Project design document form for CDM project activities
(Version 05.0)

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Modelo del Callao Landfill Gas Capture and Flaring System
Version number of the PDD	Version 6
Completion date of the PDD	01/06/2015
Project participant(s)	PETRAMAS S.A.C.
Host Party	Republic of Peru.
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	Sectoral scope: • 13, Waste handling and disposal. Methodology: • ACM0001 Version 11, “Approved Consolidated Baseline Methodology for Landfill Gas Project Activities”
Estimated amount of annual average GHG emission reductions	61,024 tCO_2e/year

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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. The landfill has an area of 54 hectares (ha) and receives in year 2009 around 1,250 tonnes (t) of municipal solid waste (MSW) daily from Callao and the district of San Martin de Porras. It is expected that the amount of MSW could be incremented according to markets conditions of the MSW management sector. 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. through public bidding. 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. If the proposed CDM project activity on the landfill yields profits, these will be shared with the municipality of Callao.

The Project aims to reduce methane (CH_4) emissions by flaring LFG. Destruction of CH_4 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 (tCO_2e) over the first 7 years, or an average of 61,024 tCO_2e 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[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 a LFG recovery and flaring system financed by CDM revenues.

The Project's contributions to sustainable development are:

1) reducing global climate change by destroying the CH_4 captured from Modelo del Callao's LFG;
2) reducing possible health risks by destroying most of the non- CH_4 organic compounds, mainly volatile organic compounds (VOCs) that are present in Modelo del Callao's LFG;
3) reducing landfill odors by combusting the LFG;

4) creating jobs associated with the design, construction, and operation of the LFG capture since much of the construction and development funding is to be spent locally for drilling, piping, construction, and operational personnel;

[1] Source: Dr. Julio Kuroiwa "Estudio para el uso eficiente seguro y con protección del medio ambiente del Relleno Sanitario Modelo del Callao"2009. Chapter 6 page 8.

A.2. Location of project activity

A.2.1. Host Party

Republic of Peru.

A.2.2. Region/State/Province etc.

Province of Callao.

A.2.3. City/Town/Community etc.

District of Ventanilla.

A.2.4. Physical/Geographical location

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 -77.123583West.

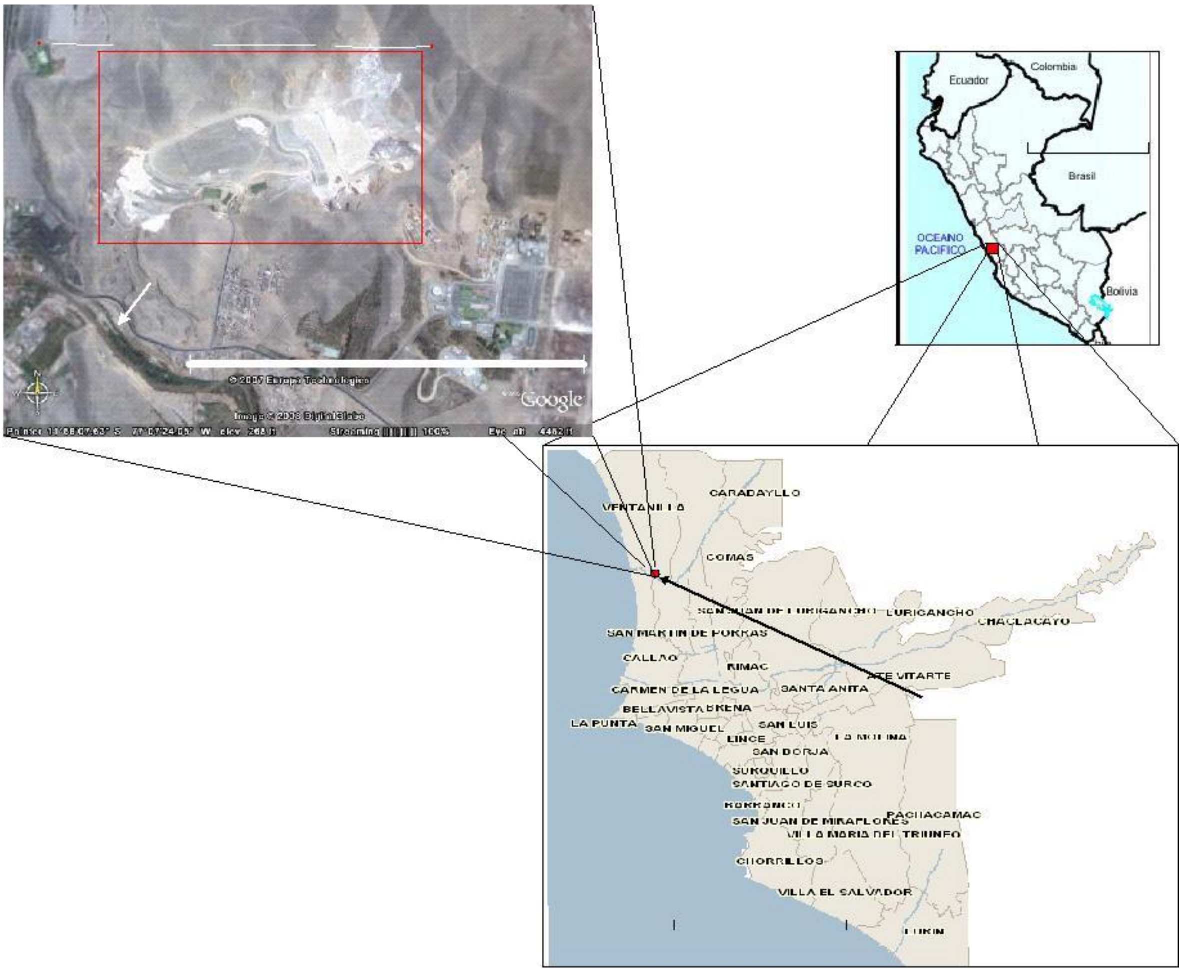

Figure 1. Project Location.

A.3. Technologies and/or measures

The Project will be the third CDM LFG recovery project in Peru[2]. The first one was the Huaycoloro project[3] 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.

The collection system will be installed comprehensively over the closed areas of the landfill. Installations will include initially approximately 50 vertical extraction wells of high density polyethylene pipes (HDPE). The wells will have a depth of around 20 meters. The diameter of these pipes will be 16 cm and 50% of its surface will be perforated. Also these pipes will end with a perforated top and will rest over a bed of rocks of 0.3m wide. The pipelines will be surrounded by gravel of 1.5¨ to 3¨ that would serve as a filter between the pipelines and solid waste. 60% of the pipeline length will be covered with this gravel. After the pipelines will be surrounded by slime until reach 90% of the length of the pipe, the remaining 10% will be covered with bentonite. These pipes will be coupled to a high-density polyethylene pipe grid to transport the LFG to the flare station and LFG control plant. This grid will have a length of around 4,780 meters. The diameters of the pipes that compose the grid will be 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 will have a minimum slope of 3% and the management of **condensates** will be made in tanks.

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.

The project also includes an automatic flare station composed by blowers, moisture separator and enclosed flaring station, and the LFG measuring and recording equipment. The flaring station will have a maximum capacity of 1,500 SCFM and a destruction efficiency between 98% and 100%. This system will have thermocouples that would allow to control the temperature of the flame in order to guarantee the destruction efficiency of the system A standard operation and maintenance (O&M) program for LFG collection and system equipment will be implemented according to equipment manufacturer. 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 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.

[2] The first two LFG projects are Huaycoloro Landfill Gas Capture and Combustion Project, and Ancon EcoMethane Landfill Gas Project, both of which are registered with the CDM.

[3] Huaycoloro Landfill Gas Capture and Combustion. Reference Number 0708.

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Peru (host)	PETRAMAS S.A.C.	No

A.5. Public funding of project activity

There are no public funds involved in the proposed project.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

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 CO_2 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).*

B.2. Applicability of methodology and standardized baseline

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 additionality is demonstrated using the “Tool for the demonstration and assessment of additionality”.

The “Tool to Calculate the Emission Factor for an Electricity System ” is not used since the emission factor from the grid is determined according to the default value of 1.3 tCO2/MWh of Option A2 of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”. Besides, as the project will not produce energy, this tool is not necessary.

The “Tool to Calculate Project or Leakage CO2 Emissions from Fossil Fuel Combustion” is not used since the project will not consume fossil fuels.

B.3. Project boundary

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.

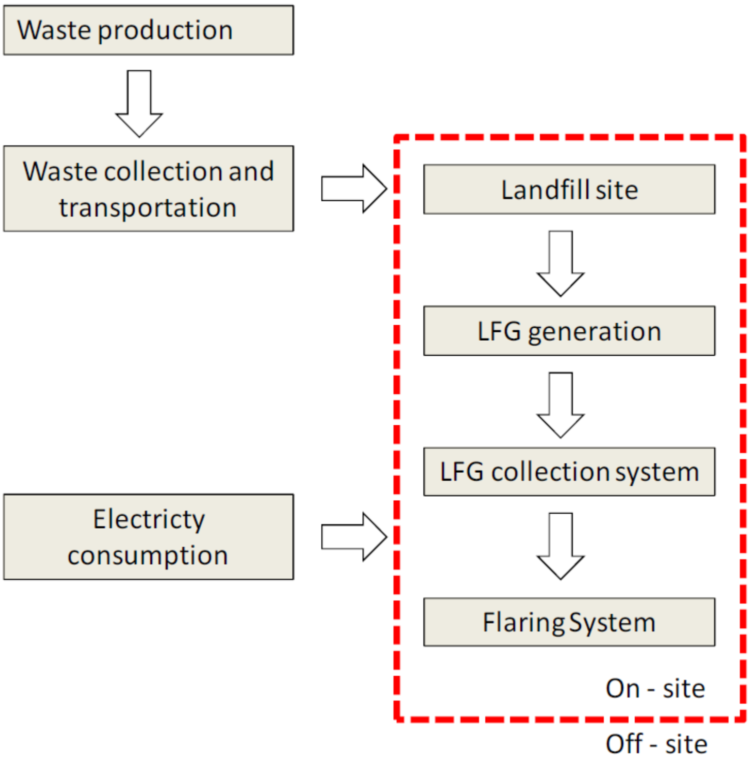

Figure 2. Project boundary of the proposed project activity

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.

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Emissions from decomposition of waste at the SWDS site	CH_4	Yes	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 thermal energy generation	CO_2	No	There is no thermal energy generation included in the baseline scenario
		CH_4	No	There is no thermal energy generation included in the baseline scenario
		N_2O	No	There is no thermal energy generation included in the baseline scenario
	Emissions from electricity consumption	CO_2	Yes	Electricity may be consumed from the grid or generated on-site/offsite in the baseline scenario
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
Project scenario	On-site fossil fuel consumption due to the project activity other than for electricity consumption.	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 on-site electricity use	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

Project emissions thus include:

- CH_4 from the incomplete combustion of LFG in flares accounted for as project emissions[4].
- 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

[4] Per the Tool to Determine Project Emissions from Flaring Gases Containing Methane, issued at the 24th meeting of the CDM Meth Panel in December 2006

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

B.5. Demonstration of additionality

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. However, it must be noted that electricity generation is not within the core capabilities (SWM) of the project sponsor; and there is no infrastructure available to transmit electricity to the grid. Moreover, there is not any experience in Peru on this regard. In addition, due to the location of the project, there are no potential end-users for potential electrical or thermal applications,

Alternative 4, Heat generation in the absence of the project activity. (Includes alternatives H1 to H7)

Given the isolation of the project site and the lack of local off-takers (the landfill is in a tropical country where heat demand for house heating is zero and there is no potential industrial off-taker nearby) heat generation is not only unfeasible but unrealistic as well.

Other types of alternatives that do not involve the treatment of solid waste in landfills (i.e. building a waste incineration facility to produce energy) were not considered to be realistic and credible alternatives since they are not within the scope of the Project Developer's core business.

Outcome of Step 1a: identified realistic and credible alternative scenario(s) to the project activity

After identifying the alternatives to the project activity, only two alternatives remain that can be realistic and credible scenarios to the proposed project activity:

Table 3. Identified realistic and credible alternatives to the proposed project activity

Alternative		Baseline		Description of situation
	Landfill gas	Electricity	Heat	
1	LFG1	N/A	N/A	The proposed project activity, undertaken without CDM incentives. The landfill gas is captured and combusted by flaring. The electricity is taken from the national grid.
2	LFG2	N/A	N/A	The atmospheric release of landfill gas or landfill gas passive venting. (Maintenance of status quo.)

Sub-step 1b - Consistency with mandatory laws and regulations

The existing SWM legislation in Peru, governed by Law 27314, the *General Solid Waste Law*, sets out the requirements for final disposal of MSW in landfills, but does not provide a specific requirement for the collection and combustion of LFG. Articles 87 and 88 of this law set minimum conditions for installing and operating landfills respectively, including LFG control and LFG evacuation chimneys, but they do not regulate the amount of the LFG to be controlled. Furthermore, installing venting wells without any flaring, which would not destroy any CH_4 but simply avoid explosions, is not directly prohibited under the *General Solid Waste Law*.

Therefore, all identified alternatives in Table 3. above satisfy the national requirements and are plausible scenarios.

Since alternatives to the Project have been identified that are consistent with current laws and regulations, the Project is considered to be additional under Step 1.

Therefore, the selected baseline scenario is the atmospheric release of landfill gas or landfill gas passive venting. (Maintenance of status quo.)

Step 2: Investment Analysis

Sub-step 2a – Determine appropriate analysis method

Per the *Tool for the Demonstration and Assessment of Additionality*, there are three options that can be used for investment analysis: (1) simple cost analysis, (where no benefits other than CDM income exist for the Project); (2) investment comparison analysis (where comparable alternatives to the Project exist); or (3) benchmark analysis. As the proposed project activity not generate

revenues other than CER income, the *Tool for the Demonstration and Assessment of Additionality* specifies that the (1) simple cost analysis is appropriate.

Sub-step 2b: Option I – apply Simple Cost Analysis

According to the methodology for determination of additionality, if the CDM project activity generates no financial or economic benefits other than CDM related revenues, then the simple cost analysis shall be used. In this case, the most likely alternative to the Project is simply not installing flaring equipment at the site, which would constitute the business-as-usual scenario.

The project costs are listed in the table below:

Table 4. The investment and O&M costs of the project activity calculated 22 years

Capital costs	US$ $ 929,130
Operational and Maintenance costs (per year)	US$ $ 200,000
Total cost during the lifetime of the project (22 years)	**$ 5,329,130**

Source: PETRAMAS based in quotations and its experience of its other LFG CDM project "Huaycoloro"

By investing in a LFG collection and flaring system, the Project would not generate any revenues in the absence of the CDM. Therefore, the project activity is not economically attractive and not a realistic baseline scenario; hence, it is demonstrably additional.

Step 4 – Common Practice Analysis

Sub-step 4a: Analyze other activities similar to the proposed project activity.

The Guidelines on Common Practice (EB 63 Report. Annex 12) propose four steps to determine if the proposed project activity is a common practice.

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

> The landfill do not have an output but have capacity to receive municipal solid waste (MSW). The landfill daily capacity of Modelo del Callao used in the PDD is 1,250 tones of Municipal Solid Waste (MSW). Therefore the +/-50% range of daily capacity goes form 625 tones to 1,875 tones of MSW. However, the daily capacity is variable and receiving more or less MSW would affect not the daily capacity but the useful life of the landfill. As we have data only for daily disposal is hard to determine comparable capacities among other landfills, thus, a conservative approach is to consider all landfills of Peru.

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

> As it is mentioned above, it is considered all landfills of Peru. On this regard, according to the report of the current situation of Solid waste management in Peru elaborated by the

Peruvian Ministry of Environment, in Peru there are only 9 landfills[5]. 50% of the landfills are located in Lima which receives 92% of the MSW of Lima[6].

According to the Agency for Environmental Health at the Peruvian Ministry of Health-DIGESA [7] and the Peruvian Ministry of Environment, the only projects that have implemented systems for collecting and flaring are the landfills of Huaycoloro and Ancon, which both are CDM projects

The table below, prepared based in the report made by the Ministry of environment, present the official list of dumps and landfill located in Peru.

Table 5. Dumps and Landfills of Peru

Name	**Amount of Waste Disposal (tonnes/ day)**	**Waste treatments**
Ancon	1,199	Landfill. Has impleemnted a system for the collection and flaring of LFG since this facility has a CDM registered project. Before was a landfill with passive venting and flaring.
Zapallal	128	Landfill. Passive venting and flaring.
Portillo Grande	1,269	Landfill. Passive venting and flaring.
Huaycoloro	2,511	Landfill. Has implemented a system for the collection and flaring of LFG since this facility has a CDM registered project. Before was a landfill with passive venting and flaring.
5 landfills in provinces	No data	Landfill. Passive venting (maybe flaring)

Own elaboration based in a report made by the Peruvian Ministry of Environment. Source.Ministerio de Ambiente "Informe de la Situación Actual de la Gestion de residuos Solidos Municiaples" October 2008. Page 16 . http://www.redrrss.pe/material/20101021014024.pdf

Therefore Nall = would be 7: the landfills of Zapallal, Portillo Grande and 5 landfills in provinces.

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

As the table above indicates, landfills in Peru have, either no system for collecting, venting or flaring LFG, or only passive systems are used. Since Decree 057-04- PCM was adopted in 2004; no new proper LFG collection and flaring or utilization system has been developed in Peru, unless they were in the CDM context. The situation is even worse in other areas of Peru. According to the report of the Peruvian Ministry of Environment, only 19.3% of municipal Solid waste is delivered to an authorized landfill[9] .Moreover, according to a report by the Peruvian Ombudsman's Office[10], only 73.7% of the MSW in the country is collected, from which only 30% goes to a landfill and the rest to inadequate dumps. Only 14.7 % of

[5] Ministerio de Ambiente "Informe de la Situación Actual de la Gestion de residuos Solidos Municiaples" October 2008. Page 15 . http://www.redrrss.pe/material/20101021014024.pdf

[6] Ministerio de Ambiente "Informe de la Situación Actual de la Gestion de residuos Solidos Municiaples" October 2008. Page 17 . http://www.redrrss.pe/material/20101021014024.pdf

[7] DIGESA is the Agency for Environmental Health at the Peruvian Ministry of Health. This institution, among its other responsibilities, is in charge of providing environmental authorization to waste management companies for final disposal of MSW.

the MSW is recycled.

Similar technologies have not been implemented in Peru before without considering carbon revenues. As mentioned above, the current national legislation in Peru does not enforce landfills to collect and flare LFG. When landfill gases are collected, it is done for safety reasons, to avoid explosions and fires, and the volumes effectively collected and destroyed are insignificant. Hence, investments done with this purpose are so far negligible and based on very low level technology (passive venting, no reliable combustion system), with a few exceptions (which are all CDM projects).

Only two similar projects exist; namely, Huaycoloro and Ancon. However, both of these are registered CDM projects, and their CDM status prevents them from being part of common practice.

Current Peruvian national legislation does not specify how to capture LFG, nor does it provide any specifications on the appropriate percentage of LFG that needs to be collected and flared.

As it is mentioned before, the law that regulates the management of solid waste in Peru is Law No 27314 "Ley General de Residuos Solidos"issued in July 21, 2000[11] and the corresponding Decree No. 057-04- PCM issued in July 24,2004[12]. 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" it is mentioned paragraph 3 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.

Therefore N_{diff} would be all landfills in Peru less LFG CDM projects. This is equal to 7.

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

$F = 1 - 7/7 = 0$

The proposed project activity is a "common practice" within a sector in the applicable geographical area if the factor F is greater than 0.2 and $N_{all}-N_{diff}$ is greater than 3.

The proposed project activity is not a common practice since factor F is 0 and $N_{all}-N_{diff}$ is 7-7= 0.

Sub-step 4b: Discuss any similar options that are occurring

No LFG collection and flaring or utilization systems are currently being considered for development in Peru without considering carbon revenues. Alternative 1 has never been implemented in the country. Alternative 2 is widely spread, and therefore, considered to be common practice since final disposition of MSW in landfills is required by the General Solid Waste Law, even though clandestine dumps are still prevalent.

Since no similar LFG collection and flaring or utilization systems exist without considering carbon revenues, the Project is additional.

The CDM consideration of the project activity is summarized in the following table:

Table 6. Timeline of events and actions related to CDM consideration and project start date

DATE	KEY EVENTS	EVIDENCE
10/11/2003	It was signed the concession contract for the management of the landfill of Modelo del Callao for 30 years between the Municipality of el Callao and PETRAMAS.	Concession Contract
12/08/2009	The host country letter of Approval was given to the project developer.	Peru LoA Modelo del Callao
18/09/2009	The proposed project activity was published in the web page of the UNFCCC as part of the validation process.	Web page of the UNFCCC
03/03/2010	Modelo del Callao landfill was authorized by the Municipality of El Callao to have a useful life (receiving waste) for 22 years from year 2008.	Municipal resolution Number 0012-2010-MPC-GGPMA
13/05/2010	On site visit by DOE as part of the validation procedure	
03/12/2010	Starting date of the project Activity: The flare system was bought	Flaring System Invoice
01/01/2012	Commissioning of the project activity. Although it is planed to be operational by September 2011, it is thought that by January 2012 would be full operational since the period before would be consider as a testing phase .	Project profile document

As summarized in Table 6 above, CDM decisions are taken at an early stage of the project, indicating that consideration of applying CDM is present well before the final investment decision is made.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

B.6.1.1. Emission Reductions

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.

B.6.1.2. Baseline emissions

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).

$$BE_y = \left(MD_{project,y} - MD_{BL,y}\right) * GWP_{CH4} + EL_{LFG,y} \cdot CEF_{elec,BL,y} + ET_{LFG,y} * CEF_{ther,BL,y} \qquad (1)$$

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:

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

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, in tonnes of methane (tCH4)
GWP_{CH4}	=Global Warming Potential value for methane for the first commitment period is 21 tCO2e/tCH4

1. Methane destroyed by the project activity ($MD_{project,y}$):

$MD_{project,y}$ will be determined ex post by metering the actual quantity of methane captured and destroyed once the project activity is operational. The methane destroyed by the project activity (MDproject,y) during a year is determined by monitoring the methane actually flared.

a) Ex post:

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y} + MD_{PL,y} \quad (2)$$

$MD_{flared,y}$	= Quantity of methane destroyed by flaring (tCH4)
$MD_{electricity,y}$	= Quantity of methane destroyed by generation of electricity (tCH4)
$MD_{thermal,y}$	= Quantity of methane destroyed for the generation of thermal energy (tCH4)
$MD_{PL,y}$	= Quantity of methane sent to the pipeline for feeding to the natural gas distribution network (tCH4)

As the proposed project activity is a simple gas flaring project and the LFG is only fed to the flare, $MD_{project,y}$ can be simplified as below:

$$MD_{project,y} = MD_{flared,y}$$

Where:

$MD_{project,y}$	= The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH4) in project scenario
$MD_{flared,y}$	= Quantity of methane destroyed by flaring (tCH4)

The quantity of methane destroyed by flaring is calculated using the following equation:

$$MD_{flared,y} = (LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / \mathrm{GWP_{CH4}}) \quad (3)$$

Where:

$LFG_{flare,y}$ = Quantity of landfill gas fed to the flare(s) during the year measured in cubic meters (m3)

$w_{CH4,y}$ = Average methane fraction of the landfill gas as measured13 during the year and expressed as a fraction (in m³ CH4/m³ LFG)

D_{CH4} = Methane density expressed in tonnes of methane per cubic meter of methane (tCH4/m3CH4)14

$PE_{flare,y}$ = Project emissions from flaring of the residual gas stream in year y (tCO2e) determined following the procedure described in the "Tool to determine project emissions from flaring gases containing methane". If methane is flared through more than one flare, the PEflare,y shall be determined for each flare using the tool

As the sum of quantities fed to the flare must be compared annually with the total quantity of methane generated in order to adopt the lowest value of $MD_{project,y}$, the following estimation must be carried out:

b) Ex ante estimation of the the amount of methane that would have been destroyed/combusted during the year, in tonnes of methane ($MD_{project,y}$)

The ex ante estimation of the amount of methane that would have been destroyed/combusted during the year, in tonnes of methane ($MD_{project,y}$) will be done with the latest version of the approved "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site", considering the following additional equation:

$$MD_{project,y} = BE_{CH4,SWDS,y}/GWP_{CH4} \quad (13)$$

Where:

$BE_{CH4,SWDS,y}$ = Methane generation from the landfill in the absence of the project activity at year y (tCO2e), calculated as per the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site". The tool estimates methane generation adjusted for, using adjustment factor (f) any landfill gas in the baseline that would have been captured and destroyed to comply with relevant regulations or contractual requirements, or to address safety and odor concerns. As this is already accounted for in equation 2, "f" in the tool shall be assigned a value 0

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

Parameter	Description	Value used
φ	Model correction factor to account for model uncertainties	0.9
f	Fraction of methane captured at the SWDS and flared, combusted or used in another manner	0
GWP	Global Warming Potential (GWP) of methane, valid for the relevant commitment period	21 tCO2/tCH4
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)	0.1
F	Fraction of methane in the SWDS gas	0.5
DOCf	Fraction of degradable organic carbon (DOC) that can decompose	0.5

<table>
<tr><td>Wj,x</td><td>Total amount of organic waste type j prevented from disposal in the SWDS in the year x</td><td><table><tr><th>Waste type</th><th>Percentage</th></tr><tr><td>Food</td><td>36.3</td></tr><tr><td>Wood</td><td>1.8</td></tr><tr><td>Paper</td><td>18.1</td></tr><tr><td>Green Waste</td><td>4.2</td></tr><tr><td>Textile</td><td>3.6</td></tr><tr><td>Plastics</td><td>6.9</td></tr><tr><td>Inert</td><td>29.1</td></tr></table>Data is based in an study regarding the efficient use of the landfill Modelo del Callao made by Enginer Julio Kuroiwa.[8]</td></tr>
<tr><td>DOCj</td><td>Fraction of degradable organic carbon (by weight) in the waste type j</td><td><table><tr><th>Waste type</th><th>DOC_j</th></tr><tr><td>Pulp, paper and cardboard</td><td>40</td></tr><tr><td>Wood & Straw (excl. lignin)</td><td>43</td></tr><tr><td>Garden/Park Waste (organic putrescibles)</td><td>20</td></tr><tr><td>Food, food waste, beverages and tobacco</td><td>15</td></tr><tr><td>Textiles</td><td>24</td></tr></table></td></tr>
<tr><td>kj</td><td>Decay rate for the waste type</td><td><table><tr><th>Waste type</th><th>K_j</th></tr><tr><td>Pulp, paper and cardboard</td><td>0.04</td></tr><tr><td>Wood & Straw (excl. lignin)</td><td>0.02</td></tr><tr><td>Garden/Park Waste (organic putrescibles)</td><td>0.05</td></tr><tr><td>Food, food waste, beverages and tobacco</td><td>0.06</td></tr></table></td></tr>
<tr><td>j</td><td>Waste type category</td><td></td></tr>
</table>

The above specified default values were taken from the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” (Version 5.1.0) where the tool provides different values to choose from, the chosen values are summarised below:

- OX: 0.1 as set for managed solid waste disposal sites that are covered with oxidising material such as soil or compost. At the Modelo del Callao landfill site, when a specific area closes permanently, it is covered by clayed soil.
- MCF: 1.0 the landfill site belongs to the category of anaerobic managed solid waste disposal site. This factor is only applicable if the site has got controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste. At the landfill site of Modelo del Callao, the waste is directed to the specific section of the deposition area, there is no scavenging on the site and through the wells reaching from the bottom to the top of the landfill, there is good control of fires. When a specific area closes permanently, it is covered by clayed soil.
- DOCj: Values are chosen assuming that the waste is wet (there is no drying process prior to land filing)

[8] Source: Dr. Julio Kuroiwa “Estudio para el uso eficiente seguro y con protección del medio ambiente del Relleno Sanitario Modelo del Callao”2009. Chapter 6 page 8 and 13

- kj: Although the location of the project activity is located in a tropical region, The boreal and temperate default values are applicable as per the "Tool to determine methane emissions

  avoided from disposal of waste at a solid waste disposal site". In Lima and Callao, the mean annual temperature is in the range of 18°C to 20°C ,the mean annual precipitation is only 40 mm. and the potential evapo-transpiration is 1,600 mm[9].

The GWP_{CH4} is the global warming potential of methane, which is set at the default value 21 tCO_2e/tCH_4. This value is valid for the relevant commitment period and shall be updated according to future COP/MOP decisions.

2. Methane that would have been destroyed/combusted in the absence of the project activity due to regulatory and/or contractual requirements (*MDBL,y*):

For the amount of methane destroyed in the baseline scenario, the following equation is used:

$$MD_{BL,y} = MD_{project,y} * AF$$

Where:

MDBL,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, in tonnes of methane (tCH4)
MDproject,y	=The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH4) in project scenario
AFy	=Adjustment factor expressed as a percentage (%)

The AF was considered to be zero. This value is justified based on the fact that the regulatory requirements, including the concession contract do not indicate any specific amount of gas collection and destruction, or utilization and that in practice, no LFG is collected and flared in the Modelo del Callao landfill. Therefore, $MD_{BL,y}$ will be equal to zero for the ex-ante ER calculation. Nevertheless, laws and regulations will be reviewed periodically, and at least once a year, and the AF will be modified accordingly in case any law or regulation requires a minimal amount of methane to be captured and/or destroyed.

B.6.1.3. Project emissions

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).

The approach selected to determine the flare efficiency is to use a 90% default value. Continuous monitoring of compliance with manufacturer's specification of flare (temperature, flow rate of residual gas at the inlet of the flare) will be performed. The manufacturer's operational manual of the flare[10], specify the following design parameters:

- Temperature of operation: from 1,400ºF (760ºC) to 1,800ºF (982ºC), with a shutdown at 2,000ºF (1,093ºC)

[9] Source: Sistema de Informacion sobre el Uso del Agua en la Agricultura y el Medio Rural de la FAO "Peru" http://www.fao.org/nr/water/aquastat/countries/peru/indexesp.stm

[10] See manufacturer's manual under the name "Callao_Flare Manual Spanish_ Ztof"

- Flow rate of residual gas at the inlet of the flare is set at the maximum flow of 4,000 SCFM (6,430 Nm3/h)

If in a specific hour any of the parameters are out of the limit of manufacturer's specifications, a 50% default value for the flare efficiency will be used for the calculations for this specific hour.

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 (PE_{flare}) 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.

$$FM_{RG,h} = \rho_{RG,n,h} \times FV_{RG,h} \quad (1)$$

Where

Variable	SI Unit	Description
$FM_{RG,h}$	kg/h	Mass flow rate of the residual gas in hour h
$\rho_{RG,n,h}$	kg/m^3	Density of the residual gas at normal conditions in hour h
$FV_{RG,h}$	m^3/h	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h

$$\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \times T_n} \quad (2)$$

Where

Variable	SI Unit	Description
$\rho_{RG,n,h}$	kg/m^3	Density of the residual gas at normal conditions in hour h
P_n	Pa	Atmospheric pressure at normal conditions (101 325)
R_u	Pa.m^3/kmol.K	Universal ideal gas constant (8 314)
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour h
T_n	K	Temperature at normal conditions (273.15)

And:

$$MM_{RG,h} = \sum_i (fv_{i,h} * MM_i) \quad (3)$$

Variable	SI Unit	Description
MMRG,h	kg/kmol	Molecular mass of the residual gas in hour h
fvi,h		Volumetric fraction of component i in the residual gas in the hour *h*
MM_i	kg/kmol	Molecular mass of residual gas component *i*

I		The components CH_4, CO, CO_2, O_2,H_2, N_2

As simplified approach, project participants may only measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2).

STEP 2. Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

Determine the mass fractions of carbon, hydrogen, oxygen and nitrogen in the residual gas, calculated from the volumetric fraction of each component *i* in the residual gas, as follows:

$$fm_{j,h} = \frac{\sum_{i} fv_{i,h} \cdot AM_j \cdot NA_{j,i}}{MM_{RG,h}} \quad (4)$$

Where:

Variable	SI Unit	Description
$fm_{j,h}$		Mass fraction of element *j* in the residual gas in hour *h*
$fv_{i,h}$		Volumetric fraction of component *i* in the residual gas in the hour *h*
AM_j	kg/kmol	Atomic mass of element *j*
$NAj_{,i}$		Number of atoms of element *j* in component *i*
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour *h*
j		The elements carbon, hydrogen, oxygen and nitrogen
i		The components CH_4, CO, CO_2, O_2,H_2, N_2

STEP 3. Determination of the volumetric flow rate of the exhaust gas on a dry basis

This step is only applicable if the methane combustion efficiency of the flare is continuously monitored. For the case in this PDD, since enclosed flares and use of the default value for the flare efficiency is chosen, this step is no applicable.

STEP 4. Determination of methane mass flow rate in the exhaust gas on a dry basis

This step is only applicable if the methane combustion efficiency of the flare is continuously monitored. For the case in this PDD, since enclosed flares and use of the default value for the flare efficiency is chosen, this step is no applicable.

STEP 5. Determination of methane mass flow rate in the residual gas on a dry basis

The quantity of methane in the residual gas flowing into the flare is the product of the volumetric flow rate of the residual gas (*FVRG,h*), the volumetric fraction of methane in the residual gas (*fvCH4,RG,h*) and the density of methane (ρ*CH4,n,h*) in the same reference conditions (normal conditions and dry or wet basis).

It is necessary to refer both measurements (flow rate of the residual gas and volumetric fraction of methane in the residual gas) to the same reference condition that may be dry or wet basis. If the residual gas moisture is significant (temperature greater than 60ºC), the measured flow rate of the residual gas that is usually referred to wet basis should be corrected to dry basis due to the fact that the measurement of methane is usually undertaken on a dry basis (i.e. water is removed before sample analysis).

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n} \quad (13)$$

Variable	SI Unit	Description
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*
$FV_{RG,h}$	m3/h	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h*
$fv_{CH4,RG,h}$		Volumetric fraction of methane in the residual gas on dry basis in hour *h* (NB: this corresponds to fvi,RG,h where *i* refers to methane).
$\rho_{CH4,n}$	kg/m3	Density of methane at normal conditions (0.716)

STEP 6. Determination of the hourly flare efficiency

The 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 by project participants to determine the flare efficiency (default value or continuous monitoring). For the case in this PDD, enclosed flares and use of the default value for the flare efficiency is chosen.

Therefore, for the estimations of emission reductions and since no records for monitoring would exist, the default value for enclosed flare is selected and the flare efficiency in the hour *h* is:

- 0% if the temperature in the exhaust gas of the flare (Tflare) is below 500 °C for more than 20 minutes during the hour *h* .
- 50%, if the temperature in the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour *h,* but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour *h*.
- 90%, if the temperature in the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour *h* and the manufacturer's specifications on proper operation of the flare are met continuously during the hour *h*.

STEP 7. Calculation 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:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \left(1-\eta_{flare,h}\right) \times \frac{GWP_{CH4}}{1000} \quad (15)$$

Variable	SI Unit	Description
PEflare,y	tCO2e	Project emissions from flaring of the residual gas stream in year *y*
TMRG,h	kg/h	Mass flow rate of methane in the residual gas in the hour *h*
ηflare,h		Flare efficiency in hour *h*
GWPCH4	tCO2e/tCH4	Global Warming Potential of methane valid for the

		commitment period

2) Determination of project emissions from electricity consumption

$$PEy = PE_{EC,y} + PE_{FC,y} \qquad (16)$$

Where:

PE_y	=	Project emissions in year *y* (tCO2/y)
$PE_{EC,y}$	=	Emissions from consumption of electricity in the project case (tCO_2/y)
$PE_{FC,y}$	=	Emissions from consumption of heat in the project case (tCO_2/y)

Since the proposed project activity is a simple landfill gas flaring project and does not include heat consumption, the project emissions are calculated with the following simplified formula:

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

Where:

PEy	=	Project emissions in year *y* (tCO2/y)
$PE_{EC,y}$	=	Emissions from consumption of electricity in the project case (tCO_2/y)

For this project there will be no use of thermal energy. Furthermore, no back-up fossil fuel generator will be associated with this project. Therefore the project emissions will be equal to the project emissions from electricity consumption which will be calculated according to equation (1) of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, justified by Scenario A: electricity consumption from the grid:

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

$PE_{EC,y}$	=	Project emissions from electricity consumption by the project activity during the year, (tCO
$EC_{PJ,y}$	=	Quantity of electricity consumed by the project activity during the year y (MWh)
$EF_{EL,j,y}$	=	Emission factor for the grid in year (tCO2/MWh)
TDL_y	=	Average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site

The option A2: has been used to determine the value of $EF_{EL,j,y}$wich is the default value of 1.3 tCO_2/MWh.

For the value TDL, it is used the default value of 20% suggested by the *Tool to Calculate Baseline, Project and/or Leakage Emissions from Electricity Consumption(Version 1)* to be conservative

B.6.1.4. Leakage

No leakage effects are accounted for under this methodology.

Emission Reductions

$ER_y = BE_y - PE_y$

where:

.

ER_y	=	Emission reduction in year *y* (tCO_2e/y)
BE_y	=	Baseline emissions in year *y* (tCO_2e/y)
PE_y	=	Project emissions in year *y* (tCO_2/y)

The above formula shall be modified in order to clearly differentiate between project emissions from flaring ($PE_{flare,y}$) and electricity consumption ($PE_{EC,y}$). Project emissions from flaring are already included in the calculation of $MD_{flared,y}$ (equation (9) of ACM0001 version 11) and therefore in $MD_{project}$ and BE_y. Hence, they shall not be deducted once more in the overall emission reduction calculation in equation (17) above.

The modified equation is as follows:

$ER_y = BE_y – PE_{EC,y}$

All ex-ante calculations for obtaining the emission reductions from the project activity are listed in Section B.6.3.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**Regulatory requirements relating to landfill gas**
Unit	-
Description	Regulatory requirements relating to landfill gas
Source of data	Publicly available information of the Host Country's regulatory requirements relating to landfill gas.
Value(s) applied	-
Choice of data or Measurement methods and procedures	Further information can be found in Section B.5
Purpose of data	Baseline emissions
Additional comment	The information though recorded annually, is used for changes to the adjustment factor (AF) or directly $MD_{BL,y}$ at renewal of the credit period. Relevant regulations for LFG project activities shall be updated at renewal of each credit period. Changes to regulation should be converted to the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{BL,y}$). Project participants should explain how regulations are translated into that amount of gas

Data / Parameter	GWP_{CH4}
Unit	tCO_2e/tCH_4
Description	Global warming potential of CH_4
Source of data	IPCC
Value(s) applied	21
Choice of data or Measurement methods and procedures	Value of 21 is set for the first commitment period. Shall be updated according to any future COP/MOP decisions.
Purpose of data	Baseline and Project emissions
Additional comment	-

Data / Parameter	D_{CH4}
Unit	tCH_4/m^3CH_4
Description	Methane Density
Source of data	ACM0001 version 11, adopted at EB 47, "Consolidated baseline and monitoring methodology for landfill gas project activities", page 14
Value(s) applied	0.0007168
Choice of data or Measurement methods and procedures	At standard temperature and pressure (0 degree Celsius and 1,013 bar) the density of methane is 0.0007168 t/m^3
Purpose of data	Baseline and Project emissions
Additional comment	-

Data / Parameter	$BE_{CH4,SWDS,y}$
Unit	tCO_2e

Description	Methane generation from the landfill in the absence of the project activity at year, *y*
Source of data	Calculated as per the *Tool to Determine Methane Emissions Avoided from Disposal of Waste at a Solid Waste Disposal Site*
Value(s) applied	See spread sheet : " ER Calculation Modelo del Callao"
Choice of data or Measurement methods and procedures	As per the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Purpose of data	Baseline emissions
Additional comment	Used for ex-ante estimation of the amount of methane that would have been destroyed/combusted during the year

Data / Parameter	MD_{Hist}
Unit	tCH_4
Description	Amount of methane destroyed historically for the previous year before the start of project activity
Source of data	Project proponent
Value(s) applied	Zero
Choice of data or Measurement methods and procedures	Historically there were not any infrastructure in the landfill capable to destroy methane
Purpose of data	Baseline emissions
Additional comment	The landfill historically never flare LFG

Data / Parameter	**φ**
Unit	-
Description	Model correction factor to account for model uncertainties
Source of data	Tool to Determine Methane Emissions Avoided from Disposal of Waste at a Solid Waste Disposal Site default value.
Value(s) applied	0.9
Choice of data or Measurement methods and procedures	Oonk et el. (1994) have validated several landfill gas models based on 17 realized landfill gas projects. The mean relative error of multi-phase models was assessed to be 18%. Given the uncertainties associated with the model, and in order to estimate ERs in a conservative manner, a discount factor of 10% is applied to the model results.
Purpose of data	Baseline emissions
Additional comment	-

Data / Parameter	**OX**
Unit	Number
Description	Oxidation factor (reflecting the amount of methane from solid waste disposal site (SWDS) that is oxidized in the soil or other material covering the waste)
Source of data	Conduct a site visit at the solid waste disposal site in order to assess the type of cover of the solid waste disposal site. Use the IPCC 2006 Guidelines for National Greenhouse Gas Inventories for the choice of the value to be applied.

Value(s) applied	0.1
Choice of data or Measurement methods and procedures	Use 0.1 for managed solid waste disposal sites that are covered with oxidizing material such as soil or compost.
Purpose of data	Baseline emissions
Additional comment	-

Data / Parameter	**MCF**
Unit	-
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	1.0
Choice of data or Measurement methods and procedures	In accordance with the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” the landfill site belongs to the category of anaerobic managed solid waste disposal site. This factor is only applicable if the site has got controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste. At the landfill site of Modelo del Callao, the waste is directed to the specific section of the deposition area, there is no scavenging on the site and through the wells reaching from the bottom to the top of the landfill, there is good control of fires. When a specific area closes permanently, it is covered by clayed soil.
Purpose of data	Baseline emissions
Additional comment	The MCF accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

Data / Parameter	**DOCj**
Unit	-
Description	Fraction of degradable organic carbon (by weight) in the waste type, j
Source of data	IPCC 2006, Guidelines for National Greenhouse Gas Inventories. Volume 5: Waste. Page 2.14 Table 2.4 “Default dry matter content, DOC content, total carbon content and fossil carbon fraction of different MSW components”

Value(s) applied	The following values for the different waste types j are applied: <table><tr><th>Waste type j</th><th>DOCj (% wet waste)</th></tr><tr><td>Wood and wood products</td><td>43</td></tr><tr><td>Pulp, paper and cardboard (other than sludge)</td><td>40</td></tr><tr><td>Food, food waste, beverages and tobacco (other than sludge)</td><td>15</td></tr><tr><td>Textiles</td><td>24</td></tr><tr><td>Garden, yard and park waste</td><td>20</td></tr><tr><td>Glass, plastic, metal, other inert waste</td><td>0</td></tr></table>
Choice of data or Measurement methods and procedures	In accordance with the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”.
Purpose of data	Baseline emissions
Additional comment	According to the “Tool”: “If a waste type, prevented from disposal by the proposed CDM project activity, can not clearly be attributed to one of the waste types in the table above, project participants should choose among the waste types that have similar characteristics that waste type where the values of DOCj and kj result in a conservative estimate (lowest emissions), or request a revision of / deviation from this methodology.” In this case, the classification provided in the tool is used, and no deviation from the methodology is needed. The disposed waste is measured on wet basis.

Data / Parameter	K_j
Unit	-
Description	Decay rate for the waste type j
Source of data	“Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” which applies IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)

<table>
<tr><td>Value(s) applied</td><td>The following values are applied for the different waste types:
<table>
<tr><td colspan="2" rowspan="2">Waste type j</td><td>Boreal and Temperate (MAT≤20°C)</td></tr>
<tr><td>Dry (MAP/PET <1)</td></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.04</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.02</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.05</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.06</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>The above mentioned “Tool” provides default values for different waste types as a function of climate, specifically mean annual temperature (MAT, ºC) , mean annual precipitation (MAP, mm per year) and potential evapo-transpiration(PET mm per year) . According to FAO (http://www.fao.org/nr/water/aquastat/countries/peru/indexesp.stm) , Lima and Callao area has a MAT in the range of 18ºC to 19 ºC, the MAP is only 40 mm. and the PET is 1,600 mm. Therefore, the values that were selected and applied to the estimation correspond to the conditions of dry climate (MAP/PET<1) with Boreal and temperate temperature (MAT<20 ºC).</td></tr>
<tr><td>Purpose of data</td><td>Baseline emissions</td></tr>
<tr><td>Additional comment</td><td>According to the “Tool”: “If a waste type, prevented from disposal by the proposed CDM project activity, can not clearly be attributed to one of the waste types in the table above, project participants should choose among the waste types that have similar characteristics that waste type where the values of DOCj and kj result in a conservative estimate (lowest emissions), or request a revision of / deviation from this methodology.”
The waste is characterized into 11 categories at the project site. However, these can be aggregated to the four waste types list in the table above.</td></tr>
</table>

Data / Parameter	**F**
Unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	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.

Purpose of data	
Additional comment	-

Data / Parameter	**DOC_f**
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	-
Purpose of data	Baseline emissions
Additional comment	-

Data / Parameter	**$EF_{EL,j,y}$**
Unit	tCO_2/MWh
Description	Emission factor of the grid
Source of data	*Tool to Calculate Baseline, Project and/or Leakage Emissions from Electricity Consumption*
Value(s) applied	Default Value: 1.3 tCO_2/MWh
Choice of data or Measurement methods and procedures	There is no captive power plant installed at the site and no on-site captive power plant exists. Therefore the electricity is purchased from the grid only.
Purpose of data	Project emissions
Additional comment	The electricity consumption of the project is greater than the electricity consumption of the baseline (no electricity consumption in baseline).

Data / Parameter	**W_{total}**
Unit	Tons
Description	The amount of waste disposed in the landfill sites in year x
Source of data	Data is based in an study regarding the efficient use of the landfill Modelo del Callao[11].made by Enginer Julio Kuroiwa[12]

[11] Source: Dr. Julio Kuroiwa "Estudio para el uso eficiente seguro y con protección del medio ambiente del Relleno Sanitario Modelo del Callao"2009. Chapter 6 page 8.

[12] Julio Kuroiwa. Professor Emeritus. National University of Engineering. Scientific Advisor to Peru's Civil Defense. Lima –Peru. He is a well-known recognized scientific in seismic engineering and is considered by the International Biographical Centre of Cambridge part of the 2000 outstanding Scientifics of the 20 Century. He has more than 35 years as engineering consultant and is author of more than 95 works about natural disasters. Among it positions, important ones have been Director of the International Association for Earthquake engineering..

Value(s) applied	Year / tons: 2,007 – 343,534.65; 2,008 – 435,737.26; 2,009 – 447,294.75; 2,010 – 459,151.76; 2,011 – 471,316.35; 2,012 – 483,795.78; 2,013 – 496,598.59; 2,014 – 509,732.51; 2,015 – 523,206.52; 2,016 – 537,029.14; 2,017 – 551,208.97; 2,018 – 565,755.29
Choice of data or Measurement methods and procedures	In the study made by Mr. Kuroiwa, it is calculated that the landfill could receive waste for 22 year starting from year 2008[13]. The projection were based in data from: demographic statistics made by the Peruvian government[14], the municipal plan from waste management[15], analysis of the density of waste[16] and the capacity of the landfill according to project design. Based on this In the emission reduction calculation it is assumed that the project will receive MSW until year 2030. The reception of waste for 22 years starting from year 2008 has been approved by the Municipality of Callao, which is the institution in charge of given the concession for the operation of the landfill.. In the other hand the project developer has a concession to operate the landfill for 30 years starting from November, 2003[17]. Before year 2007, there is not reliable information about the accumulated waste disposed since it was an open dump. Therefore, it has not been taken in account historic data before year 2007 due to inconsistencies in the records.
Purpose of data	Baseline emissions
Additional comment	-

Year	tons
2,007	343,534.65
2,008	435,737.26
2,009	447,294.75
2,010	459,151.76
2,011	471,316.35
2,012	483,795.78
2,013	496,598.59
2,014	509,732.51
2,015	523,206.52
2,016	537,029.14
2,017	551,208.97
2,018	565,755.29

Data / Parameter	**CE**
Unit	%
Description	LFG collection efficiency
Source of data	As per project setup

13 Source: Dr. Julio Kuroiwa “Estudio para el uso eficiente seguro y con protección del medio ambiente del Relleno Sanitario Modelo del Callao”2009. Chapter 6 Section 6.7.

14 National Institute of Statistic and Computing- INEI, “National survey 2007:XI of population and VI of Housing”. Peru 2007.

15 Provincial Municipality of Callao “ Comprehensive Plan for the Environmental Management of Solid Waste – PIGARS”. October 2002.

16 Laboratory test number 216-08 LAB No 20 made by the National University of Engineering in July 2008.

17 Source: Municipalidad Provincial del Callao. “Contrato de Concesión Tratamiento y Disposición Final de Residuos Sólidos” Clausula Sexta.

November 10,2003.

Value(s) applied	50%
Choice of data or Measurement methods and procedures	The efficiency is estimated based on engineering practice and on physical conditions of this Landfill as well as the capping material (soil cover) used to cover the waste. According to an article made by Dr. C. P. Eden[18], the collection efficiency in a landfill is between 50 and 80%. So, to be conservative and to take in account that the LFG capture technology of the project is not state of the art, it has been selected the assumption of 50% collection efficiency.
Purpose of data	Baseline emissions
Additional comment	Factor needed to quantify the amount of landfill gas flared (MD_{flared})

Data / Parameter	$\eta_{flare,h}$
Unit	%
Description	Flare efficiency in hour h
Source of data	As per the "Tool to Determine Project Emissions from Flaring Gases Containing Methane" Version 1
Value(s) applied	90%
Choice of data or Measurement methods and procedures	In case of enclosed flares and use of the default value for the flare efficiency, the flare efficiency in the hour h (ηflare,h) is: • 0% if the temperature in the exhaust gas of the flare (Tflare) is below 500 °C for more than 20 minutes during the hour h . • 50%, if the temperature in the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour h, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour h. • 90%, if the temperature in the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour h and the manufacturer's specifications on proper operation of the flare are met continuously during the hour h.
Purpose of data	Project emissions
Additional comment	Application of default value as per the "Tool to Determine Project Emissions from Flaring Gases Containing Methane" Version 1

[18] Source: Dr. C.P. Eden. CLP Organogas "GAS DE VERTEDEROS PROBLEMAS Y OPORTUNIDADES" Copyrights © 2001 aborgaseedifesa.com.

Parameter	SI Unit	Description	Value
MM_{CH4}	Kg/kmol	Molecular mass of methane	16.04
MM_{CO}	Kg/kmol	Molecular mass of carbon monoxide	28.01
MM_{CO2}	Kg/kmol	Molecular mass of carbon dioxide	44.01
MM_{O2}	Kg/kmol	Molecular mass of oxygen	32.00
MM_{H2}	Kg/kmol	Molecular mass of hydrogen	2.02
MM_{N2}	Kg/kmol	Molecular mass of nitrogen	28.02
AM_{C}	Kg/kmol(g/mol)	Atomic mass of carbon	12.00
AM_{H}	Kg/kmol(g/mol)	Atomic mass of hydrogen	1.01
AM_{O}	Kg/kmol(g/mol)	Atomic mass of oxygen	16.00
AM_{N}	Kg/kmol(g/mol)	Atomic mass of nitrogen	14.01
Pn	Pa	Atmospheric pressure at normal conditions	101,325
Ru	Pa m^3/kmol K	Universal ideal gas constant	8,314,.472
Tn	K	Temperature at normal conditions	273.15
MF_{O2}	Dimensionless	O2 volumetric fraction of air	0.21
MVn	m^3/kmol	Volume of one mole of any ideal gas at the normal temperature and pressure	22.414
$\rho_{CH4,n}$	Kg/m^3	Density of methane gas at normal conditions	0.7168
$N_{Ai,j}$	Dimensionless	Number of atoms of element j in component I, depending on molecular structure	

Source of data: “Tool to determine project emissions from flaring gases containing methane”

B.6.3. Ex ante calculation of emission reductions

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”.

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:

Baseline emissions

$$BEy = (MD_{project,,y} - MD_{BL,y}) * GWP_{CH4} \quad (1)$$

1. MD $_{project,y}$

a) Estimated amount of methane destroyed by the project activity – Sum of quantities fed to the flare:

$$MD_{project,y} = MD_{flared,y} \quad (8)$$

.

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**

Where the quantity of methane destroyed by flaring was calculated using the following equation:

$$MD_{flared,y} = (LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / GWP_{CH4}) \quad (9)$$

Table 8

Year	$LFG_{flare,y}$ (Nm^3)	$PE_{flare,y}$ (tCO_2e)	$MD_{flared,y}$ (tCH_4)
June 2012	3,586,093	2,699	1,157
2013	6,730,184	5,065	2,171
2014	7,721,182	5,811	2,491
2015	8,699,849	6,548	2,806
2016	9,667,749	7,276	3,118
2017	10,626,391	7,998	3,428
2018	11,577,227	8,713	3,734
May 2019	4,988,399	3,754	1,609
Total	**63,597,074**	**47,864**	**20,514**

(Default values: w_{CH4} = 50%; D_{CH4} = 0.0007168 tCH_4/m^3CH_4; GWP_{CH4} = 21)

b)Ex-ante estimation of the amount of methane that will be destroyed/combusted during the year (MDproject,y)

$$MD_{project,y} = BE_{CH4,SWDS,y} / GWP_{CH4} \quad (13)$$

Table 9

year	$BE_{CH4,SWDS}$ (tCO_2e)	$MD_{project,y}$ (tCH_4)
June 2012	26,990	1,285
2013	50,654	2,412
2014	58,113	2,767
2015	65,479	3,118
2016	72,763	3,465
2017	79,978	3,808
2018	87,135	4,149
May 2019	37,545	1,788
Total	**478,657**	**22,793**

The comparison of MDproject,y from Table7. and Table 9. shows, that MDproject,y from Table 7. gives lower values, as it includes the project emissions from flaring. Therefore, the lower MDproject,y values from Table 7.will be adopted for the ex-estimation of the emission reductions.

The methane actually destroyed by the project activity is determined ex-post by monitoring the quantity of methane flared.

2. $MD_{BL,y}$

For the amount of methane destroyed in the baseline scenario, the following equation is applied:

$$MD_{BL,y} = MD_{project,y} * AF \quad (2)$$

The adjustment factor (AF) is set at 0%.

Table 10

Year	$MD_{project,y}$ (tCH_4)	AF (%)	$MD_{BL,y}$ (tCH_4)
June 2012	1,157	0	0
2013	2,171	0	0
2014	2,491	0	0
2015	2,806	0	0
2016	3,118	0	0
2017	3,428	0	0
2018	3,734	0	0
May 2019	1,609	0	0
Total	**20,514**	**0**	**0**

$$BE_y = (MD_{project,,y} - MD_{BL,y}) * GWP_{CH4} \quad (1)$$

Table 11

Year	$MD_{project,y}$ (tCH_4)	$MD_{BL,y}$ (tCH_4)	GWP_{CH4} (tCO_2e/tCH_4)	BEy (tCO_2e)
June 2012	1,157	0	21	24,297
2013	2,171	0	21	45,591
2014	2,491	0	21	52,311
2015	2,806	0	21	58,926
2016	3,118	0	21	65,478
2017	3,428	0	21	71,988
2018	3,734	0	21	78,414
May 2019	1,609	0	21	33,789
Total	**20,514**	**0**		**430,794**

Project emissions

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:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH4}}{1000} \quad (15)$$

TMRG,h is calculated with the following equation:

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n}$$

.

.

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**

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.

$$PEy = PE_{EC,y} \quad (16)$$

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

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)	$PE_{EC,y}$ (tCO_2)
June 2012	193	0.20	1.3000	302
2013	332	0.20	1.3000	518
2014	332	0.20	1.3000	518
2015	332	0.20	1.3000	518
2016	332	0.20	1.3000	518
2017	332	0.20	1.3000	518
2018	332	0.20	1.3000	518
May 2019	138	0.20	1.3000	216

Leakage:

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

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

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
June 2012	24,297	302	0	23,995
2013	45,591	518	0	45,073
2014	52,311	518	0	51,793
2015	58,926	518	0	58,408
2016	65,478	518	0	64,960
2017	71,988	518	0	71,470
2018	78,414	518	0	77,896
May 2019	33,789	216	0	33,573
Total	430,794	3,626	0	**427,168**
Total number of crediting years	7 years			
Annual average over the crediting period	**61,542**	**518**	**0**	**61,024**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	**$LFG_{total,y}$**
Unit	m^3
Description	Total amount of landfill gas captured at normal temperature and pressure
Source of data	Measured by the flow meter placed directly on the installation.
Value(s) applied	9,085,296 (annual average during the first crediting period)
Measurement methods and procedures	The flow meter will express gas flow in cubic meters (m^3). The proportion of the data to be monitored is 100% and the data are aggregated monthly and yearly.
Monitoring frequency	There will be continuous monitoring frequency.
QA/QC procedures	The flow meter will be subject to a regular maintenance and testing regime to ensure accuracy. The flow meter will be calibrated according to manufacturer`s specifications. Uncertainty level is low (+/- 1 %).
Purpose of data	Baseline emissions
Additional comment	$LFG_{total,y}$ will equal to $LFG_{flare,y}$, therefore, no separate flow meter will be installed.

Data / Parameter	**$LFG_{flare,y}$**
Unit	m3
Description	Amount of LFG flared at normal temperature and pressure
Source of data	Measured by the flow meter placed directly on the installation.
Value(s) applied	9,085,296 (annual average during the first crediting period)

Measurement methods and procedures	The flow meter will express gas flow in cubic meters (m^3). The proportion of the data to be monitored is 100% and the data are aggregated monthly and yearly.
Monitoring frequency	There will be continuous monitoring frequency.
QA/QC procedures	The flow meter will be subject to a regular maintenance and testing regime to ensure accuracy. The flow meter will be calibrated according to manufacturer`s specifications. Uncertainty level is low (+/-1 %).
Purpose of data	Baseline emissions
Additional comment	The amount of landfill gas flared equals to the amount of landfill gas sent to the flare. Furthermore, LFGflare,y will equal to LFGtotal,y, therefore, the same flow meter will be used. Methane fraction of the landfill gas and LFG flow has to be measured on the same basis (either wet or dry).

Data / Parameter	**T**
Unit	°C
Description	Temperature of the landfill gas
Source of data	Project participants
Value(s) applied	No value was estimated.
Measurement methods and procedures	Continuous measurement. Measured to determine the density of methane DCH4. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters
Monitoring frequency	Continuous measurement.
QA/QC procedures	Measuring instruments should be subject to a regular maintenance and testing regime in accordance to appropriate national/international standards
Purpose of data	Baseline emissions
Additional comment	-

Data / Parameter	**P**
Unit	Pa
Description	Pressure of the landfill gas
Source of data	Project participants
Value(s) applied	No value was estimated.
Measurement methods and procedures	Continuous measurement. Measured to determine the density of methane DCH4. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters
Monitoring frequency	Continuous measurement.
QA/QC procedures	Measuring instruments should be subject to a regular maintenance and testing regime in accordance to appropriate national/international standards
Purpose of data	Baseline emissions
Additional comment	-

Data / Parameter	T_{flare}
Unit	°C

Description	Temperature in the exhaust gas of the flare.
Source of data	Thermocouple
Value(s) applied	N/A
Measurement methods and procedures	Measured continuously. Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 500 ºC indicates that a significant amount of gases are still being burnt and that the flare is operating.
Monitoring frequency	Measured continuously.
QA/QC procedures	Thermocouples will be replaced or calibrated every year.
Purpose of data	Baseline and Project emissions
Additional comment	-

Data / Parameter	**$MD_{BL,y}$** or **AF**
Unit	% or tons
Description	Methane destroyed due to regulatory or other requirements
Source of data	Local and/or national authorities
Value(s) applied	0
Measurement methods and procedures	Changes in regulatory requirements, relating to the baseline landfill(s) need to be monitored in order to update the adjustment factor (AF), or directly MDreg. This is done at the beginning of each crediting period.
Monitoring frequency	This is done at the beginning of each crediting period.
QA/QC procedures	-
Purpose of data	Baseline emissions
Additional comment	The AF was set at 0%. This value is justified based on the fact that the regulatory requirements do not indicate any specific amount of gas collection and destruction or utilization and that in practice, no amounts of LFG are actually flared.

Data / Parameter	**$PE_{flare,y}$**
Unit	tCO2e
Description	Project emissions from flaring of the residual gas stream in year *y*
Source of data	Calculated as per the “Tool to determine project emissions from flaring gases containing methane”
Value(s) applied	Annual average of the first crediting period is 6,838 tCO2e

Measurement methods and procedures	The approach selected to determine the flare efficiency is to use a 90% default value. Continuous monitoring of compliance with manufacturer's specification of flare (temperature, flow rate of residual gas at the inlet of the flare) will be performed. The manufacturer's operational manual of the flare, specifies the following design parameters: • Temperature of operation: from 1,400ºF (760ºC) to 1,800ºF (982ºC), with a shutdown at 2,000ºF (1,093ºC) • Flow rate of residual gas at the inlet of the flare is set at the maximum flow of 4,000 SCFM (6,430 Nm3/h) If in a specific hour any of the parameters are out of the limit of manufacturer's specifications, a 50% default value for the flare efficiency will be used for the calculations for this specific hour. In case of enclosed flares and use of the default value for the flare efficiency, the flare efficiency in the hour h ($\eta_{flare,h}$) is: • 0% if the temperature in the exhaust gas of the flare (Tflare) is below 500 °C for more than 20 minutes during the hour h . • 50%, if the temperature in the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour h, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour h. • 90%, if the temperature in the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour h and the manufacturer's specifications on proper operation of the flare are met continuously during the hour h.
Monitoring frequency	Continuous
QA/QC procedures	As per the "Tool to determine project emissions from flaring gases containing methane" and regular maintenance and testing regime in line with the manufacturer`s recommendations will ensure optimal operation of the flare.
Purpose of data	Project emissions
Additional comment	-

Data / Parameter	w_{CH4}
Unit	m³ CH4/m³ LFG
Description	Methane fraction in the landfill gas
Source of data	Gas quality analyser
Value(s) applied	An estimation of 0.50 was taken into account according to IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Measurement methods and procedures	Shall be measured using equipment that can directly measure methane content in the landfill gas, estimation of methane content of landfill gas based on measurement of other constituents of the landfill gas such as CO2 is not permitted. Measured by continuous gas quality analyzer. Continuous monitoring frequency (average value in a time interval not greater than an hour shall be used in the calculations of emission reductions)
Monitoring frequency	Continuous.
QA/QC procedures	The gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy. The gas analyser will be calibrated according to manufacturer's specifications.

Purpose of data	Baseline and Project emissions
Additional comment	Methane fraction of the landfill gas and LFG flow has to be measured on the same basis (either wet or dry).

Data / Parameter	**$fv_{i,h}$**
Unit	-
Description	Volumetric fraction of component *i* in the residual gas in the hour *h* where $i = CH_4, CO, CO_2, O_2, H_2, N_2$
Source of data	Measurements by project participants using a continuous gas analyser
Value(s) applied	An estimation of 0.50 was taken into account for the volumetric fraction of CH_4 according to IPCC 2006 Guidelines for National Greenhouse Gas Inventories. (See parameter wCH_4)
Measurement methods and procedures	Continuously. Values to be averaged hourly or at a shorter time interval. Ensure that the same basis (dry or wet) is considered for this measurement and the measurement of the volumetric flow rate of the residual gas ($FV_{RG,h}$) when the residual gas temperature exceeds 60 ºC.
Monitoring frequency	Continuous
QA/QC procedures	Analyzers will be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas.
Purpose of data	Baseline emissions
Additional comment	As a simplified approach, project participants may only measure the methane content of the residual gas and consider the remaining part as N2.

Data / Parameter	**$EC_{PJ,j,y}$**
Unit	MWh
Description	Quantity of electricity consumed by the project electricity consumption source *j* in year *y* (MWh/yr)
Source of data	Project developer
Value(s) applied	332 MWh per year. Based in the maximum consumption of the equipments to be installed as part of the project (Blowers and Auxiliary services) and 8760 operating hours per year (conservative).
Measurement methods and procedures	Electricity will be measured continuously at the project site with an electricity meter.
Monitoring frequency	Project emissions
QA/QC procedures	The information is going to be cross-referenced with the electricity bills. Meters should be installed, maintained and calibrated according to equipment manufacturer instructions and be in line with national standards.
Purpose of data	
Additional comment	-

Data / Parameter	**TDL_y**
Unit	-
Description	Average technical transmission and distribution losses for providing electricity from the grid.

Source of data	*"Tool to calculate baseline, project and/or leakage emissions from electricity consumptions"*
Value(s) applied	20%
Measurement methods and procedures	There is no captive power plant installed at the site and no on-site captive power plant exists. Therefore the electricity is purchased from the grid only. As such, the default value of Scenario A is applied
Monitoring frequency	Monitoring frequency: If data available annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years
QA/QC procedures	N/A
Purpose of data	Project emissions
Additional comment	-

Data / Parameter	$PE_{EC,y}$
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	An average of 518 tCO2e was estimated for the first crediting period.
Measurement methods and procedures	As per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Monitoring frequency	-
QA/QC procedures	As per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Purpose of data	Project emissions
Additional comment	-

Data / Parameter	$FV_{RG,h}$
Unit	m^3/h
Description	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h
Source of data	Measurements by project participants using a flow meter
Value(s) applied	9,085,296 (annual average during the first crediting period) (See parameter LFGflare,y respectively LFGtotal,y)
Measurement methods and procedures	The flow meter will express gas flow in cubic meters (m^3). The proportion of the data to be monitored is 100% and the data are aggregated monthly and yearly. There will be continuous monitoring frequency. The same basis (dry or wet) is considered for this measurement and the measurement of volumetric fraction of all components in the residual gas (fvi,h) when the residual gas temperature exceeds 60 C.
Monitoring frequency	Continuous
QA/QC procedures	The flow meter will be subject to a regular maintenance and testing regime to ensure accuracy. The flow meter will be calibrated according to manufacturer`s specifications. Uncertainty level is low (+/-1 %).
Purpose of data	Baseline emissions

Additional comment	Please note: the volumetric flow rate and the amount of landfill gas sent to flare ($LFG_{flare,y}$ respectively $LFG_{total,y}$) is measured by one flow meter.

B.7.2. Sampling plan

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.

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

B.7.4. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

The baseline study and monitoring methodology was completed on 26/08/2009 by:

Francisco Fernandez-Asin
Endesa Carbono
Email: francisco.asin@ahlcarbono.com

This entity is not a Project participant of the project

The PDD was updated on 25/02/2015 as a result of Post-Registration Change by ClimaLoop, which is not a project participant. The responsible person is Sergi Cuadrat, Climate Change Mitigation Consultant of ClimaLoop. His contact details are:

Address: Travessera de Sant Pau, 1. Post Code 43202, Reus. Spain.
Tel: +34 636 075 989
Website: www.climaloop.com
Email: sergi.cuadrat@climaloop.com

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

03/12/2010

C.1.2. Expected operational lifetime of project activity

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

C.2. Crediting period of project activity

C.2.1. Type of crediting period

Renewable

C.2.2. Start date of crediting period

01/06/2012

C.2.3. Length of crediting period

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

SECTION D. Environmental impacts

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[19] has determined that Modelo del Callao fulfills all the requirements established in Article 85 of the General Solid Waste Law[20] 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 CH4 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.

[19] Resolución Gerencial No. 196-2006-MPOC-GGPMA. 20 October, 2006.

[20] Artículo 85 del reglamento de la Ley General de Residuos Solidos.

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[21], Articles 2 and 3.

D.2. Environmental impact assessment

Environmental impacts are considered not significant. 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

[21] National Law No. 27446, Ley del Sistema Nacional de Evaluación del Impacto Ambiental, 2001

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. Solicitation of comments from local stakeholders

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 August 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 August 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. Report on 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 Letter of Approval from the "Ministerio del Ambiente" from Perú was received on 08/07/2011.

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	PETRAMAS S.A.C
Street/P.O. Box	Av Tomas Marsano 2813- piso 8
Building	-
City	Lima
State/Region	Lima/Santiago de Surco
Postcode	Lima 41
Country	Peru
Telephone	(511) 271-6378 -(511) 271-6337
Fax	(511) 271-6337 – Ext. 15
E-mail	informes@petramas.com
Website	www.petramas.com
Contact person	
Title	
Salutation	Mr.
Last name	Zegarra
Middle name	
First name	Jorge
Department	
Mobile	
Direct fax	
Direct tel.	Petramas
Personal e-mail	jzegarra@petramas.com

Project participant and/or responsible person/ entity	☐ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	ClimaLoop
Street/P.O. Box	Travessera de Sant Pau, 1
Building	
City	Reus
State/Region	Tarragona / Catalunya
Postcode	43202
Country	Spain
Telephone	+34 877 012 827
Fax	
E-mail	sergi.cuadrat@climaloop.com
Website	www.climaloop.com
Contact person	Sergi Cuadrat
Title	Climate Change Mitigation Consultant
Salutation	Mr.
Last name	Cuadrat
Middle name	
First name	Sergi
Department	
Mobile	+34 636 075 989
Direct fax	
Direct tel.	+34 877 012 827
Personal e-mail	sergi.cuadrat@climaloop.com

Appendix 2. Affirmation regarding public funding

The Project has not received, and will not receive, any public funding.

Appendix 3. Applicability of methodology and standardized baseline

BASELINE INFORMATION

Calculation of $BE_{CH4,SWDS}$

Table 1. WASTE 2007 - 2018

years			$W_{j,x}$						
	j		Food	Wood	Paper	Green Waste	Textile	Plastics	Inert
	Fraction		0.363	0.018	0.181	0.042	0.036	0.069	0.291
	W_total (t/y)	Refuse-in							
2007	343,535	343,535	124,703	6,184	62,180	14,428	12,367	23,704	99,969
2008	435,737	779,272	158,173	7,843	78,868	18,301	15,687	30,066	126,800
2009	447,295	1,226,567	162,368	8,051	80,960	18,786	16,103	30,863	130,163
2010	459,152	1,685,718	166,672	8,265	83,106	19,284	16,529	31,681	133,613
2011	471,316	2,157,035	171,088	8,484	85,308	19,795	16,967	32,521	137,153
2012	483,796	2,640,831	175,618	8,708	87,567	20,319	17,417	33,382	140,785
2013	496,599	3,137,429	180,265	8,939	89,884	20,857	17,878	34,265	144,510
2014	509,733	3,647,162	185,033	9,175	92,262	21,409	18,350	35,172	148,332
2015	523,207	4,170,368	189,924	9,418	94,700	21,975	18,835	36,101	152,253
2016	537,029	4,707,397	194,942	9,667	97,202	22,555	19,333	37,055	156,275
2017	551,209	5,258,606	200,089	9,922	99,769	23,151	19,844	38,033	160,402
2018	565,755	5,824,362	205,369	10,184	102,402	23,762	20,367	39,037	164,635

			Food	Wood	Paper	Green Waste	Textile	Plastics	Inert
	DOCj		0.15	0.43	0.40	0.20	0.24	0.00	0.00
	kj	best case	0.060	0.020	0.040	0.050	0.040	0.000	0.000

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**

With Collection Efficiency

For PDD year	Collection efficiciency	$BE_{CH4,SWDS}$ (tCO2e)	$MD_{project,y}$ (tCH_4)
June 2012	50%	26,990	1,285
2013	50%	50,654	2,412
2014	50%	58,113	2,767
2015	50%	65,479	3,118
2016	50%	72,763	3,465
2017	50%	79,978	3,808
2018	50%	87,135	4,149
May 2019	50%	37,545	1,788
Total		**478,657**	**22,793**

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

Not applicable

Appendix 5. Further background information on monitoring plan

TABLE OF CONTENTS

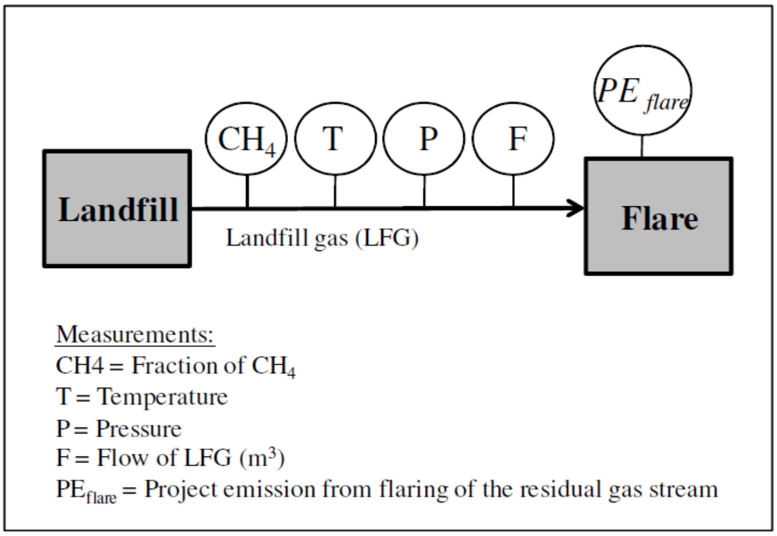
I. Background Information

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 flowmeter is necessary. (Parameters to be monitored: $LFG_{total,y}$ and $LFG_{flare,y}$)

- The fraction of methane in the landfill gas (wCH_{4},y) should be measured with a continuous analyzer; Methane fraction of the landfill gas and LFG flow have to be measured on same basis (either wet or dry).

- The parameters used for determining the proj*ect em*issions from flaring of the residual gas stream in year *y* ($PE_{flare,y}$) should be monitored as per the "Tool to determine project emissions from flaring gases containing methane";

- Temperature (T) and pressure (p) of the landfill gas are required to determine the density of methane in the landfill gas; No separate monitoring of temperature and pressure is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.

- The quantity of electricity imported, in the baseline and the project situation, to meet the requirements of the project activity, if any;

- Relevant regulations for LFG project activities shall be monitored and updated at renewal of each credit period. Changes to regulation should be converted to the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity (MDBL,y). Project participants should explain how regulations are translated into that amount of gas;

For this methodology, a continuous monitoring system for methane fraction of the landfill gas and LFG flow is one that continuously acquire data from the process (continuous sampling) in order to process it and deliver the required information (methane fraction of the landfill gas and LFG flow) as an average value in a time interval not greater than an hour. Paired values of the methane fraction of the landfill gas and LFG flow which are averaged for the same time interval should be used in the calculation of emission reductions (i.e. methane fraction of landfill gas averaged at hour x should be used with LFG flow which is averaged at the same hour x).

Parameters monitored in the project activity

Parameter	Description	Measurement equipment
$LFG_{total,y}$	Total amount of landfill captured at Normal Temperature and Pressure	Only one flow meter will measure the amountof landfill gas captured and sent to flare. For that reasons:LFGtotal,y= LFGflare,y. ; No separate monitoring of temperature and pressure is necessary since it will be used aflow meter that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.
$LFG_{flare,y}$	Quantity of landfill gas fed to flare(s) during the year measured in cubic meters (m³)	
T	Temperature of the landfill gas	
P	Pressure of the landfill gas	
w_{CH4}	Average methane fraction of the landfill gas measured during the year and expressed as a fraction (in m^3 CH_4/m^3 LFG)	Gas quality analyser
Tflare	Temperature in the exhaust gas of the flare	Thermocouple

Characteristics of the measurement Equipment:

Flow meter

THERMAL MASS FLOW METER	**Ranges Available**	0 to 1500 SCFM
	Accuracy and Repeatability	±1% Full Scale
	Calibration	yearly

Gas quality analyser

METHANE ANALYZER (CONTINOUS)	**Ranges Available**	0 TO 100% CH_4
	Accuracy and Repeatability	±1% OF FULL SCALE
	Sample flow rate	1 LPM
	Calibration	yearly

Thermocouple

THERMOCOUPLE	**Temperature Range**	-200 to 1250 °C
	Accuracy	±2.2 °C or 0.75% above 0°C
	Output	-5 to 5 mV
	Calibration	replaced yearly

II. Organizational, Operational and Monitoring Obligations

Obligations of the Operator

Monitoring the Project's ER performance requires proper data collection and processing by the Project Operator, PETRAMAS S.A.C. The Project Operator has the primary obligation to calculate ERs based on the most recent available information, following the ERs Calculation Procedure

(ERCP) presented in this Monitoring Plan (MP), and to abide by the ERCP Organizational Structure as well as the ERCP Quality Control provisions presented in the Annex to this MP.

The ERCP Organizational Structure dictates that the ERCP Manager will be responsible for performing the ERCP (monthly), and the MP Steering Committee will be responsible for supervising the ERCP Manager's monitoring work (monthly). The ERCP Manager will report to the MP Steering Committee (monthly), and the ERCP Manager and MP Steering Committee will coordinate in reporting to the DOE at Verification.

The ERCP Quality Control provisions in the Annex to this MP offer guidance on how to handle monitoring data to ensure that sufficient and accurate information is made available to the DOE. Specifically, the ERCP Quality Control demonstrates how to trace back the CH_4 avoided from the Modelo del Callao landfill. All data required for the MP will come from the Project Operator's information system, and it is the responsibility of the Project Operator to ensure that this data is made available monthly to the ERCP Manager.

It is believed that the monitoring approach presented in this MP will result in an accurate, yet conservative calculation of ERs. However some uncertainties, especially errors in the data monitoring and processing system, may result in a discrepancy between the monitored ERs and the verified ERs. The Project Operator is expected to prevent such errors, and the verification audits are expected to uncover any potential ones. Given that CERs can only be certified after Verification, there is a significant internal incentive for the Project Operator to perform all steps related to data collection and calculations as accurately as possible.

The ERCP Manager will seek to establish and maintain a positive and efficient relationship with the DOE verifying the Project's ERs so as ensure a dependable and transparent outcome. In doing so, the ERCP Manager will:

- Provide all necessary monitoring information to facilitate the verification work, and cooperate with the DOE in a timely manner on all data requests and questions;

- During the crediting period, always take into account requests by the CDM Executive Board and conduct preparatory work for the verification to obtain high quality and efficient results; and,

- Ensure that all monitoring reports are reviewed by the ERCP Manager and the MP Steering Committee before they are transmitted to the DOE.

Training is an important element in successful monitoring of ERs. All relevant personnel will be trained by Endesa Carbono at a one-day workshop on a comprehensive set of tools and knowledge required to implement the MP, including: (a) accurate monitoring of the performance and output characteristics of the plant for recording and keeping accurate data; (b) collection and integration of utility data for the current year; (c) incorporation of these data sets into Excel spreadsheets pre-prepared by Endesa Carbono, and (d) consistently calculating verifiable CERs as a function of measured plant output against a current-year emission factor that serves as a recognized proxy for emissions displaced from the grid.

Adequate equipment will be defined and procured during project construction, which will be used for monitoring gas flows, concentration and flare temperature. Procedures for maintenance and installation of equipment, as well as calibration, will be performed according to manufacturer's specifications. All measurements, data gathering, record keeping, and procedures for dealing with possible data adjustments will be performed taking into consideration the specific data gathering requirements of the MP, and will meet the requirements of ACM0001.

The ERCP is designed for performing quality control on the ER calculation, and provides procedures to guarantee the accuracy of the results. The quality control procedures deal with data collection, processing, record keeping, and cross-checking. It is therefore, expected that the MP approach presented in this PDD will result in an accurate, yet conservative calculation of ERs.

Table A4-1: Monthly Data Collection: Division of Labor

Project Operator	• directly measure the CH_4 destroyed by flaring and from generation following ACM0001; • estimate the project emissions following the *Tool to Determine Project Emissions from Flaring Gases Containing Methane;* • perform the monthly calculation of ERs following the ERCP; and, • prepare and submit the annual report of the total project ERs to the DOE.

The ERCP Organizational Structure and the ERCP Quality Control will be attached to the Annex to this MP below.

Troubleshooting procedures

In case of any power outages the complete landfill gas extraction system, including booster and flare, is out of operation as there is no emergency power supply installed.

Therefore, all measurement devices would be out of operation. The project operator will analyse the situation as soon as possible and solve the failure if the problem is located internally.
In the unlikely event of any malfunction of the gas flow meter, the gas quality analyser, the gas analyser and the data logger, these measurement devices and/or any other related equipments will be taken care of according to the defined procedures listed in the OM&M Schedule.

In the unlikely event of emergency cases that can cause unintended emissions the following procedures will apply:

If fire, gas leak or explosion at the landfill site has occurred the affected area should be identified and isolated.

Personnel are to abandon the affected area immediately and be evacuated. If actions taken to control the emergency are insufficient, the fire department should be notified and further actions coordinated with the fire department.

If LFG leaks are detected from collection system, piping or wells during system inspections and monitoring tours the affected system should be determined, and the leak repaired. If it is required that the entire

Emissions Reductions Calculation Procedure and Required Spreadsheets

The ERCP is the basic instrument for gathering, recording and processing information that will result in the measured ERs. The Project Operator shall consider the Project's ERCP as a manual. The ERCP should contain data processed by the Project Operator. All data processing should be done using Excel software. The ERCP is designed for monthly and yearly calculation, based monthly recording and continuous recording of the meters installed. Entering the data monthly in the required spreadsheets will provide the opportunity to review formulas, minimize errors and have data readily available for the DOE at any time during the year.

For effective data management, the Project Operator have pre-programmed spreadsheets such that it will only need to collect the information as described and apply the formulas as instructed in the MP.

The Project Operator will calculate the ERs on the basis of the MP, following the ERCP. Calculations will follow ACM0001 to calculate ERs from the CH_4 destroyed by the Project.

The variables measured in the destruction process (Temperature, LFG composition, and LFG flow) will be recorded directly, electronically and automatically in a chart recorder devise.

From this devise the information will be sent and storage in it original extension in a file called "Callao Original Data yearly period in question". This information is in a unalterable and inviolable form . From there the data will be exported to an Excell format for its processing.

The data will be organized in a file called "Callao Organized Data yearly period in question". This file will contain 12 excel spread sheets corresponding each one to a month of the monitored year. Each monthly spreadsheet will contain workbooks for each day of the month containing data that was recorded in minute frequency.

Data that are out of the precision range of the meters will be selected for its purge.

The data is purged and the purged data will be recorded in a file called "Callao Purged Data yearly period in question".

This purged data will be feed a file called "Callao Processed Data yearly period in question "that will contain an excel spreadsheets called "Callao Processed Data yearly period in question.xls". In this excel spread sheet will calculate the ERs of the period and will be delivered to the DOE.

All excel files will have access passwords to ensure the no manipulation of the information.

The ERCP Quality Control and Organizational Structure can be seen bellow:

Monitoring Plan (MP)–ERs for methane destruction monitoring–Quality Control (QC)

Flaring

ERCP

- *Continuous recording*
- *Check calibration of meters, periodically,*
- *Only one person will be responsible for the ERCP: ERCP Manager*

Data

- LFG flared registered by the flow meter
- FE periodic measurement
- WCH4, measured by a continuous gas quality analyzer
- T, measured to determine the density of the CH4
- P, measured to determine the density of the CH4

Quality of Data Collection

- Which data comes? All of the above
- By what means does it come? By Physical and/or electronic means
- How does it come? Original data recording programs and excel
- How frequently does it come? Monthly, except for FE which is quarterly
- From whom does it come? From measurement devices
- To whom does it comes? ERCP Manager

Quality of Data Processing

- Original Data
- Organized Data
- Entered Data
- Processed Data
- Result

- Monthly calculation involves 5 steps
- All of it must be done in excel and documented with Physical and/or electronic data
- Yearly consolidation of monthly calculation

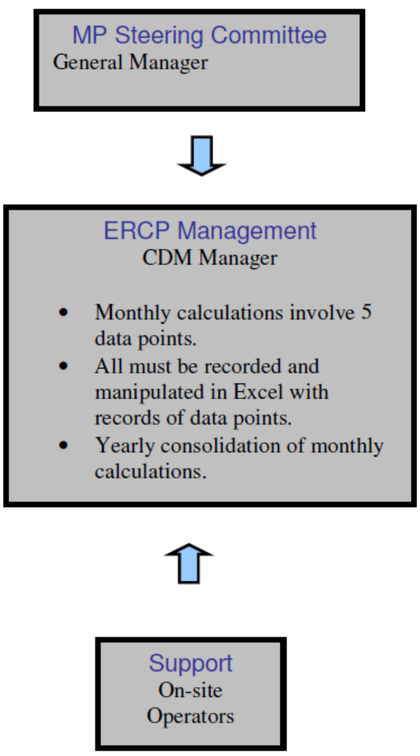
Quality of Data Storage

- Keep all data for 2 years after the first crediting period (9 years) – assign a password to excel spreadsheets used for the ERCP
- Save the document with the last date in which an alteration was made, so that old versions are kept in disk
- Keep all written documentation in a folder that will be provided to the verifier together with the data in excel collected

Quality of Data Delivery

- Provide to the Verifier documents through which original data was delivered to the ERCP Manager
- Provide to the Verifier all calculations made (all steps of Data Processing) by showing all preliminary versions of spreadsheets saved in disk

ERCP Organizational Structure:



Appendix 6. Summary of post registration changes

The following corrections and permanent changes from the registered monitoring plan or applied methodology are summarized with the assessment on the impact of each change:

Permanent changes to the project design of the registered project activity	Assessment on the impact of each change		
	The applicability and application of the applied methodology	**The additionality of the project activity;**	**The scale of the project activity.**
The continuous monitoring of methane destruction efficiency of the flare has been replaced by the approach to use a 90% default value.	Do not adversely impact	Do not adversely impact	Do not adversely impact

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Document information

Version	*Date*	*Description*
05.0	25 June 2014	Revisions 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;* • Editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b
04.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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