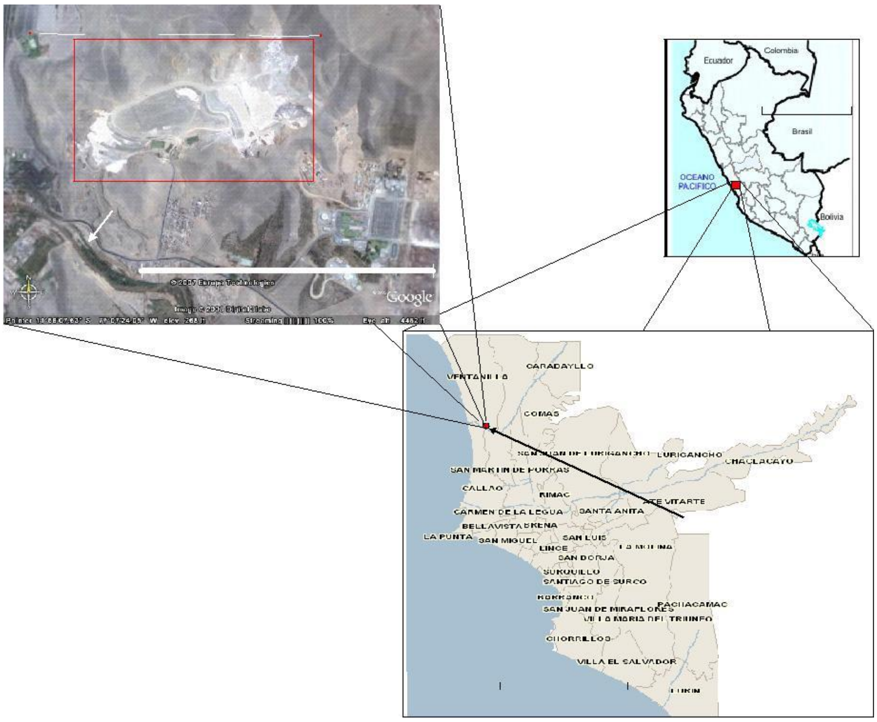


Figure 1: Location of the project

A.3. Technologies/measures

The objective of "Modelo del Callao Landfill Gas Capture and Flaring System" is to capture the landfill gas (LFG) and to flare and/or utilize it leading to GHG emissions reductions. Prior to project implementation, there was no combustion of LFG, hence no methane destruction. The situation before the project implementation coincides with the baseline scenario. In this second crediting period, the project activity is 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: As the LFG flow has been proven to be steady (in terms of volume and quality) for the electricity generation, a second project phase have being carried out and a

Eliminado: The Project will be the third CDM LFG recovery project in Peru[3] The first one was the Huaycoloro project[4] also belonging to the same Project Developer, which has now been registered as a CDM project. The experience gained in Huaycoloro will be used in the Modelo del Callao project.¶

reciprocating engine facility has been installed. This phase imply the installation of generating equipment that combust the methane of the LFG in order to produce electricity. Two (2) LFG Engines with capacity of 1.2 MW each (total generation capacity of 2.4 MW) has been installed in 01/06/2018.

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, as follows:

- The LFG Collection System has been installed comprehensively over the closed areas of the landfill. Installations included initially approximately 77[5] vertical and 12 horizontal extraction wells of high-density polyethylene pipes (HDPE). of high-density polyethylene pipes (HDPE). The wells have a depth of around 20 meters. The diameter of these pipes will be 16 cm and 50% of its surface are perforated. The pipes end with a perforated top and will rest over a bed of rocks of 0.3m wide. The pipelines are surrounded by gravel of 1.5¨ to 3¨ that serve as a filter between the pipelines and solid waste. 60% of the pipeline length is covered with gravel. After the pipelines have been surrounded by slime until reach 90% of the length of the pipe, the remaining 10% have been covered with bentonite. These pipes have been coupled to a high-density polyethylene pipe grid to transport the LFG to the flare station and LFG control plant. This grid has a length of around 4,780 meters. The diameters of the pipes that compose the grid are 315mm; 250mm, 160mm and 110mm. These pipes are joined through thermo fusion. The system is hermetically sealed to compensate all the pressure forces existent in the grid. The main pipeline has a minimum slope of 3% and the management of condensates will be made in tanks. It is projected that future well-field expansions to collect LFG from new disposal areas will require approximately 5 new wells during each year of operation. Wells that are inefficient will need to be, recovered, replaced or closed.

- The LFG Flare System is composed by blowers, moisture separator and enclosed flaring station, and the LFG measuring and recording equipment. The LFG Flare System has a maximum capacity of 1,500 SCFM and a destruction efficiency between 98% and 100%. The system is composed by thermocouples that allow to control the temperature of the flame in order to guarantee the destruction efficiency of the system. An operation and maintenance (O&M) program for the LFG Flare System equipment has been implemented according to equipment manufacturer. The LFG Flare System of "Modelo del Callao Landfill Gas Capture and Flaring System" was commissioned on 13/08/2012 and has been operating since then. The project was fully operational by the date of registration on 20/08/2012. Since its registration date it has been implemented and monitored as per the monitoring plan of the PDD, with continuous operation.

Eliminado: The suction system will have a maximum transportation capacity of 1500 Standard cubic feet per minute (SCFM) with a pressure loss in the system of 40 inches H2O of total static pressure. Thus, the system will require two blowers of 750 SCFM each.¶

Eliminado: Wells that are inefficient will need to be, recovered, replaced or closed.

Under Phase 2. LFG is used to generate electricity and only the excess LFG is send to the flare. Thus all LFG is combusted in one of these two ways and methane contained in LFG is destroyed.

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

[5] The PDD of the 1st Crediting Period estimated that, during the whole project activity, 50 wells are to be installed whereas at the moment, 99 wells are installed (77[5] vertical and 12 horizontal) due to the fact that the current LFG Collection System covers the LFS area with a higher well density to improve the collection of LFG.

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

Equipment	Description and Capacity	Operational date (Age)	Operational Lifetime[6]
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 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.	13/08/2012 (6.5 years)	15 years
LFG Combustion System	• An Enclosed ZTOF Biogas Flare[7] with a capacity of 1500 SCFM (equivalent to 2411 Nm3/h) 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.	13/08/2012 (6.5 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 negative pressure in the pipeline structures in order to send the landfill gas to the flaring system and considering future electricity generator flow demands.	13/08/2012 (6.5 years)	15 years
LFG Pre-treatment System	• The pre-treatment is 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).	01/06/2018	15 years
Electricity generation System	• Two (2) LFG Engines with capacity of 1.2 MW each installed in 01/06/2018 providing a total capacity of 2.4 MW. The two engines are model Caterpillar	01/06/2018	15 years

[6] 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).

[7] 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 03.0.0, 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.

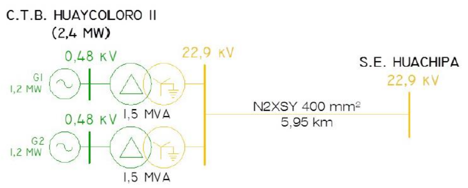
	(Model CG170-12). The configuration is determined by the following one-line diagram: 		

Figure 2: Electricity generation engines

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:

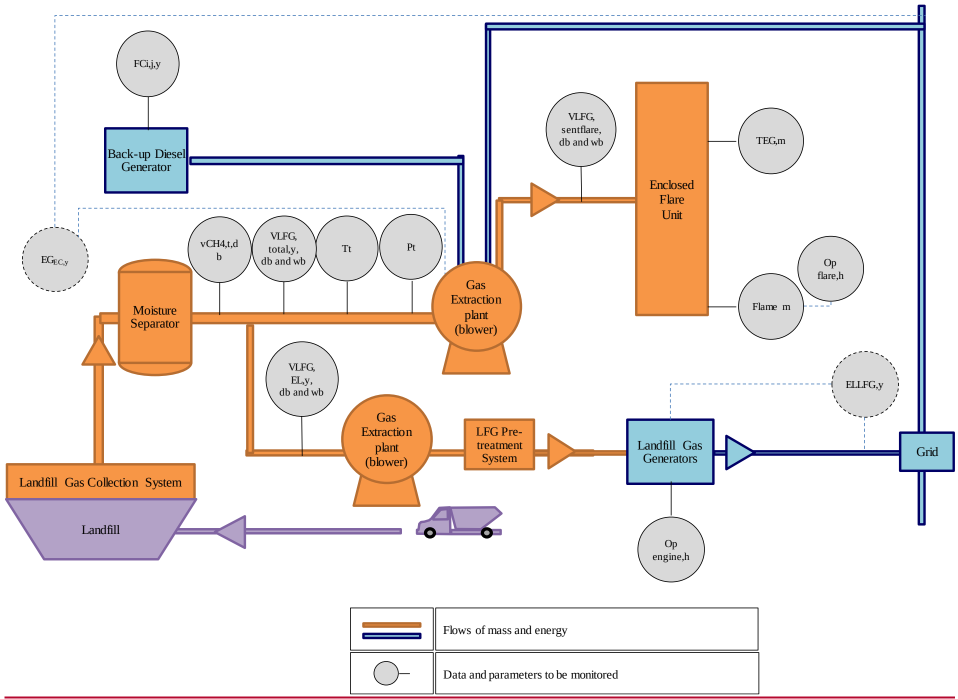


Figure 3: Process Diagram of the project activity including the monitoring equipment location

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 needs some engineers and other specialists with experience in this area to advice the company while implementing the project. These professionals train local operators and engineers on operations and maintenance of the facilities. This kind of technology is still not widely applied in Peru, where very few landfills have installed equipment for the collection and flare of landfill gas without the CDM incentive.

Con formato: Inglés (Reino Unido)

Eliminado: The Project will transfer environmentally safe and sound technology to Peru, by: ¶
• providing training to Peruvian labor in O&M; ¶
• serving as example of one of the most environmentally beneficial modes of SWM; and, ¶
• expanding and disseminating knowledge on the potential of CDM for this type of activity.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Peru (host)	PETRAMAS S.A.C.	Yes

A.5. Public funding of project activity

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

Eliminado: There are no public funds involved in the proposed project.

Eliminado: ¶

A.6. History of project activity

The proposed CDM project activity was registered as a CDM project activity on 20/08/2012. The current CDM-PDD is presented for the renewal of the crediting period.

A.7. Debundling

Not applicable.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

The approved baseline and monitoring methodology used for the project activity is ACM0001, "Flaring or use of landfill gas"(version 19.0). 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)
- "Project emissions from flaring" (version 03.0.0)
- "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)
- "Tool to calculate the emission factor for an electricity system" (version 7.0)
- "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)
- "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (version 03.0)
- "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)

B.2. Applicability of methodologies and standardized baselines

The methodology ACM0001 "Flaring or use of landfill gas"(version 19.0) 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;[8] 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 19.0) are met by the project activity:

a) At the validation of the project activity, the existent legislation of Solid Waste Management (SWM) in Peru, ruled by the national law 27314 on Solid Waste ("General Law of Solid

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

Eliminado: ¶
Approved Consolidated Baseline Methodology for Landfill Gas Project Activities, ACM0001, Version 11 (EB 47), as a consolidated baseline methodology for landfill gas project activities ¶
¶
The methodology also refers to the latest versions of each of the following tools: ¶
¶
• Tool for the Demonstration and Assessment of Additionality (Version 5.2.1); ¶
• Tool to Determine Project Emissions from Flaring Gases Containing Methane (Version 1); ¶
• Tool to Calculate Baseline, Project and/or Leakage Emissions from Electricity Consumption(Version 1); ¶
• Tool to Calculate Project or Leakage CO2 Emissions from Fossil Fuel Combustion (Version 2); ¶
• Combined Tool to Identify the Baseline Scenario and Demonstrate Additionality (Version 4.0.0); ¶
• Tool to Determine Methane Emissions Avoided from Disposal of Waste at a Solid Waste Disposal Site (Version 5.1.0) ; and, ¶
• Tool to Calculate the Emission Factor for an Electricity System (Version 02.2.1).

Eliminado: The baseline methodology, ACM0001, is applicable to LFG capture project activities, where the baseline scenario is the partial or total atmospheric release of the gas and the project activities include situations such as: ¶
a) the captured gas is flared; and/or, ¶
b) the captured gas is used to produce energy (e.g. electricity/thermal energy); ¶
c) the captured gas is used to supply consumers through a natural gas distribution network. If emissions reductions are claimed for displacing natural gas, project activities may use approved methodology, AM0053. ¶
¶
The baseline for the Project is the partial or total atmospheric release of the biogas generated. The project activity is based on one activity, namely: ¶
¶
• The collection and flaring or combustion of LFG, thus converting its CH4 content into CO2, reducing its greenhouse gas effect. ¶
¶
The Project, therefore, fulfils the conditions of Option (a), and thus ACM0001 was considered the most appropriate methodology. ¶
¶
In addition, the applicability conditions included in the tools used apply. ¶
¶
The "Tool to determine project emissions from flaring gases containing methane" is applicable to projects where residual gas stream to be flared contains no other combustible gases than methane, carbon monoxide and hydrogen and the residual gas to be flared is obtained from decomposition of organic material (through landfills, bio-digesters or anaerobic lagoons, among others). ¶
¶
The project activity includes the flaring of the residual gas, obtained from decomposition of municipal organic waste and thus the tool is applicable to the project. ¶
¶
The "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" applied to situations where electricity is consumed in the project, thus this tool is applicable to the project. Furthermore, the Scenario A applied to the project case (i.e., electricity consumption from the grid). ¶
¶
The "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" is applicable in cases where the solid waste disposal site where the waste would be dumped can be clearly identified. Under this project activity, the municipal waste will be deposited in a site that is clearly identified, thus the tool is applicable to the project. ¶
¶
The "Combined tool to identify the baseline scenario and demonstrate additionality" is not necessary since the ...

Residues") gave the requirement of final solid waste disposal in the landfill. Under such legislation, there was not a specific requirement for the collection and combustion of LFG. Articles 87 and 88 of this law set minimum installations and operating conditions for landfills, respectively, (including LFG control and LFG evacuation chimneys) but it does not give any regulatory percentage of the LFG to be controlled. Furthermore, venting wells, without any flaring (which would not destroy any CH4 but avoid explosions) is not directly prohibited in this law. Therefore, prior to the implementation of the project activity, the LFG was mostly vented to the atmosphere.

At the time of the renewal of the crediting period, the Law No 27314 "Ley General de Residuos Solidos" issued in July 21, 2000 and the corresponding Decree No. 057-04- PCM issued in July 24, 2004 are still applicable. This regulation defines responsibilities regarding waste management, as well as the specifications for environmental protection in the selection, operation, monitoring and closure of final disposal sites for MSW. LFG is mentioned in Decree No. 057-04- PCM in article 85 "Minimal Installation of a Landfill", where paragraph 3 states that a landfill should have drainage and ventilation shafts and gases control but it does not stipulate any regulatory percentage of the LFG to be controlled. Furthermore, under the Law, venting wells without any flaring (which would not destroy any CH4 but simply avoid explosions) are not directly prohibited.

Since the landfill gas capture was not mandated by law prior to the implementation of the project activity (and it is not mandated neither at the time of the renewal of the crediting period under the new regulation), the project activity implied the installation of a new LFG capture system in the existing SWDS, so the application of the methodology is met by the project activity corresponding to the applicability criteria (a) set above.

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 intends 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. 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 19.0) 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.

Prior to the project implementation, there was no collection and/or destruction of landfill gas from the landfill. The baseline scenario at the time of validation was the practice prior to the implementation of the project activity, which was the atmospheric release of LFG from the SWDS (so the project meets the applicability criteria (a) above) and power generation using existing and/or new grid-connected power plants (so the project meets the applicability criteria (b) (i) above).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 19.0) 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 19.0) 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 03.0.0) is used to determine $PE_{flare,y}$ as required by the ACM0001 "Flaring or use of landfill gas" (version 19.0).

- 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 and electricity generation component to the grid has been added as design change, 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 19.0) and the applicable tools.

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

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	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

Eliminado: ¶

Eliminado: According to the applicable methodology ACM0001, the project boundary is the site of the project activity where the gas is captured and destroyed/used.¶
Precisely, the project`s system boundaries comprise of the landfill gas (LFG) collection system and the enclosed flaring system.¶
The project activity requires electricity from the grid for the operation of the facility; therefore, the electricity source is included in the project boundary.¶

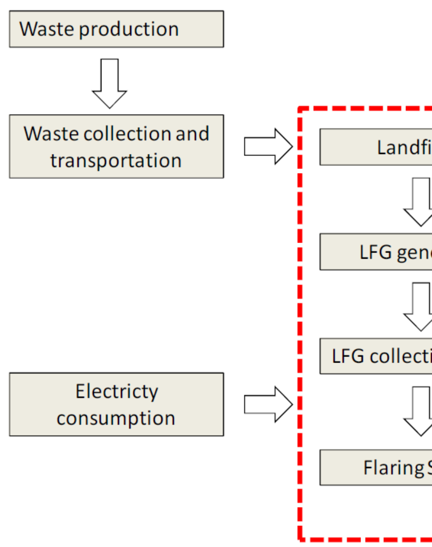


Figure 2. Project boundary of the proposed project activity¶

Eliminado: The project activity avoids methane emissions by capturing the LFG and flaring it. The gases included in the baseline and the project activities are described in Table 2.¶

Eliminado: Source

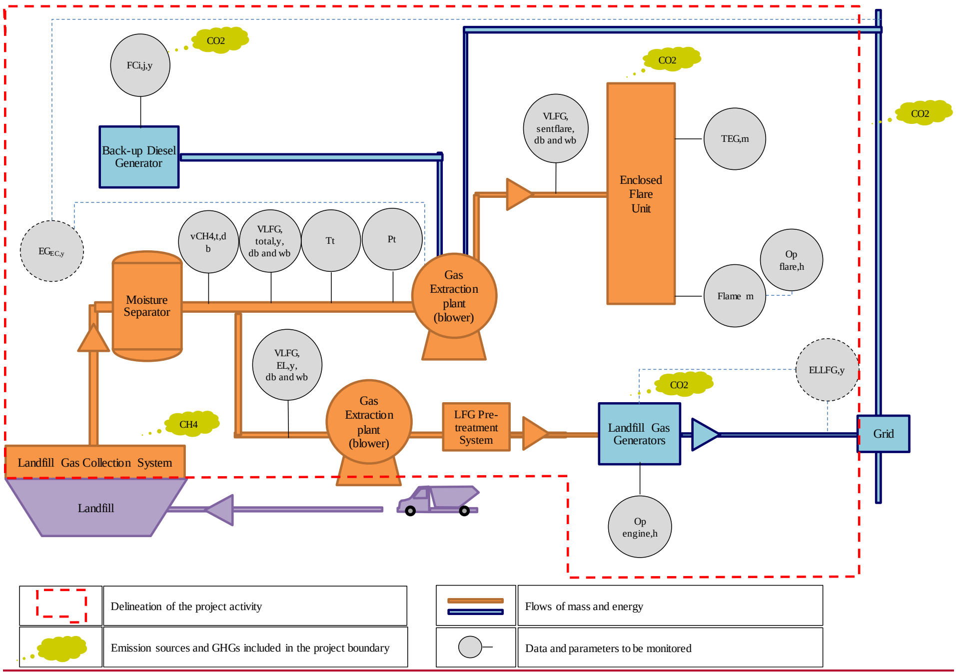
	the project activity			
	Emissions from electricity consumption due to the project activity	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be 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 19.0), 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 19.0), as follows:

Eliminado: Project emissions thus include:¶
¶
<#>CH_4 from the incomplete combustion of LFG in flares accounted for as project emissions[9]. ¶
¶
<#>CO_2 emissions from the consumption of electricity required for project activities from the Peruvian power grid. ¶
¶
Emissions do not include:¶
¶
<#>CO_2 resulting from the conversion of CH_4 into CO_2 as a consequence of flaring. As this CO_2 is originally contained in the biomass held within the landfill, it is considered to be carbon neutral; hence, long-term CO_2 emissions are counted as zero. ¶



B.4. Establishment and description of baseline scenario

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"[10] 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

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

Eliminado: As described in Section A.4.3 the proposed project activity will involve the capture and combustion of landfill gas thereby converting methane into CO2 and reducing the emissions of greenhouse gases.¶
¶
The project will replace the existing passive landfill gas venting system at the Modelo del Callao landfill site with an active LFG collection and flaring system.¶
¶
During construction and filling of the landfill site, wells are installed in order to reduce the increasing gas pressure within the landfill body.¶
¶
Passive venting of LFG is common practice in Peru, and the proposed project activity is not an obligation neither under the current nor under the expected future regulatory¶

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 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 validation of the project activity, the existent legislation of Solid Waste Management (SWM) in Peru, ruled by the national law 27314 on Solid Waste ("General Law of Solid Residues") gave the requirement of final solid waste disposal in the landfill. Under such legislation, there was not a specific requirement for the collection and combustion of LFG. Articles 87 and 88 of this law set minimum installations and operating conditions for landfills, respectively, (including LFG control and LFG evacuation chimneys) but it does not give any regulatory percentage of the LFG to be controlled. Furthermore, venting wells, without any flaring (which would not destroy any CH4 but avoid explosions) is not directly prohibited in this law. Therefore, prior to the implementation of the project activity, the LFG was mostly vented to the atmosphere and the legislation applicable at the submission for validation of the project activity did not require landfills to collect nor utilize the gas generated hence it was not mandated by regulations.
At the time of the renewal of the crediting period, the Modelo del Callao's landfill activity is regulated by Legislative Decree No. 1278, which approves the Law on Solid Waste Management published on 23/12/2016, which replaces General Law of Solid Residues (Law No. 27314).The Legislative Decree No. 1278 does not have any specific requirement for the collection and combustion of LFG. Therefore, Modelo del Callao 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 Peru 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.

Since the landfill gas capture was not mandated by law prior to the implementation of the project activity (and it is not mandated neither at the time of the renewal of the crediting period under the new regulation), 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. As per the tool, given that 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 or the submission of the previous request for renewal of the crediting period and are applicable at the time of requesting renewal of the crediting period, then the Step 1.2 is followed.

Step 1.2: Assess the impact of circumstances

Following the tool, and given that the baseline scenario identified at the time of validation of the project activity was the continuation of the practice prior to the implementation of the project activity without any investment, (i.e. is continuation of the practice at the time with limited collection and flaring of methane from the landfills), then an assessment of the changes in market characteristics has been conducted.

In accordance to the report[11] of the current situation of solid waste management in Peru elaborated by the Peruvian Ministry of Environment, in Peru there are only 10 landfills and 5 of them are located in Lima Region which receives 92% of the MSW of Lima. The table below, prepared based in the report made by the Ministry of Environment, present the list of landfills located in Peru identifying the ones which have installed a collection and flaring system and the ones which are CDM projects:

Landfill Name	Collection and flaring of methane from the landfill?	CDM Project?
Zapallal	No	No
Portillo Grande	No	No
Callao	Yes	Yes
Huaycoloro	Yes	Yes
Ancón[12]	Yes	Yes

As can be seen above, the landfills of Callao, Huaycoloro and Ancón are the only ones in the country which have installed a collection and flaring system and, at the same time, are CDM projects. At the time of validation of the project activity, Huaycoloro was the first of its kind since no similar activities were implemented in Peru ever before. Therefore, the market conditions for landfill gas collection and use outside of the CDM, continue to be the same as when the project was first presented for validation. Without the expectations coming from the CDM revenues, there is no real incentive for landfill sites to implement this type of technology. In addition, since there have not been any updates that have come into effect after the submission of the project activity for validation with respect of the requirement to capture and flare LFG at the start of the second crediting period by any mandatory law, then the conditions used to determine the baseline emissions in the previous crediting period are still valid.

As for the availability of new fuels or raw materials, it should be noted that the implementation of a fossil fuel fired or renewable based cogeneration plant is very unlikely as there is no demand for heat around the project location. In addition fossil fuel fired or renewable based captive power plants are not credible and realistic alternatives due to the high costs and the unavailability of renewable resources such as hydro or biomass at the project location. The solar photovoltaic technology is not financially affordable for the project owner. Therefore, the baseline alternative of electricity generation is to produce equivalent amount of electricity by grid-connected power plants located throughout Peru.

In summary, the new market conditions, as well as the prevailing practice and the availability of alternative technologies to generate energy, continue to be the same as those that applied for the first crediting period.

Since there have not been any updates that have come into effect after the submission of the project activity for validation in respect of the requirement to capture and flare LFG at the start of the second crediting period by any mandatory law, there is no impact of circumstances existing at the time of requesting renewal of the crediting period on the current baseline emissions. Moreover, the conditions used to determine the baseline emissions in the previous crediting period are still valid for the renewal of the crediting period.

[11] Ministerio de Ambiente "Informe de la Situación Actual de la Gestión de residuos Sólidos Municipales" October 2008. Page 15. http://www.redrrss.pe/material/20101021014024.pdf

[12] At the time of renewal of the crediting period, the Ancón project has been closed due to contamination according to http://www.larepublica.pe/29-09-2011/clausuran-un-relleno-sanitario-de-ancon

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. Additionally, the following monitoring parameters have been added in section B.7.1 of this revised PDD to cover the electricity generation component, in compliance with the monitoring plan as per the methodology ACM0001 (Version 19.0):

- Volumetric flow of total landfill gas which is sent to flare and used for electricity generation in year y on a dry basis
- Volumetric flow of landfill gas which is used for electricity generation in year y on a dry basis
- Net quantity of electricity generated using LFG
- Operation of the engine that consumes the LFG

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 19.0). 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 and other parameters from the methodology ACM001 (Version 19.0) have been added to cover the electricity generation component to the grid. 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 19.0), 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 19.0).

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 19.0 of ACM0001. As per paragraphs 22 and 23 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas" (Version 19.0), 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 Peru 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

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 19.0)

Eliminado: ***Step 1. Identification of alternatives to the project activity consistent with current laws and regulations***¶
Sub-step 1a. Define alternatives to the project activity¶
According to ACM0001 version 11, the following alternatives should be included for the disposal/treatment of the waste in the absence of the project activity:¶
<#>LFG1: The project activity (i.e. capture of landfill gas and its flaring and/or its use) undertaken without being registered as a CDM project activity;¶
<#>LFG2: Atmospheric release of the landfill gas or partial capture of landfill gas and destruction to comply with regulations or contractual requirements, or to address safety and odour concerns.¶
These options are the most common and realistic alternatives for the context of the project activity.¶
For power generation, the realistic and credible alternative(s) may include:¶
<#>P1: Power generated from landfill gas undertaken without being registered as CDM project activity ¶
<#>P2: Existing or construction of a new on-site or off-site fossil fuel fired cogeneration plant; ¶
<#>P3: Existing or construction of a new on-site or off-site renewable based cogeneration plant;¶
<#>P4: Existing or construction of a new on-site or off-site fossil fuel fired captive power plant;¶
<#>P5: Existing or construction of a new on-site or off-site renewable based captive power plant; P6: Existing and/or new grid-connected power plants.¶
For heat generation, the realistic and credible alternative(s) may include:¶
<#>H1: Heat generated from landfill gas undertaken without being registered as CDM project activity; ¶
<#>H2: Existing or Construction of a new on-site or off-site fossil fuel fired cogeneration plant;¶
<#>H3: Existing or Construction of a new on-site or off-site renewable based cogeneration plant;¶
<#>H4: Existing or new construction of on-site or off-site fossil fuel based boilers, air heaters or other heat generating equipment (e.g. kilns);¶
<#>H5: Existing or new construction of on-site or off-site renewable energy based boilers, air heaters or other heat generating equipment (e.g. kilns);¶
<#>H6: Any other source such as district heat;¶
<#>H7: Other heat generation technologies (e.g. heat pumps or solar energy).¶
The following realistic alternatives could be identified in the absence of the project activity:¶
Alternative 1, LFG1: The project activity, including the capture of landfill gas and its flaring, undertaken without being registered as a CDM project activity.¶
Under this scenario, the flaring would need to be financed without any potential payback. Simple flaring of the landfill gas does not generate any financial revenues as the gas is not utilized but destroyed.¶
According to the investment analysis in Step 2., the total cost of the investment for the project lifetime (22 years) would be USD 5,329,130 without any potential financial benefits from the project activity.¶
Therefore, this scenario is realistic but is not an economically feasible scenario.¶
Alternative 2, LFG2: Atmospheric release of the landfill gas or partial capture of landfill gas and destruction to comply with regulations or contractual requirements, or to address safety and odour concerns.¶
In Peru, the business-as-usual practice for landfills is simple venting of the landfill gas into the atmosphere in order to comply with regulations or contractual requirements.¶
The environmental regulations recommends installing systems for LFG collection, control and monitoring but no further guidance is provided. Moreover, The Modelo del Callao landfill currently is operating with passive venting while fulfills with the permits given by the local municipality.¶
Therefore, the most plausible scenario would be the continuation of the current venting system.¶
Alternative 3, Power generation in the absence of the project activity (Alternatives P1 to P6)¶
This alternative involves capital investments that would result in revenues, and is thus credible as a business proposition. ...

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 19.0)
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 19.0), 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 is used to generate electricity in one power plant composed by 2 power engines with a total nameplate capacity that equals or is below 10 MW (2.4 MW) under the current 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 19.0), the project activity is deemed automatically additional.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$ **(26) equation of the ACM0001 Version 19.0**

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)

Baseline Emissions

Eliminado: As the applicability of the methodology ACM0001 version 11 indicates, the Modelo del Callao landfill gas flaring project fulfils the applicability requirement of the methodology and relates to option a) flaring of the captured gas.¶
¶
Therefore, according to the requirement of the methodology and the CDM related regulations, the emission reductions for this project shall be calculated using the methodology and its related tools:¶
¶
<#>"Tool for the demonstration and assessment of additionality" version 5.2.1; ¶
¶
<#>"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" version 5.1.0; ¶
¶
<#>"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" version 01; ¶
¶
<#>"Tool to determine project emissions from flaring gases containing methane" version 1. ¶

Eliminado: It was identified that the baseline consists of the simple passive venting system where no destruction of the LFG is taking place.¶
¶
The baseline emissions reductions due to the partial collection and destruction of the LFG (if any) will be taken into account by applying the Adjustment Factor (AF).¶
¶

$$BE_y = (MD_{project,y} - MD_{BL,y}) * GWP_{CH4} + EL_{LFG,}$$

¶
Where:¶
BE_y =Baseline emissions in year y (tCO2e) ¶
$MD_{project,y}$ =The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH4) in project scenario ¶
$MD_{BL,y}$ =The amount of methane that would have been destroyed/combusted during the year in the absence of the project due to regulatory and/or contractual requirement, intonnes of methane (tCH4) ¶
GWP_{CH4} =Global Warming Potential value for methane for the first commitment period is ¶
21 tCO2e/tCH4 ¶
$EL_{LFG,y}$ =Net quantity of electricity produced using LFG, which in the absence of the project¶
activity would have been produced by power plants connected to the grid or by an¶
on-site/off-site fossil fuel based captive power generation, during year y, in ¶
megawatt hours (MWh) ¶
$CEF_{elecy,BL,y}$=CO2 emissions intensity of the baseline source of electricity displaced, in ¶
tCO2e/MWh This is estimated as per equation (9) below ¶
$ET_{LFG,y}$ = The quantity of thermal energy produced utilizing the landfill gas, which in the¶
absence of the project activity would have been produced from onsite/offsite fossil¶
fuel fired boiler/air heater, during the year y in TJ ¶
$CEF_{ther,BL,y}$ =CO2 emissions intensity of the fuel used by boiler/air heater to generate thermal¶
energy which is displaced by LFG based thermal energy generation, in tCO2e/TJ.¶
This is estimated as per equation (10) below ¶
¶
Since the proposed project activity is a simple landfill gas flaring project and does not include electricity or thermal energy generation, the baseline emissions are calculated with the following simplified formula:¶
¶

$$BE_y = (MD_{project,y} - MD_{BL,y}) * GWP_{CH4}$$

Where:¶
BE_y =Baseline emissions in year y (tCO2e)¶
...

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 19.0 uses:

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}$$ **(1) of the ACM0001 Version 19.0**

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:[18]

$$BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y}\right) \times GWP_{CH4}$$ **(2) equation of the ACM0001 V 19.0**

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 ($t\ CO_2e/t\ CH_4$)

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

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 19.0, 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 19.0**

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 19.0)**

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[19].

$F_{CH4,flared,y}$ 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:

[19] "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"

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 19.0**

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 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 $V_{LFG,sent\_flare,y,db}$ (m³ dry gas/h) or $V_{LFG,sent\_flare,y,wb}$ (m³ wet gas/h) and Option A (T_t > 60ºC) or B (T_t < 60ºC) will be used accordantly. Therefore, the parameters $V_{LFG,sent\_flare,y,db}$ (m³ dry gas/h) or $V_{LFG,sent\_flare,y,wb}$ (m³ 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 $V_{LFG,sent\_flare,y,db}$ (m³ 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 $V_{LFG,sent\_flare,y,wb}$ (m³ 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 19.0 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 (m³ dry gas/h)
$v_{i,t,db}$	=	Volumetric fraction of greenhouse gas *i* in the gaseous stream in a time interval *t* on a dry basis (m³ gas *i*/m³ dry gas)
$\rho_{i,t}$	=	Density of greenhouse gas *i* in the gaseous stream in time interval *t* (kg

		gas *i*/m³ gas *i*)
P_t	=	Absolute pressure of the gaseous stream in time interval *t* (Pa)
MM_i	=	Molecular mass of greenhouse gas *i* (kg/kmol)
R_u	=	Universal ideal gases constant (Pa.m3/kmol.K)
T_t	=	Temperature of the gaseous stream in time interval *t* (K)

- **Option B**

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 (m³ dry gas/h)
$V_{t,wb}$	=	Volumetric flow of the gaseous stream in time interval *t* on a wet basis (m³ wet gas/h)
$v_{H2O,t,db}$	=	Volumetric fraction of H2O in the gaseous stream in time interval *t* on a dry basis (m³ H2O/m³ 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 (m³ H2O/m³ 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 03.0.0).*

The determination ex-post of $PE_{flare,y}$ will be conducted using the *"Project emissions from flaring" (Version 03.0.0)*. 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 A: Apply a default value for flare efficiency".

The following steps will be applied ex-post to calculate the methane destruction efficiency of the flare applying the "Project emissions from flaring" (Version 03.0.0)**:**

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* ($\eta flare,m$) is 50% when the flame is detected in the minute *m* (Flamem), otherwise $\eta flare,m$ 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* ($\eta flare,m$) 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 03.0.0. 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 03.0.0, 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: Measure 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 03.0.0. 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

Default value for flare efficiency (90%) will be used to calculate the amount of methane destroyed by flaring ex post as per Option A of "Project emissions from flaring" version 03.0.0.

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 03.0.0. 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 03.0.0, 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 19.0**

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 19.0.
y		Year for which methane emissions are calculated

Since ACM0001, V 19.0 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 19.0 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 19.0**

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 19.0**

$F_{CH4,BL,R,y}$ 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 19.0**

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 19.0**

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:[20]

$$F_{CH4,BL,R,y} = 0.2 \times F_{CH4,PJ,capt,y}$$ **(10) equation of the ACM0001 V 19.0**

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 19.0**

- 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 19.0**

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)
$F_{CH4,sent\_flare,y}$	=	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 19.0**

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 19.0**

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

[20] 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.

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 19.0**

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:

$$F_{CH4,BL,y} = \max\{F_{CH4,BL,R,y};\ F_{CH4,BL,sys,y}\}$$ **(16) equation of the ACM0001 V 19.0**

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 Peru 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 19.0. 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 19.0**

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*

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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.

Project Emissions

To estimate the project emissions, the ACM0001 V 19.0, 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 19.0**

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:

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

Eliminado: 1) Determination of project emissions from flaring

According to the "Tool to determine project emissions from flaring gases containing methane", determination of the hourly flare efficiency depends on the operation of flare (e.g. temperature), the type of flare used (open or enclosed) and, in case of enclosed flares, the approach selected to determine the flare efficiency (default value or continuous monitoring).

Since the project will use enclosed flare, the temperature in the exhaust gas of the flare is measured to determine whether the flare is operating or not.

The continuous monitoring of the methane destruction efficiency of the flare has been chosen taking into account that if there is no record of the temperature of the exhaust gas of the flare or if the recorded temperature is less than 500 °C for more than 20 minutes for any particular hour, it shall be assumed that during that hour the flare efficiency is zero.

In the proposed project activity, the flare efficiency will be continuously monitored on a minute basis.

However, for being conservative, the set default value of 90% for the methane destruction efficiency of the flare was applied for the required emission reduction estimates.

Project emissions from flaring of the residual gas stream (PEflare) have to be determined according to the

procedure described in the "Tool to determine project emissions from flaring gases containing methane". In the following equations of the tool, all seven steps will be described below:

STEP 1. Determination of the mass flow rate of the residual gas that is flared

This step calculates the residual gas mass flow rate in each hour h, based on the volumetric flow rate 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.

<object>

Where

<object>

Variable

...

Eliminado:

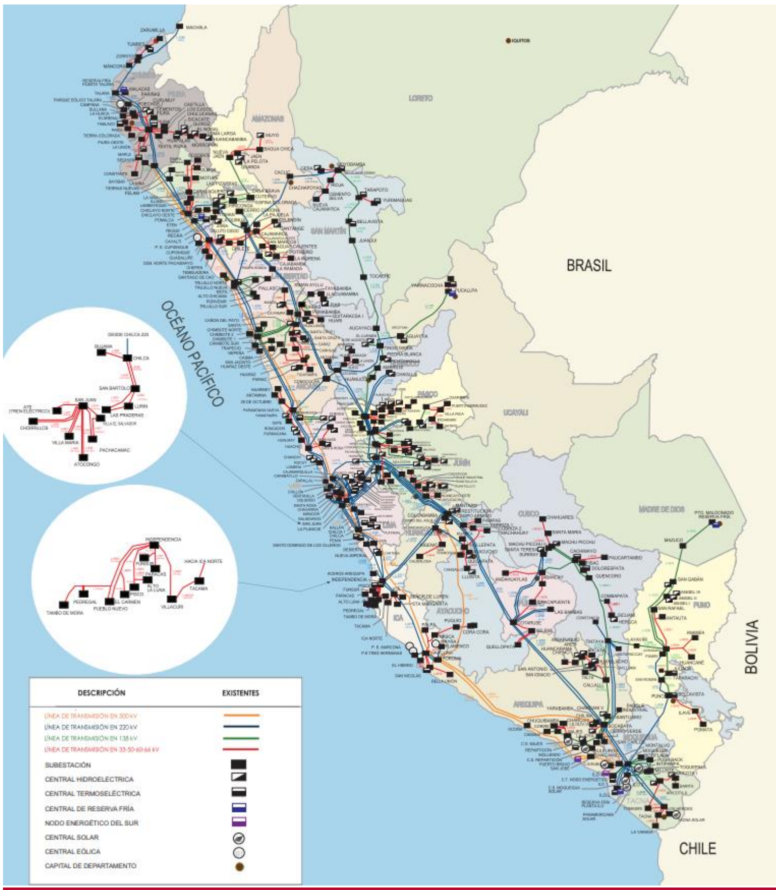
$PE_{EC,y}$	Are the project emissions from electricity consumption by the project activity during the year y (tCO_2 / yr)
$EC_{PJ,y}$	Is the quantity of electricity consumed by the project activity during the year y (MWh),
$EF_{EL,j,y}$	Is the emission factor for the grid in year y (tCO_2/MWh)
$TDL_{j,y}$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

Step 1: Identify the relevant electricity systems

Option 1 was chosen. A delineation of the project electricity system and connected electricity systems published by the DNA or the group of the DNAs of the host country(ies). In this case, the electricity system is delineated by the COES, The Economic Operation Committee ff the National Interconnected System of Peru:



National Electricity Grid Delineation from the COES (Peru)

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

Option 1 was chosen, only grid power plants are included in the calculation.

Step 3: Select a method to determine the operating margin (OM)

As Low-cost/must-run resources constitute more than 50 per cent of total grid generation (excluding electricity generated by off-grid power plants) in average of the five most recent years (2015, 2016, 2017, 2018 and 2019), simple Adjusted OM method was chosen.

Additionally, ex-ante option has been chosen for the emission factor calculation. Thus, the emission factor is determined once at the validation stage, and no monitoring and recalculation of the emissions factor during the crediting period is required. The 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation has been used, thus, the years selected have been 2017, 2018 and 2019 as there are the most recent years with official electricity generation records available in the time of submission of this PDD to the DOE for Validation.

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

Simple adjusted OM procedure was selected for the calculation. The simple adjusted OM emission factor ($EF_{grid,OM-adj,y}$) is a variation of the simple OM, where the power plants/units (including imports) are separated in low-cost/must-run power sources (k) and other power sources (m). As under Option A of the simple OM, it is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

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

Where:

$EF_{grid,OM-adj,y}$	Simple adjusted operating margin CO2 emission factor in year y (t CO2/MWh)
λ_y	Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year y
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EG_{k,y}$	Net quantity of electricity generated and delivered to the grid by power unit k in year y (MWh)
$EF_{EL,m,y}$	CO2 emission factor of power unit m in year y (t CO2/MWh)
$EF_{EL,k,y}$	CO2 emission factor of power unit k in year y (t CO2/MWh)
m	All grid power units serving the grid in year y except low-cost/must-run power units
k	All low-cost/must run grid power units serving the grid in year y
y	The relevant year as per the data vintage chosen in Step 3

$EF_{EL,m,y}$ is calculated as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y}\times NCV_{i,y}\times EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$	CO2 emission factor of power unit m in year y (t CO2/MWh)
$FC_{i,m,y}$	Amount of fuel type i consumed by power unit m in year y (Mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	CO2 emission factor of fuel type i in year y (t CO2/GJ)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
m	All power units serving the grid in year y except low-cost/must-run power u nits
i	All fuel types combusted in power unit m in year y
y	The relevant year as per the data vintage chosen in Step 3

$EF_{EL,k,y}$ is calculated in the same manner as **$EF_{EL,m,y}$** but considering the low-cost/must-run power units k.

$EG_{m,y}$ and $EG_{k,y}$ are determined as per the provisions in the monitoring tables used from the COES (Committee of Economic Operation of the National Interconnected System of Peru).

The parameter λy is defined as follows:

$$\lambda_y(per\ cent) = \frac{Number\ of\ hours\ \text{low}-\text{cost/must}-\text{run}\ are\ on\ the\ margin\ in\ year\ y}{8760\ hours\ per\ year}$$

In this case, the Approach 2, using the appendix 3 of the "*Tool to calculate the emission factor for an electricity system*" ***V.7.0***. has been used to determine λy for the years 2017, 2018 and 2019.

For λy calcilation, the UNFCCC official excel spreadsheet "Table to calculate the emission factor for an electricity system (version 04.0) has been used. In the case of λ_{2017} and λ_{2018}, lambda values are N/A in the official excel spreadhseet as there is not intersection and it is considered that λ =0. In the case of λ_{2019}, there is intersection and λ_{2019} value = 0.00273.

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

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

The sample group of power units m used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\ units}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20 per cent of AEG_{total} (if 20 per cent falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) (SET≥20 per cent) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20}$ per cent, in MWh);

(c) From $SET_{5\text{-}units}$ and SET≥20 per cent select the set of power units that comprises the larger annual electricity generation (SET_{sample}); Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. In this case ignore Steps (d), (e) and (f). In this renewal, some power units in SET_{sample} started to supply electricity to the grid more than 10 years ago so the step (d) have been followed.

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20 per cent of the annual electricity generation of the project electricity system (if 20 per cent falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}}$

sample-CDM, in MWh); If the annual electricity generation of that set is comprises at least 20 per cent of the annual electricity generation of the project electricity system (i.e. $AEGSET_{sample-CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample-CDM}$ to calculate the build margin. Ignore Steps (e) and (f).

The build margin emissions factor is the generation-weighted average emission factor (t CO2/MWh) of all power units m during the most recent year y for which electricity generation data is available, calculated as follows:

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

Where:

$EF_{grid,BM,y}$	Build margin CO2 emission factor in year y (t CO2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	CO2 emission factor of power unit m in year y (t CO2/MWh)
m	Power units included in the build margin
y	Most recent historical year for which electricity generation data is available

Step 6: Calculate the combined margin emissions factor

Option (a) Weighted average has been used for the CM calculation:

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

$EF_{grid,BM,y}$	Build margin CO2 emission factor in year y (t CO2/MWh)
$EF_{grid,OM,y}$	Operating margin CO2 emission factor in year y (t CO2/MWh)
w_{OM}	Weighting of operating margin emissions factor (per cent)
w_{BM}	Weighting of build margin emissions factor (per cent)

The following default values have been used for w_{OM} and w_{BM}: $w_{OM} = 0.5$ and $w_{BM} = 0.5$ for the first crediting period, and $w_{OM} = 0.25$ and $w_{BM} = 0.75$ for the second and third crediting period.

Considering this, the build margin CO_2 emission factor in year 2019 is **0.43676** t CO_2/MWh.

$PE_{FC,y}$ will be calculated using the "*Tool to calculate project or leakage CO_2 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 CO_2 emission coefficient of those fuels, as follows:

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

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.

Leakage

No leakage effects are accounted for under this methodology.

Eliminado: Emission Reductions¶
$ER_y = BE_y - PE_y$¶
¶
where:¶
<object>¶
ER_y ...

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.

<table>
<tr><td>Data/Parameter</td><td>$BE_{CH4, SWDS,y}$</td></tr>
<tr><td>Data unit</td><td>tCO_2e</td></tr>
<tr><td>Description</td><td>Methane generation from the landfill in the absence of the project activity at year y</td></tr>
<tr><td>Source of data</td><td>Calculated as per the “Emissions from solid waste disposal sites” – (Version 08.0)</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th>Start Date</th><th>End Date</th><th>$BE_{CH4,SWDS,y}$ ($t\ CO_2e$)</th></tr>
<tr><td>20/08/2019</td><td>19/08/2020</td><td>562,796</td></tr>
<tr><td>20/08/2020</td><td>19/08/2021</td><td>612,751</td></tr>
<tr><td>20/08/2021</td><td>19/08/2022</td><td>662,523</td></tr>
<tr><td>20/08/2022</td><td>19/08/2023</td><td>712,480</td></tr>
<tr><td>20/08/2023</td><td>19/08/2024</td><td>762,954</td></tr>
<tr><td>20/08/2024</td><td>19/08/2025</td><td>814,242</td></tr>
<tr><td>20/08/2025</td><td>19/08/2026</td><td>866,615</td></tr>
<tr><td colspan="2">Total</td><td>4,994,362</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>As per the “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>Used for ex-ante estimation of the amount of methane that would have been destroyed/combusted during the year</td></tr>
</table>

<table>
<tr><td>Data/Parameter</td><td>φ</td></tr>
<tr><td>Data unit</td><td>-</td></tr>
<tr><td>Description</td><td>Model correction factor to account for model uncertainties</td></tr>
<tr><td>Source of data</td><td>As per the “Emissions from solid waste disposal sites” (Version 08.0)</td></tr>
<tr><td>Value(s) applied</td><td>0.75</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>
<table>
<tr><th></th><th>Humid/wet conditions</th><th>Dry conditions</th></tr>
<tr><td>Application A</td><td>0.75</td><td>0.75</td></tr>
<tr><td>Application B</td><td>0.85</td><td>0.80</td></tr>
</table>
</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>Not applicable</td></tr>
</table>

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 19.0 "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 19.0 "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

Data/Parameter	**k_j**
Data unit	-
Description	Decay rate for the waste type *j*.
Source of data	IPCC 2006 Guidelines for Nationall Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value(s) applied	see table below
Choice of data or measurement methods and procedures	The Modelo de Callao Landfill is located in Lima (Perú), which has a mean annual temperature (MAT) of 19.4ºC and mean annual precipitation (MAP) of 13 mm. Data on potential evapotranspiration (PET) is 1. Therefore, the site is based in a Boreal and Temperate in dry climatic conditions (MAT<20ºC) and dry precipitations (MAP<1000 mm)
Purpose of data	Calculation of baseline emissions
Additional comment	The conditions of the LFS have sourced at: http://worldweather.wmo.int/en/city.html?cityId=109

Value(s) applied:

	Waste type *j*	Boreal and Temperate (MAT≤20°C)		Tropical (MAT>20°C)	
		Dry (MAP/PET <1)	Wet (MAP/PET >1)	Dry (MAP< 1000mm)	Wet (MAP> 1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
Slowly degrading	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.10	0.065	0.17
Rapidly degrading	Food, food waste, beverages and tobacco (other than sludge)	0.06	0.185	0.085	0.40

Data/Parameter	**$EF_{grid, OM, y}$**
Data unit	tCO_2/MWh
Description	Operating margin CO_2 emission factor in year y
Source of data	Calculated as per the "Tool to calculate the emission factor for an electricity system" Version 7.0. See detailed calculation in sheets provided to DOE
Value(s) applied	0.57048
Choice of data or measurement methods and procedures	Calculated as per the "Tool to calculate the emission factor for an electricity system" Version 7.0
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	$EF_{grid, BM, y}$
Data unit	tCO2/MWh
Description	Build margin CO2 emission factor in year y
Source of data	Calculated as per the "Tool to calculate the emission factor for an electricity system" Version 7.0. See detailed calculation in sheets provided to DOE
Value(s) applied	0.38676
Choice of data or measurement methods and procedures	Calculated as per the "Tool to calculate the emission factor for an electricity system" Version 7.0
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	$EF_{grid, CM, y}$
Data unit	tCO2/MWh
Description	Combined margin emissions factor in year y
Source of data	Calculated as per the "Tool to calculate the emission factor for an electricity system" Version 7.0. See detailed calculation in sheets provided to DOE
Value(s) applied	0.43268
Choice of data or measurement methods and procedures	Calculated as per the "Tool to calculate the emission factor for an electricity system" Version 7.0
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:	$FC_{i,m,y}$, $FC_{i,y}$, $FC_{i,k,y}$, $FC_{i,n,y}$ ***and*** $FC_{i,n,h}$
Data unit:	Mass or volume unit
Description:	Amount of fuel type *i* consumed by power plant/unit *m*, *k* or *n* (or in the project electricity system in case of $FC_{i,y}$) in year *y* or hour *h*
Source of data:	COES (Committee of Economic Operation of the National Interconnected System of Peru).
Measurement procedures (if any):	-
Monitoring frequency:	Simple adjusted OM: Either once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option). Years 2017, 2018 and 2019 have been used as most recent official data. BM: For the first crediting period, either once ex ante. For the second and third crediting period, only once ex ante at the start of the second crediting period.
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ/mass or volume unit
Description:	Net calorific value (energy content) of fuel type *i* in year *y*

Source of data:	IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Measurement procedures (if any):	-
Monitoring frequency:	Simple adjusted OM: Either once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option). BM: For the first crediting period, either once ex ante. For the second and third crediting period, only once ex ante.
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	***$EF_{CO2,i,y}$* and *$EF_{CO2,m,i,y}$***
Data unit:	t CO_2/GJ
Description:	CO_2 emission factor of fuel type *i* used in power unit *m* in year *y*
Source of data:	IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Measurement procedures (if any):	-
Monitoring frequency:	Simple adjusted OM: Either once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option). BM: For the first crediting period, either once ex ante. For the second and third crediting period, only once ex ante.
QA/QC procedures:	-
Any comment:	For biofuels the value applied to the CO_2 emission factor is zero

Data / Parameter:	***$EG_{m,y}$*, *EG_y*, *$EG_{k,y}$* and *$EG_{n,h}$***
Data unit:	MWh
Description:	Net electricity generated by power plant/unit *m, k* or *n* (or in the project electricity system in case of *EGy*) in year *y* or hour *h*
Source of data:	COES (Committee of Economic Operation of the National Interconnected System of Peru).
Measurement procedures (if any):	-
Monitoring frequency:	Simple adjusted OM: Either once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option). BM: For the first crediting period, either once ex ante. For the second and third crediting period, only once ex ante.
QA/QC procedures:	-
Any comment:	-

Data/Parameter	$\eta_{flare,m}$
Data unit	%
Description	Flare Efficiency in the minute m
Source of data	As per “Project emissions from flaring” (Version 03.0.0)
Value(s) applied	0.9
Choice of data or measurement methods and procedures	Default value of flare efficiency will be used to calculate the amount of methane destroyed by flaring ex post as per Option A of “Project emissions from flaring” version 03.0.0.
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 03.0.0. 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 03.0.0, 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 19.0, 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 19.0, 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

Ex ante calculation 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 19.0:

Table 2: Annual calculation for BECH4,y

Period			BE_{CH4} (tonnes of CO2)
Period Year	Start Date	End Date	
1	20/08/2019	19/08/2020	267,547
2	20/08/2020	19/08/2021	289,157
3	20/08/2021	19/08/2022	311,546
4	20/08/2022	19/08/2023	334,112
5	20/08/2023	19/08/2024	357,999
6	20/08/2024	19/08/2025	380,321
7	20/08/2025	19/08/2026	404,205
Total			2,344,887
Annual average			334,984

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

Eliminado: The ex-ante emission reduction calculation requires the estimation of several values. Most of the estimated parameters can be found under Section B.6.2. including inter alia the estimation of landfill gas production from the waste at the site, the prognosis of the waste deposit for the crediting period, the LFG collection efficiency and the adjustment factor.¶
¶
According to the proposed project activity, the collected LFG would be destroyed in a high efficient flaring facility.¶
¶
In order to estimate the emission reductions generated by the project activity the flare efficiency and the operating hours of the flare needed to be assumed.¶
¶
For conservativeness, the estimations assume a default flare efficiency of 90% as recommended in the "Tool to determine project emissions from flaring gases containing methane". However, as from the moment when the entire measurement equipment for continuous measurement of the fraction of methane in the exhaust gas is installed and is operational, the flare efficiency will be monitored continuously ex-post and the default value only applies according to Step 6 of the Tool to determine project emissions from flaring gases containing methane.¶
¶
Based on the formulae given in section B.6.1., and the parameters presented in section B.6.2., the estimated emission reductions due to the project activity are calculated as below, giving the following results:¶

Eliminado: ¶
<object>¶
¶
1. MD $_{project,y}$¶
¶
<#>Estimated amount of methane destroyed by the project activity – Sum of quantities fed to the flare: ¶
<object>¶
¶
¶
Table 7¶

Year	$MD_{project,y}$ (tCH_4)	$MD_{flared,y}$ (tCH_4)
June 2012	1,157	1,157
2013	2,171	2,171
2014	2,491	2,491
2015	2,806	2,806
2016	3,118	3,118
2017	3,428	3,428
2018	3,734	3,734
May 2019	1,609	1,609
Total	20,514	20,514

¶
<object><object>¶
Where the quantity of methane destroyed by flaring was calculated using the following equation:¶
<object>¶
¶
¶
¶
Table 8¶
¶
...

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 19.0:

Table 3: Annual calculation for FCH4,PJ,y

Period			$F_{CH4,PJ,y}$ (tonnes of CH_4)
Period Year	Start Date	End Date	
1	20/08/2019	19/08/2020	11,891
2	20/08/2020	19/08/2021	12,851
3	20/08/2021	19/08/2022	13,846
4	20/08/2022	19/08/2023	14,849
5	20/08/2023	19/08/2024	15,911
6	20/08/2024	19/08/2025	16,903
7	20/08/2025	19/08/2026	17,965
Total			**104,216**
Annual average			**14,888**

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	20/08/2019	19/08/2020	9,969
2	20/08/2020	19/08/2021	9,969
3	20/08/2021	19/08/2022	9,969
4	20/08/2022	19/08/2023	9,969
5	20/08/2023	19/08/2024	9,969
6	20/08/2024	19/08/2025	9,969
7	20/08/2025	19/08/2026	9,969
Total			**69,783**
Annual average			**9,969**

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	20/08/2019	19/08/2020	19,200
2	20/08/2020	19/08/2021	19,200
3	20/08/2021	19/08/2022	19,200
4	20/08/2022	19/08/2023	19,200

5	20/08/2023	19/08/2024	19,200
6	20/08/2024	19/08/2025	19,200
7	20/08/2025	19/08/2026	19,200
Total			**134,400**
Annual average			**19,200**

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 19.0:

Table 6: *Annual calculation for BE_y*

Period			**BE_y (tCO2e)**
Period Year	**Start Date**	**End Date**	
1	20/08/2019	19/08/2020	277,516
2	20/08/2020	19/08/2021	299,126
3	20/08/2021	19/08/2022	321,515
4	20/08/2022	19/08/2023	344,081
5	20/08/2023	19/08/2024	367,968
6	20/08/2024	19/08/2025	390,290
7	20/08/2025	19/08/2026	414,174
Total			**2,414,670**
Annual average			**344,953**

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	20/08/2019	19/08/2020	72
2	20/08/2020	19/08/2021	72

Eliminado: 1) Determination of annual project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions from each hour *h*, based on the methane flow rate in the residual gas ($TM_{RG,h}$) and the flare efficiency during each hour *h* ($\eta_{flare,h}$), as follows:

<object>

TMRG,h is calculated with the following equation:

<object>

Table 12

Year	$FV_{RG,y}$ (Nm^3)	$TM_{RG,y}$ (kg)	$PE_{flare,y}$ (tCO_2e)
June 2012	3,586,093	1,285,256	2,699
2013	6,730,184	2,412,098	5,065
2014	7,721,182	2,767,272	5,811
2015	8,699,849	3,118,026	6,548
2016	9,667,749	3,464,921	7,276
2017	10,626,391	3,808,498	7,998
2018	11,577,227	4,149,278	8,713
May 2019	4,988,399	1,787,842	3,754
Total	**63,597,074**	**22,793,191**	**47,864**

<object><object><object><object><object><object><object>

These project emissions are already included in the calculation of equation (8), therefore, they shall not be deducted again in the overall emission reduction calculation.

<object>

$$PE_{EC,y} = EC_{PJ,y} * EF_{EL,j,y} * (1+TDL_y)$$

The 20% default value is applied for the technical transmission and distribution losses. The grid factor (**$EF_{EL,j,y}$**) used for the calculation is the default value of 1.3 tCO_2/kWh.

Table 13

Year	$EC_{PJ,y}$ (MWh)	TDLy (%)	$EF_{EL,j,y}$ (tCO_2/MWh)	PE (tC
June 2012	193	0.20	1.3000	30
2013	332	0.20	1.3000	51
2014	332	0.20	1.3000	51
2015	332	0.20	1.3000	51
2016	332	0.20	1.3000	51
2017	332	0.20	1.3000	51
2018	332	0.20	1.3000	51
May 2019	138	0.20	1.3000	21

3	20/08/2021	19/08/2022	72
4	20/08/2022	19/08/2023	72
5	20/08/2023	19/08/2024	72
6	20/08/2024	19/08/2025	72
7	20/08/2025	19/08/2026	72

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	20/08/2019	19/08/2020	0
2	20/08/2020	19/08/2021	0
3	20/08/2021	19/08/2022	0
4	20/08/2022	19/08/2023	0
5	20/08/2023	19/08/2024	0
6	20/08/2024	19/08/2025	0
7	20/08/2025	19/08/2026	0
Total			**0**
Annual average			**0**

The project emissions in the project activity are calculated as per equation (21) of the ACM0001 Version 19.0, with the following results:

Table 9: *Annual calculation for PE,y*

Period			$PE_{,y}$ (tCO2)
Period Year	**Start Date**	**End Date**	
1	20/08/2019	19/08/2020	72
2	20/08/2020	19/08/2021	72
3	20/08/2021	19/08/2022	72
4	20/08/2022	19/08/2023	72
5	20/08/2023	19/08/2024	72
6	20/08/2024	19/08/2025	72
7	20/08/2025	19/08/2026	72
Total			**504**
Annual average			**72**

Ex ante calculation of Leakage

No leakage effects are accounted for under this methodology.

Eliminado: No leakage effects need to be accounted under the selected methodology, ACM0001 version 11.

Eliminado: ¶

Ex ante calculation of Emission reductions

The emissions reductions expected from the project activity are calculated as per equation (26) of the ACM0001 Version 19.0, with the results shown in the following point B.6.4.

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

Eliminado: Year

Year	Baseline emissions ($t\ CO_2e$)	Project emissions ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions ($t\ CO_2e$)
1	277,516	72	0	277,443
2	299,126	72	0	299,054
3	321,515	72	0	321,443
4	344,081	72	0	344,009
5	367,968	72	0	367,895
6	390,290	72	0	390,217
7	414,174	72	0	414,102
Total	**2,414,670**	**504**	**0**	**2,414,163**
Total number of crediting years	7 years			
Annual average over the crediting period	**344,953**	**72**	**0**	**344,880**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Eliminado: Data / Parameter

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 19.0, 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 19.0, 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	$V_{LFG,total,y,db}$[21]
Data unit	m^3 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

[21] 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.

Value(s) applied	<table><tr><th>Year Period</th><th>$V_{LFG,total,y,db} = LFG_{total,y}$</th></tr><tr><td>1</td><td>33,177,932</td></tr><tr><td>2</td><td>35,857,805</td></tr><tr><td>3</td><td>38,634,189</td></tr><tr><td>4</td><td>41,432,582</td></tr><tr><td>5</td><td>44,394,712</td></tr><tr><td>6</td><td>47,162,780</td></tr><tr><td>7</td><td>50,124,639</td></tr></table>
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	$V_{LFG,sent\_flare,y,db}$[22]
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	<table><tr><th>Year Period</th><th>$V_{LFG,sent\_flare,y,db} = LFG_{flare,y}$</th></tr><tr><td>1</td><td>25,189,235</td></tr><tr><td>2</td><td>27,869,108</td></tr><tr><td>3</td><td>30,645,491</td></tr><tr><td>4</td><td>33,443,885</td></tr><tr><td>5</td><td>36,406,015</td></tr><tr><td>6</td><td>39,174,082</td></tr><tr><td>7</td><td>42,135,941</td></tr></table>

[22] 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.

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	**$V_{LFG,EL,y,db}$**[23]
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	(see table below)

Year Period	**$V_{LFG,EL,y,db} = LFG_{electricity,y}$**
1	7,988,697
2	7,988,697
3	7,988,697
4	7,988,697
5	7,988,697
6	7,988,697
7	7,988,697

[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.

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	**$Maintenance_y$**
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	. 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	**$EG_{PJ,y}$**
Data unit	MWh
Description	Amount of electricity generated using LFG by the project activity in year y
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>$EG_{PJ,y}$</th></tr><tr><td>1</td><td>19,200</td></tr><tr><td>2</td><td>19,200</td></tr><tr><td>3</td><td>19,200</td></tr><tr><td>4</td><td>19,200</td></tr><tr><td>5</td><td>19,200</td></tr><tr><td>6</td><td>19,200</td></tr><tr><td>7</td><td>19,200</td></tr></table>
Measurement methods and procedures	Electricity meter will be used to measure $EG_{PJ,y}$ 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 ($EG_{PJ,y}$) 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	<table><tr><th>Year Period</th><th>$EG_{EC,y}$[24]</th></tr><tr><td>1</td><td>139.6</td></tr><tr><td>2</td><td>139.6</td></tr><tr><td>3</td><td>139.6</td></tr><tr><td>4</td><td>139.6</td></tr><tr><td>5</td><td>139.6</td></tr><tr><td>6</td><td>139.6</td></tr><tr><td>7</td><td>139.6</td></tr></table>
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 2nd Monitoring Period, from 20/08/2014 to 31/12/2016.

Data/Parameter	$Op_{engine,h}$
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, Opengine,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: • Opengine,h=0 when no net quantity of electricity is generated using LFG in the hour h. • Opengine,h=1 when net quantity of electricity is generated using LFG in the hour h.
Monitoring frequency	Hourly

[24] Ex-ante values based on measured data 2nd Monitoring Period, from 20/08/2014 to 31/12/2016

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	**Year Period** / **$PE_{EC,y}$**: 1 – 72; 2 – 72; 3 – 72; 4 – 72; 5 – 72; 6 – 72; 7 – 72
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.

Year Period	**$PE_{EC,y}$**
1	72
2	72
3	72
4	72
5	72
6	72
7	72

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	

Year Period	**$FC_{i,j,y}$**
1	0
2	0
3	0
4	0
5	0
6	0
7	0

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.

Eliminado: Not applicable.

B.7.3. Other elements of monitoring plan

The Monitoring Plan (MP) details the actions necessary to record all the variables and factors required by the methodology, as explained in section B.7.1 above. All data will be archived electronically, and backed up regularly. Moreover, this information will be kept for the full crediting period, plus two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Project staff will be trained regularly in order to satisfactorily fulfill their monitoring obligations. The authority and responsibility for project management, monitoring, measurement and reporting will be agreed between the project participants and formalized. Procedures will be established for calibration of monitoring equipment, maintenance of monitoring equipment and installations, and for records handling. As the project construction proceeds, the MP will be finalized to be ready for implementation at the start of project operation.

Eliminado: The full version of the MP is attached to this PDD as Annex 4.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

20/08/2012

Eliminado: 03/12/2010

C.2. Expected operational lifetime of project activity

Eliminado: ¶

C.3. 21 y – 0m Crediting period of project activity

Eliminado: The landfill is expected to have an operating lifetime of approximately 22 years.

Eliminado: ¶

C.3.1. Type of crediting period

Renewable. Second crediting period.

C.3.2. Start date of crediting period

20/08/2019

Eliminado: 01/06/2012

C.3.3. Duration of crediting period

Eliminado: ¶

7 years.

Eliminado: Seven (7) years with the option of two renewal periods.

SECTION D. Environmental impacts

Eliminado: ¶

D.1. Analysis of environmental impacts

The proposed CDM project activity will bring positive environmental impacts since it will improve overall landfill management, thereby reducing adverse global and local environmental effects of uncontrolled releases of LFG. While the main global environmental concern with gaseous emissions of methane is that it is a potent greenhouse gas, emissions of LFG can also have significant health and safety implications at the local level.

The existing Modelo del Callao landfill complies with local regulations on final solid waste disposal management as stipulated under the General Solid Waste Law of July 2000 and its corresponding Decree No 057-04- PCM. This law assigns responsibilities on waste management, and brings environmental protection specifications in the selection, operation, monitoring and closure of final disposal sites of MSW.

Article 9, paragraph 5 of the General Solid Waste Law stipulates that provincial municipalities are responsible for MSW within their boundaries and have the authority to approve and authorize the commissioning of SWM projects, including disposal. According to this, the provincial Municipality of Callao through Resolution No. 196-2006-MPC-GGPMA has determined that Modelo del Callao fulfills all the requirements established in Article 85 of the General Solid Waste Law on Guidelines in order to be qualified as a landfill, and has also authorized its operation.

The concession for the administration and operation of the landfill was given for 30 years and established that the use and exploitation of the LFG belongs to the Project Developer. If the CDM project produces profits, these will be shared with the municipality.

The General Solid Waste Law recommends installing systems for LFG collection, control and monitoring but it does not stipulate any regulatory percentage of the LFG to be controlled. Furthermore, under the Law, venting wells without any flaring (which would not destroy any CH_4 but simply avoid explosions) are not directly prohibited. Therefore, the Project will not only comply with the local regulation, but even surpass it through the installation of a well-designed LFG collection and destruction system. This system will be properly operated since the Project Developer will try to capture and destroy as much LFG as possible in order to maximize the CDM revenues. Specifically, the LFG will be captured and combusted in a controlled manner, thereby reducing the safety risks, as well as the risks of toxicity, for the surrounding local community and the local environment, while also reducing the emissions of a potent greenhouse gas.

The World Bank financed the feasibility study for the registered CDM project, Huaycoloro LFG Capture and Flaring, which is also owned by the Project Developer. The feasibility study for Huaycoloro clearly stated that the construction of the LFG collection system and the monitoring of the LFG results in positive environmental impacts because these actions minimize the negative effects of the LFG and the risks of the landfill. Given that the Modelo del Callao landfill will utilize the same technology as Huaycoloro, which is currently in operation, similar positive environmental impacts are expected from Modelo del Callao as well.

Thus, the project activity can be referred to as environmentally beneficial and therefore, cannot be considered subject to an environmental certification in the Host Country according to the Law On the National System for Environmental Impact Assessment , Articles 2 and 3.

D.2. Environmental impact assessment

No significant negative impacts are expected, as discussed in section D.1. However, we have added in section D.2 a list of potential environmental impacts and how the sponsor will mitigate those impacts. This analysis has made according to what have been implemented in the Peruvian CDM LFG registered project of Huaycoloro, which belongs to the project sponsor.

Construction Phase:

- Machinery translation: The noise generated by the machinery movement in the construction phase, eventually could be perturbing. To avoid it, the use of Ear plugs are recommended to people exposed to excessively noisy devices. In addition if necessary, mufflers should be installed in the vehicles that transport the equipment. Mufflers should be required to all vehicles that enter the project site. Moreover, it will be prohibited that vehicles' motors are turned on for unnecessary long periods of time both out and inside the landfill territory. The transportation of the equipment for the project construction should be done in the schedule that is most convenient in order to avoid disturbing the population who live nearby.

- Drilling for the LFG capture: It should be assured that the employees involved count with personal protection equipment, which is worn correctly. Vehicles' motors should be turned off and be far away from the drilling wells, during the drilling. It should be assured the optimal operational condition of the machinery that will do the drilling, before proceeding to do the drilling. The personnel that will perform the drilling should be prepared to verify the machinery conditions.

- Installation of the LFG capture-equipment: A previous check of the optimal operational conditions of the equipment, adequately programming of the drilling works, sealing of the wells immediately after the drilling, should be performed. With regards to bad odors, the personnel in charge of this activity should count necessarily with masks to avoid them.

Operations Phase:

- Condensation of liquids: A preventive maintenance and periodic controls of the state of the mechanical equipment involved in the transportation and storage of the liquids after their condensation should be enforced. Continuous supervision of the infrastructure built for the liquids transportation should be performed. The liquids should be discharged periodically into the wells. LFG utilization equipment: Disturbing noises should be minimized/avoided. Audition blockage devices should be provided to employees in case the noise exceeds the limit imposed by local regulations. All machinery involved should keep optimal operational conditions.

- Noise: To mitigate the impact of noises against health and security during operation, machinery maintenance should be performed. Moreover, the plant personnel should use audition protection, in case noises go over the limit imposed by local regulation.

- Condensate liquids: A preventive maintenance and functions control of all the installations used by condensated liquids (this includes the valves, tubes, tramps, capturing wells) should be performed to avoid a negative impact in the ground and underground level of LFG recovery plant. With regards to health and security of the personnel, they should wear all the recommended clothes and gadgets (overall, plastics boots, gloves, masks, etc.).

- Personnel's health risk: To mitigate the impacts that the plant operations could generate in the health and security of workers, training to the personnel should be performed regarding all their functions/roles in the project.

- Accidents and contamination risks: To mitigate impacts that the project can originate to the workers' security and health, training should be done for the personnel regarding how to proceed under accidents occurrences or in case of an eventual intoxication for the inhalation of the LFG or accidental swallow of the condensated liquids. Additionally, a supervision of the personnel' clothes and wearing devices should be performed.

Closing of the landfill phase:

De-installation of the infrastructure and machinery: The impacts in this phase are similar to the ones identified in the construction phase; in consequence, the mitigation of environmental risks in this phase is similarly achieved. One of the risks to take into account is the temporary bad-odor created during the deinstallation of the equipment; this should be prevented by the personnel through the use of masks.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

The Project Developer, PETRAMAS, invited local authorities of the communities located near to the project site to a public consultation to take place on 23/08/2008. The invitation letter announced the intention of the Project Developer to develop the CDM project of Landfill Gas Capture and Flaring at the Modelo del Callao landfill. The letter also announced that at the consultation, the Project Developer expected to sign an agreement to support the local community in the supply of water for human consumption and in the collection of municipal waste. The authorities invited to the meeting were: Mrs. Nasaria Quispe Hilargo, from the community of Virgen del Carmen, Mr. Orlando Faria Gonzales from the community of Virgen de las Mercedes, and Mr. Carlos Alvarado Ramos from the community of 18 de Octubre.

The meeting was held on 23 August 2008 at the landfill. Representing the Project Developer were the engineers, Manuel Lastarria, Valery Mautino, Jefferson Campos and Wiliam Segura. Representing the local communities were Nazario Quispe (Virgen del Carmen), Orlando Farias (Virgen de Las Mercedes), Carlos Alvarado (18 de Octubre) and Sebastian Cano (Virgen de Las Mercedes). An additional 26 local inhabitants also attended the meeting.

Representatives of the Project Developer informed the attendees on the improvements to the landfill and the future CDM project. They explained the benefits that a well-managed landfill can bring to the community. They also provided an opportunity for the local community representatives to air their concerns. In closing, they reasserted the Project Developer's commitments to the local population.

The municipal authority of El Callao was informed of the potential CDM project at the time of signing the concession contract for the operation of the landfill. This contract signed in November 2003, indicated that the concession is for 30 years and that the concessionary has the right to develop additional activities. If these activities bring economic benefits, a percentage of these will go to the municipality. In a recent addendum to this contract, it is mentioned that one of these activities could be a CDM project.

E.2. Summary of comments received

All the attendees to the 23/08/2008 public consultation agreed with the plans of the Project Developer. Some attendees asked for the collection of municipal waste and the provision of waste containers for the most remote areas. Others asked for an analysis of the local drinking water. Others requested that drinking water be brought in by tankers. Some others suggested that the Project Developer get outside support in providing better quality drinking water to the community.

E.3. Consideration of comments received

In response to the requests from the local community, the Project Developer committed to undertake the following:

- to perform a quality analysis of the drinking water that is delivered by tankers to the communities of Virgen de Las Mercedes, Virgen del Carmen, and 18 de Octubre;
- to deliver three tankers of drinking water weekly for these three communities;
- to collect the solid waste of these three communities;
- to plant trees at the entrance of the landfill, which will be maintained by the local inhabitants; and,
- to organize meetings with the local communities every six months in order to inform the inhabitants on the landfill and the progress of the Project

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	PETRAMAS S.A.C
Country	Peru
Address	Av Tomas Marsano 2813- 8th Floor Santiago de Surco Lima 41
Telephone	(511) 271-6378 -(511) 271-6337
Fax	
E-mail	informes@petramas.com
Website	www.petramas.com
Contact person	Jorge Zegarra

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)

Eliminado: Project participant and/or responsible person/ entity

Eliminado: BASELINE INFORMATION¶
¶
Calculation of $BE_{CH4,SWDS}$¶
¶

Table 1. WASTE 2007 - 2018				
years			$W_{j,x}$	
	j		Food	Wood
	Fraction		0.363	0.018
	W_total (t/y)	Refuse-in		
2007	343,535	343,535	124,703	6,184
2008	435,737	779,272	158,173	7,843
2009	447,295	1,226,567	162,368	8,051
2010	459,152	1,685,718	166,672	8,265
2011	471,316	2,157,035	171,088	8,484
2012	483,796	2,640,831	175,618	8,708
2013	496,599	3,137,429	180,265	8,939
2014	509,733	3,647,162	185,033	9,175
2015	523,207	4,170,368	189,924	9,418
2016	537,029	4,707,397	194,942	9,667
2017	551,209	5,258,606	200,089	9,922
2018	565,755	5,824,362	205,369	10,184

			Food	Wood
	DOCj		0.15	0.43
	kj	best case	0.060	0.020

¶

Without Collection Efficiency

For PDD year	$BE_{CH4,SWDS}$ (tCO2e)	$MD_{project,y}$ (tCH_4)
June 2012	53,981	2,571
2013	101,308	4,824
2014	116,225	5,535
2015	130,957	6,236
2016	145,527	6,930
2017	159,957	7,617
2018	174,270	8,299
May 2019	75,089	3,576
Total	957,314	45,586

W

Salto de página

Eliminado: Not applicable¶

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 19.0 "Flaring or use of landfill gas"
$EC_{PJ,y}$	MWh/yr	139.6	Electricity Consumption, yearly	Based on measured data 2nd Monitoring Period, from 20/08/2014 to 31/12/2016
ηflare,m	%	0.9	Flare Efficiency in the minute m	Default value according to the tool "Project emissions from flaring" version 03.0.0
CEG	MW	1.200	Capacity of Each Generator	Model CG170-12 Caterpillar
GE	%	43.40%	Generator efficiency	https://www.cat.com/es_MX/products/new/power-systems/electric-power-generation/gas-generator-sets/18487630.html
FLGE	m3/h	499.29	Flow LFG each generator	Calculated
Tcn	m3/h	0	Thermal Consumption	NA
ε_{boiler}	%	0	Boiler efficiency	NA
Electrical considerations				
Parameters	Unit	Value	Explanantion	Source
EFgrid,y	tCO2e/MWh	0.4327	Grid Emission Factor	Tool to calculate the emission factor for an electricity system Version 7.0
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

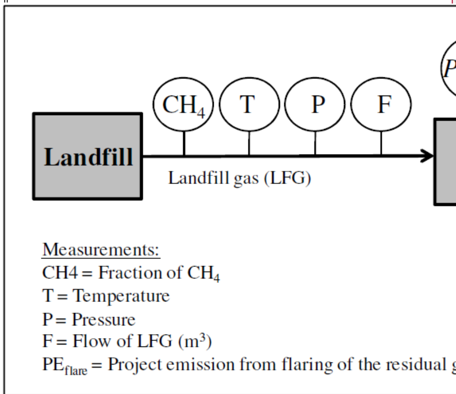
Other parameters				
Parameters	Unit	Value	Explanantion	Source
$PE_{FC,j,y}$	tCO2e/year	0	Emissions from heat consumption by the project activity	Project evaluator
CH_{4LHV}	KJ/mol	890	Methane LHV	IPCC
FCi,j,y	m3/year	0.0000	Fuel consumption	Project developer
NCVi,y	GJ/ m3	26.3000	Weighted average net 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	19.4	Mean Average Temperature	http://worldweather.wmo.int/en/city.html?cityId=108
MAP	mm/year	13	Mean average Precipitation	http://worldweather.wmo.int/en/city.html?cityId=109
PET	mm^3/mm^2	1	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

Year	Waste Input from data (tonnes)	Acumulated	Source
Total	66,630,388	66,630,388	
2004	175,354	175,354	LF Information
2005	208,860	384,214	LF Information
2006	194,485	578,699	LF Information
2007	246,593	825,293	LF Information
2008	295,149	1,120,442	LF Information
2009	465,003	1,585,444	LF Information
2010	663,152	2,248,596	LF Information
2011	695,449	2,944,045	LF Information
2012	910,361	3,854,407	LF Information
2013	978,621	4,833,028	LF Information
2014	872,320	5,705,347	LF Information
2015	915,936	6,621,283	LF Information
2016	961,732	7,583,015	LF Information
2017	1,009,819	8,592,834	LF Information
2018	1,186,250	9,779,084	LF Information
2019	1,277,500	11,056,584	LF Information Calculation
2020	1,341,375	12,397,959	LF Information Calculation
2021	1,408,444	13,806,403	LF Information Calculation
2022	1,478,866	15,285,269	LF Information Calculation
2023	1,552,809	16,838,078	LF Information Calculation
2024	1,630,450	18,468,528	LF Information Calculation
2025	1,711,972	20,180,500	LF Information Calculation
2026	1,797,571	21,978,071	LF Information Calculation
2027	1,887,449	23,865,520	LF Information Calculation
2028	1,981,822	25,847,342	LF Information Calculation
2029	2,080,913	27,928,255	LF Information Calculation
2030	2,184,959	30,113,213	LF Information Calculation
2031	2,294,206	32,407,420	LF Information Calculation
2032	2,408,917	34,816,337	LF Information Calculation
2033	2,529,363	37,345,699	LF Information Calculation
2034	2,655,831	40,001,530	LF Information Calculation
2035	2,788,622	42,790,152	LF Information Calculation
2036	2,928,053	45,718,206	LF Information Calculation
2037	3,074,456	48,792,662	LF Information Calculation
2038	3,228,179	52,020,841	LF Information Calculation
2039	3,389,588	55,410,428	LF Information Calculation
2040	3,559,067	58,969,496	LF Information Calculation
2041	3,737,021	62,706,516	LF Information Calculation
2042	3,923,872	66,630,388	LF Information Calculation

Composition	Waste composition
Glass, plastic, metal, other inert waste	10.00%
Pulp, paper, cardboard (other sludge)	7.00%
Textiles	2.00%
Wood and wood products	2.00%
Garden, yard and park waste	25.00%
Food, food waste, beverages and tobacco (other than sludge)	54.00%

Appendix 5. Further background information on monitoring plan

Eliminado: ¶
TABLE OF CONTENTS¶
¶
I. Background information¶
¶
II. Organizational, Operational and Monitoring Obligations ¶
A. Obligations of the Operator ¶
B. Emissions Reductions Calculation Procedure and Required Spreadsheets ¶
¶
III. Annexes¶
¶
I. Background Information¶
¶
The Baseline and Monitoring Methodology for the Project is in accordance with the approved consolidated baseline methodology, ACM0001 which is applicable to landfill gas capture project activities, where the baseline scenario is the partial or total atmospheric release of the gas.¶
¶
The Modelo del Callao Landfill Gas Capture and Flaring System (the Project) is being developed by PETRAMAS S.A.C. (the Project Developer) as a landfill gas (LFG) collection and flaring project. It is located in Peru, close to the right bank of Chillon River at km 19 on the highway to the district of Ventanilla, in the province of Callao. The landfill has an area of 54 ha and receives around 1,250 t of MSW daily from Callao and the district of San Martin de Porras. The Project aims to reduce CH4 emissions by flaring LFG.¶
¶
The spatial extent of the project boundary is the site of the project activity where the waste is treated. This includes the facilities for processing the waste, as well as the landfill site. The project boundary does not include facilities for waste collection, sorting and transport to the project site.¶
¶
The monitoring methodology is based on direct measurement of the amount of landfill gas captured and destroyed at the flare platform(s) to determine the quantities as shown in Figure bellow. The monitoring plan provides for continuous measurement of the quantity and quality of LFG flared. The main variables that need to be determined are the quantity of methane actually captured MDproject,y, quantity of methane flared (MDflared,y), and the quantity of methane generated (MDtotal,y). The methodology also measures energy consumed by the project activity that is produced using fossil fuels¶
¶



¶
To determine these variables, the following parameters have to be monitored:¶
<#>The amount of landfill gas generated (in m³, using a continuous flow meter), where the total quantity (*LFGtotal,y*) as well as the quantities fed to the flare(s) (*LFGflare,y)*are measured continuous*ly* with equipments calibrated periodically according to the specification of the manufacturer. Since all the LFG goes to the flare , only one ...

Please refer to section B.7.

Appendix 6. Summary report of comments received from local stakeholders

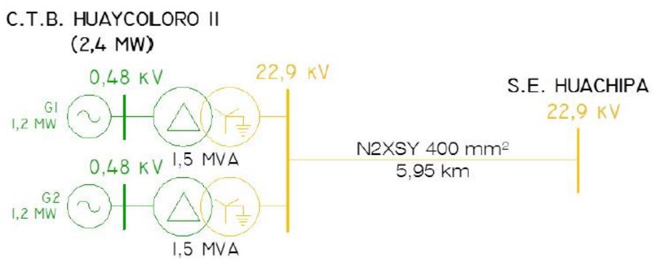
Please refer to Section E.

Appendix 7. Summary of post-registration changes

There is a post-registration change in the project design that is classified under the category (c) of the paragraph 241 of the CDM Project Standard for Project Activities (Version 02.0): Addition of new components or extension/addition of technologies/measures that introduce complimentary technologies/measures involving mass and/or energy transfer to/from the technologies/measures specified in the originally registered PDD.

This design change consists in addition of the electricity generation component in the revised PDD. As the LFG flow has been proven to be steady (in terms of volume and quality) for the electricity generation, a second project phase have been carried out and a reciprocating engine facility has been installed. This phase implies the installation of generating equipment that combust the methane of the LFG in order to produce electricity. Two (2) LFG Engines with capacity of 1.2 MW each (total generation capacity of 2.4 MW) has been installed in 01/06/2018.

This change provides a total capacity of 2.4 MW. The two engines are model Caterpillar (Model CG170-12). The configuration is determined by the following one-line diagram:



The information and milestones about the implementation process of this design change, as it is evidences in Osinergmin Report (Supervisory Body for Investment in Mining and Energy) and the receiver of the energy generated by the project, are the following:

- The Definitive Concession to develop the electricity generation activity in the future Huaycoloro II Biomass Power Plant of 2.4 MW, was granted by R.D. N ° 025-2018-GRL-GRDE-DREM of 02.28.2018.
- On 02/16/2016, EMPRESA CONCESIONARIA ENERGÍA LIMPIA S.A.C. with the C.T. Biomasa Huaycoloro II, as part of the Fourth Auction for the Supply of Electricity with Renewable Energy Resources
- The signing of the Concession Contract for the Supply of Renewable Energy to the SEIN took place on 05.17.2016. The term of this contract is 20 years.
- Work on the project began on 05/01/2017.
- The Generation Groups arrived at the construction site on 07.10.2017 and were installed on their bases.

Eliminado: ¶
No post registration changes have been conducted.¶

- On 01/19/2018, COES approved the Project's Operational Study.
- The commissioning of the generation equipment was scheduled for 12.31.2017 which was not fulfilled; therefore, the Concessionaire increased its Letter of Guarantee and requested the MINEM to extend the term of the POC until 03.31.2018.
- The concessionaire made a new request to extend the term of the POC for 06/01/2018 due to problems in the final testing stage (failure of one of the voltage transformers)

The reasons for these changes taking place were that biogas flow capacity was evaluated as adequate to generate electricity continuously and the promotion of the Ministry of Energy and Mines through the 4th RER auction for renewable energy projects.

Due to the fact that the flow of a sanitary landfill was difficult to pre-establish, until the CDM Callao began operation in 2012, it was not possible to verify that there was capacity to generate electricity continuously until, in 2015, once the project was registered, it was formally decided to start the procedures for electricity generation.

Also note that the Ministry of Energy and Mines published, on December 12, 2014, the PRIOR NOTICE of the Call for the Fourth RER Auction for electricity generation with renewable energies, giving the call for the auction on September 3, 2015. The publication of the Auction Results was performed on the OSINERGMIN Web Portal, on February 17, 2016. Advance notice of the new RER auction and PRC justification from PETRAMAS have been provided as supporting evidence.

According the paragraph 242 of the CDM Project Standard for Project Activities (Version 02.0), the impacts analysis of the actual changes to the registered CDM project activity are the following:

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

As it has been indicated in section B.2 of this revised PDD, the electricity generation is in the scope of the applicability criteria of the methodology ACM0001 "Flaring or use of landfill gas" (version 19.0) as per criteria (c), i).

As mentioned in section B.4 of this revised PDD, as per paragraphs 22 and 23 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas" (Version 19.0), the establishment and description of the baseline scenario of the project activity is considered as follows: "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".

As 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) The compliance of the monitoring plan with the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents.

The following monitoring parameters have been added in section B.7.1 of this revised PDD to cover the electricity generation component, in compliance with the monitoring plan as per the methodology ACM0001 (Version 19.0):

- Volumetric flow of total landfill gas which is sent to flare and used for electricity generation in year y on a dry basis
- Volumetric flow of landfill gas which is used for electricity generation in year y on a dry basis
- Net quantity of electricity generated using LFG
- Operation of the engine that consumes the LFG

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

As it is indicated in section B.7.1, the level of accuracy and completeness in the monitoring of the new parameters covering the new electricity generation component are in compliance with the accuracy and completeness properties as per the methodology ACM0001 (Version 19.0). Periodic calibration against a primary device will be conducted. Calibration and frequency of calibration will be according to manufacturer's specifications.

d) The additionality of the project activity

As indicated in section B.5 of the revised PDD: As per paragraph 21 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas" (Version 19.0), 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:

- 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;
- The LFG is used to generate heat for internal or external consumption;
- The LFG is flared.

The LFG under Phase 2 will be used to generate electricity in one power plant composed by 2 power engines with a total nameplate capacity that equals or is below 10 MW (2.4 MW). 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 19.0), the project activity is deemed automatically additional.

e) The scale of the project activity

The large scale threshold of more than 60,000 tons per year of emission reductions during the crediting period is not affected by the addition of the electricity generation component to the registered project activity as can be checked in section B.6.3 of the revised PDD where the annual emission reductions calculated ex-ante has been updated considering the electricity generation.

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).

Version	Date	Description
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project activities, project design document