CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Title: Intermunicipal Matamoros-Torreón Landfill Gas Project.
Version: Version 2
Date: 06/07/2012

A.2. Description of the project activity:

The project activity objective is to reduce GHG emissions through the capture, flare and combustion of the landfill gas generated by the decomposition of the organic wastes disposed at Intermunicipal Matamoros-Torreón landfill. In a first stage of the project it is planned to flare the landfill gas in a high efficiency flare; in a second stage it is planned to produce electricity if the amount of biogas generated is enough for this.

Previous to the project activity, the landfill site does not have any active gas recovery or control system in place hence LFG is being partially emitted to the atmosphere.

The project activity has been designed in two phases. The first phase involves the construction and operation of a landfill gas (LFG) collection and flare system. The second project phase, electricity generation, would be carried out if the project secures the LFG flow for it. Excess LFG, and all gas collected during periods when electricity is not produced, will be flared. Electricity generated would meet landfill needs with possible sale to local Municipality.

Intermunicipal Matamoros-Torreón landfill is owned and operated by Promotora Ambiental de la Laguna, S.A. de C.V. (hereinafter called PALA). PALA is a business of Promotora Ambiental S.A.B. de C.V- PASA[1], a private waste collection and disposal firm that offers solutions for an integral management of industrial and municipal solid waste. PASA has more than 15 years of experience and, currently, has activities in 23 landfills in Mexico.

The landfill covers 46.4 ha[2], of which 34.5[3] have been designated for waste disposal. The rest of the property is dedicated to a buffer zone, ancillary facilities, and offices. The local climate is characterized as arid, with a minimum daily average temperature of 12.4ºC and a daily maximum average of 30.6ºC. In summer the temperature could reach 42ºC in the outside in summer and 11°C in winter. The rainy season is in the months of June through September, and average annual precipitation is approximately 227.9 mm/yr. The site is located at an average of 1,124 m above sea level.

Intermunicipal Matamoros-Torreón landfill was opened in August 1st, 2001[4], and it is being developed in four macrocells divided in five cells each. The landfill receives municipal waste from Torreón and Matamoros cities and waste from local industries it is not considered as hazardous waste and can be assimilated as municipal waste. See figure1.

[1] www.pasa.mx
[2] Official land use approval.
[3] Environmental impact assessment approval
[4] COA - Anual report presented to Environmental Ministry.

Figure 1. Matamoros-Torreón Intermunicipal Landfill.

The landfill has an environmental approval to operate until 2025.[5] During 2008 the Intermunicipal Matamoros-Torreón landfill received an average of 626 tonnes MSW/day. The amount of waste disposed from the beginning of the operation to December 31, 2008 is 1,690,131 tonnes.

Passive LFG vents are installed throughout the Landfill to release LFG pressure. Until 28th July, 2009; 28 vents are distribute in the closed and operating cells of landfill. As there is no system in place to actively capture or flare the LFG generated the LFG is vented to the atmosphere.

The baseline scenario, as identified later in section B.4 and B.5, is therefore the continuation of the current operation where waste is being land-filled until the closure of the site without any gas recovery, and gas produced is being emitted into the atmosphere.

The current situation before the project implementation is the atmospheric release of landfill gas. Therefore the situation before project implementation coincides with the baseline scenario.

The project developer anticipates reducing greenhouse gas emission in two different ways. Firstly, methane emission will be reduced by an active flaring of the methane contained in the landfill gas; and secondly, by producing electricity from landfill gas the project will lead to CO_2 emission reductions attributable to the displacement of electricity, the emissions reductions being determined by the emissions factor of the interconnected power grid where the landfill is located.

[5] Environmental impact assessment approval

The Project will have several positive social, economic and environmental impacts that will contribute with the international efforts of climate change mitigation:

- The objective of LFG flaring is to reduce GHG emissions (methane), in a safe manner, and to control and reduce odour nuisance and health risks.
- It is intended to capture the methane that would be released to the atmosphere. Not only the project will confront global warming, it will also provide an environmental solution to minimize risks such as possible explosions for accumulated methane and a secure health for the local community at the landfill site.
- It will add to the national private expertise in the installation and operation of on-grid biogas power generation technology and flaring systems and strengthen institutional capacities.
- It will increase technology diversification in the power sector, enhancing the robustness of the power system and contributing to the security and reliance of supply.
- It will strengthen Mexico's participation in international carbon markets.
- Increase of job opportunities related to the management, operation and maintenance of the landfill, the landfill gas system and the power plant.
- Acording to chapter "Enviromental sustanbility" of the National Development Mexican Plan 2007-2012[6], the project activity contributes to the reach the objetive 10 – Reduce GHG emissions.

A.3. Project participants:

Table 1 Project participants

Name of Party involved (*). ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicates if the Party involved wishes to be considered as project participant (Yes/No)
Mexico (host)	Promotora Ambiental de la Laguna S.A. de C.V Private entity. Project Sponsor.	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Mexico

A.4.1.2. Region/State/Province etc.:

Coahuila de Zaragoza

[6] http://pnd.calderon.presidencia.gob.mx/sustentabilidad-ambiental/cambio-climatico.html

A.4.1.3. City/Town/Community etc.:

Matamoros

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The Matamoros-Torreón Landfill is located west of the municipality in the Highway Torreón-Saltillo km 31, Coahuila State, Mexico. See figure 2.

Matamoros town is located in Coahuila de Zaragoza State in the north of Mexico, about 1,082 kilometres northwest of Mexico City. Matamoros is located near 29 kilometres northwest of the Francisco Sarabia International Airport. Matamoros has a population of about 91,858 habitants. See figure 2.

Figure 2. General map indicating the regional area of the site project[7]*.*
Geographic coordinates: 25.5389°, -103.1485° ’’ [8]

A.4.2. Category(ies) of project activity:

Sectoral Scope 13. “Waste handling and disposal”

[7] Images obtained from Google Earth software version 5.0.11733.9347.
[8] COA - Annual report presented to the Environmental Ministry.

A.4.3. Technology to be employed by the project activity:

The purpose of the project activity is to reduce GHG emissions through an active LFG collection and flaring system. The biogas is generated by the decomposition of the organic wastes disposed at Intermunicipal Matamoros-Torreón landfill, once LFG capture has been established it could be used to produce electricity if the project secures the LFG flow for it. The project requires the installation of a gas collection system, flaring equipment and a modular electricity plant.

Prior to the start of the implementation of the project activity 28 landfill passive wells are distributed in the LF. Such wells are venting the gas from inside the waste mass to the top of each vent, with no presence of flames. The electricity needs to operate the administrative offices of the Landfill is obtained from the grid. In the current situation, prior to project implementation, there is no combustion of LFG, either for energy use or in a flare, and therefore no methane destruction.

The current situation before the project implementation coincides with the baseline scenario.

The activities/measures that will be implemented within project activity were designed in order to maximize LFG recovery rates. It consists in an active LFG collection system that will be installed. The system will consist of a series of vertical/horizontal extraction wells interconnected by header piping. The LFG will be extracted from the landfill by blowers and will initially be flared. Once LFG gas recovery is operational, project proponent would install LFG-fired power generation equipment. Subsequently, LFG would be used for power generation, with any excess LFG flared. Electricity generated would be used to meet requirements at the landfill; the excess generation could be sold to local municipalities.

The installations of the LFG capture and collection system, within the flare components, are composed by the following subsystems:

1. *Collection*: consist of a set of vertical and/or horizontal wells installed into the refuse, where the LFG is extracted from the inside.
2. *Extraction* and piping: conformed by a network of pipes and equipment to extract the LFG to the flare system. Along the circuit there are condensed traps to retain those leaches that could be with the LFG.
3. *Monitoring/Analysis*: installed between the subsystems of extraction/conduction and flaring with the objective to accurately register the quantity of methane to be burned. The gas analyzer will analyze and determine the methane present in the LFG previous to be burned at the flare system. The plant is equipped with a monitoring system for CH_4, O_2, flow, pressure and temperature of the LFG.
4. *Incineration* (or flaring): based on a burner that it has a combustion chamber for the biogas and the chimney to vent the exhaust gas to the atmosphere. The collected biogas is flared at high efficiency/high temperature flares (between 871.10 a 982.20ºC, with a 98% of effectiveness). An average of 95% of LFG captured it is expected to be flared and/or burned.

According to a study developed by SCS Engineers the next equipment could be installed (the equipment capacity and the manufacturer could change during the engineering stage of the project):

Table 2 Equipment.

Equipment	Capacity	Manufacturer
LFG enclosed flare station	1,610 m3/hr LFG capacity	John Zink blower/flare station
Reciprocating Engine Generator Set (genset). 1600-kW	1.4955 MW	Caterpillar G3520 LFG-fueled genset.
SCADA system	To be defined	Landtec

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

Taking into consideration the expected operational conditions and requirements, reciprocating engine generator sets (gensets) will be an attractive technology to be employed for power generation from LFG collected from the Site. While not totally immune, reciprocating engine generators are more tolerant of impurities and contaminants in methane from landfills. — Such as water vapor, ammonia, and sulfur.
In addition, reciprocating engine generators operate at higher electrical efficiencies than turbines and require less complicated LFG collection and pressurizing systems. It is expected to have a 3.2 MW as maximum of installed capacity.

Some of the key equipment: flares, blowers, LFG treatment, flow measurement devices, gas analysers, etc. will be provided by specialty manufacturers from Annex 1 countries. The project would provide a significant opportunity for technology transfer, with design, equipment and installations complying with international standards with regard to quality, reliability, operational safety and environmental aspects.

Until recently, there were no projects to make an active capture and flare (or otherwise use) landfill gas in Mexico, with the exception of the project in Prados de la Montaña and Simeprode project supported by the Global Environment Facility. In recent years, several other projects in Mexico have been presented for implementation under the CDM.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

Table 3: Estimated emission reductions

Period			Annual estimation of emission reductions in tons of Carbon Dioxide equivalent (tCO_2e)
Period Year	**Start Date**	**End Date**	
1	01/12/2012	30/11/2013	64,862
2	01/12/2013	30/11/2014	69,266
3	01/12/2014	30/11/2015	92,768
4	01/12/2015	30/11/2016	97,372
5	01/12/2016	30/11/2017	101,552
6	01/12/2017	30/11/2018	105,960

7	01/12/2018	30/11/2019	110,390
Total estimated reductions (tCO_2e)			**642,170**
Total number of crediting years			**7**
Annual average			**91,739**

A.4.5. Public funding of the project activity:

There is no public funding involved in the proposed project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

The baseline and monitoring methodology to be applied for the proposed project activity is the approved consolidated baseline methodology ACM0001, version 11[9] (EB47): ***"Consolidated baseline methodology for landfill gas project activities"*** refers to the following tools also used for the estimation of baseline and project emissions:

- ***"Tool for the demonstration and assessment of additionality" version5.2.1***
- ***"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 1.***
- ***"Tool to determine project emissions from flaring gases containing methane" version 1.***
- ***"Tool to calculate the emission factor for an electricity system", version 2,2.1***
- ***"Tool to calculate project or leakage CO2 emissions from fossil fuel combustion". version 2***

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The methodology chosen, ACM0001, V.11: ***"Consolidated baseline methodology for landfill gas project activities",*** is applicable to landfill gas 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; or*
b) *The captured gas is used to produce energy (e.g. electricity/thermal energy); Emission reductions can be claimed for thermal energy generation, only if the LFG displaces use of fossil fuel either in a boiler or in an air heater. For claiming emission reductions for other thermal energy equipment (e.g. kiln), project proponents may submit a revision to this methodology;*
a) *The captured gas is used to supply consumers through natural gas distribution network. If emissions reductions are claimed for displacing natural gas, project activities may use approved*

[9] http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

methodologies AM0053, but no emission reductions are claimed for displacing or avoiding energy from other sources.

The proposed project activity corresponds to alternatives a) and b). Part of the collected landfill gas will be used to generate electricity and any remaining gas would be flared.

B.3. Description of the sources and gases included in the project boundary:

According to ACM0001 v.11, the project boundary is the site of the project activity where the gas is captured and destroyed/used. And, if the electricity for project activity is sourced from grid or electricity generated by the LFG captured would have been generated by power generation sources connected to the grid, the project boundary shall include all the power generation sources connected to the grid to which the project activity is connected. Since the project activity will be operated by using the electricity from the Interconnected National System, such source has been added to the project boundary as shown in the following table and figure:

Table 4*: Summary of gases and sources included in the project boundary and justification/explanation where gases and sources are not included*

	Source	Gas	Included?	Justification/Explanation
Baseline	Emissions from decomposition of waste at the landfill site (Passive LFG venting and no flaring)	CH_4	Yes	The major source of emissions in the baseline
		N_2O	No	N_2O emissions are very small compared to CH_4 emissions from landfills. Exclusion of this gas is conservative.
		CO_2	No	CO_2 emissions from decomposition of organic waste are not accounted.
	Emissions from electricity consumption	CO_2	Yes	Electricity generated from the grid
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
Project Activity	On-site fossil fuel consumption due to the project activity other than for electricity generation	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.

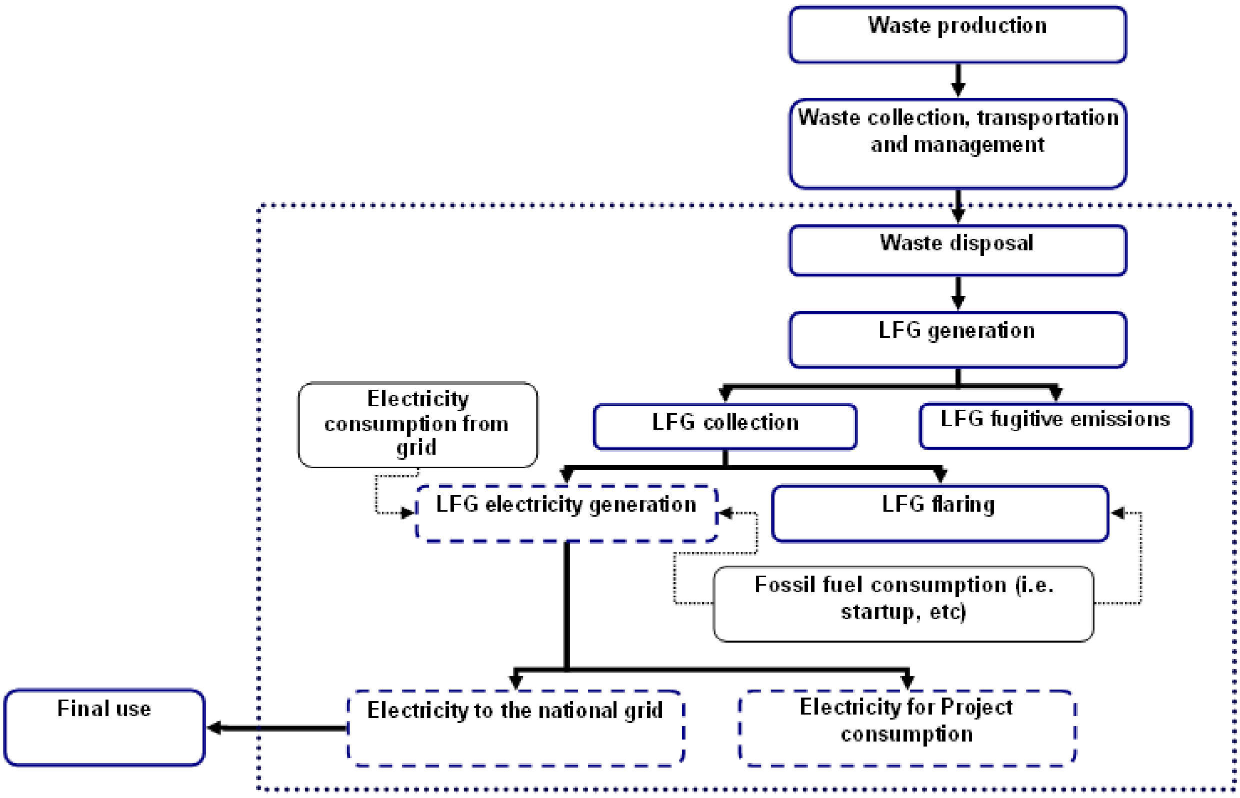

Figure 3: Flow chart of project boundaries (staggered line indicates boundaries)

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

ACM0001,V.11, establishes procedures for the selection of the most baseline plausible scenario. According to them, there are two steps to be followed:

- *"STEP 1. Identification of alternatives to the project activity consistent with current laws and regulations."*
- *"STEP 2: Identify the fuel for the baseline choice of energy source taking into account the national and/or sectoral policies as applicable."*

The latest version of the *"Tool for the demonstration and assessment of additionality Version 5.2.1"* was used to identify all realistic and credible baseline alternatives.

To determinate the baseline, the project boundary is the site of the project activity where the gas will be captured and utilized. There are two plausible scenarios to the project activity:

- LFG 1: The landfill operator would invest in landfill gas collection system of high efficiency as well as high efficiency power generator to supply the power to the national grid system without being registered as a CDM project activity.

- LFG 2: The business as usual scenario. Atmospheric release of the landfill gas with partial capture of landfill gas and destruction to comply with regulations and to address safety and odor concerns.

In the case of Matamoros-Torreón landfill, the baseline scenario is the continued release of the LFG to the atmosphere which constitutes a common practice in Mexico. There are no mandatory regulations or incentives to capture, flare and/or use the LFG.

In the section B.5 it will be described a detailed description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity, using the *"Tool for the demonstration and assessment of additionality Version 5.2.1"*.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

At the time of the validation, the contract to build the gas collection system has not been awarded and neither the equipment for extracting or flaring the LFG has not been purchased. The contract will be awarded by the project entity after the reception of the Final Validation Report. The Project participant considers the Final Validation Report as reasonably landmark for the following reasons:

- The fact of having the Final Validation Report is a milestone that reduces the risk of investment by the Project Participant as the project is in the final stages of registration. Therefore have greater assurance of obtaining carbon credits to ensure viability.
- The project participant believes its internal schedule from the beginning of the project (starting date) until the startup of burning the biogas activities are approximately 4 months. This time is considered a period similar to the UNFCCC to register projects (minimum three months) and is corroborated by the experience of the project participant in its projects like Culiacan and Leon.

The project is a new project activity (a project activity with a start date on or after 02 August 2008), for which the PDD has been published for GSC prior to the start date, therefore the CDM prior consideration does not require further demonstration.

The starting date corresponds to the first financial commitment on implementation of the project activity. PP have not committed yet to any expenditures related to implementation or construction of the project activity. No equipment has been ordered yet and no contract has been signed for equipment or construction. First real action towards implementation of the project will take place after the validation of the project, which is planned to be on 01 August 2012. The first financial commitment will be the purchase of the necessary pipework to build the gas collection system as shown in the following programme:

WBS	PROGRAMME OF CONSTRUCTION WORK 2012	01/08/2012		01/09/2012		01/10/2012		01/11/2012		01/12/2012	
I	PROYECTO BIOGAS TORREON	1	2	1	2	1	2	1	2	1	2
I.I	DRILLING										
I.I.1	Extraction well drilling										
I.I.2	Colocación de Tubería y filtro de grava										
I.I.2	Sellado de Pozos con Bentonita y material fino (arcilla)										
I.2	NETWORK INSTALLATION OF LANDFILL GAS COLLECTION										
I.2.1	Purchase of HDPE Pipe perimeter network, secondary and wells										
I.2.2	Placement and HDPE Pipe thermofusion perimeter network and secondary										
I.2.2	Instalation of wellheads in wells of biogas to conect collecting system										
I.3	CIVIL WORK										
I.3.1	Preliminary studies (Soil Mechanics, Hydrology)										
I.3.1	Leveling and construction of embankment										
I.3.1	Concrete construction and others										
I.4	FLARE INSTALLATION AND MONITORING EQUIPMENT										
I.4.1	Electrical Installation (wiring, poles and transformers)										
I.4.2	Instalation of flare stations and components										
I.4.3	Instalation of monitoring equipment										
I.4	START UP OPERATIONS										
I.4.1	Start up operations of flare station										

The PDD was published for global stakeholder consultation before the project activity start date and according to Annex 13 EB 62, this action prove the intention to seek the CDM status for Torreon Landfill Project.

The timeline for the project activity is presented below:

Date	Milestone	Evidence
01-Mar-2008	SCS Due Diligence	*1.Torreon - Due Diligence Report*
10-Nov-2008	Electricity report Caterpillar	*2.Caterpillar-Generators*
22-Dec.2008	Investment Date	*15.CDM minute 22dec08*
08-Mar-2009	Stakeholder Consultant	*6. SHC Torreon*
29-Aug-2009	Global Stakeholder Comments	*http://cdm.unfccc.int/*
28-Jul-2010	Letter of Approval	*0.Torreon_DNA*
01-Aug-2012	Start date of project activity	**Estimated*
15-Aug-2012	Start construction work	**Estimated*
01-Dec-2012	Start up operations of the flare station	**Estimated*

Based on the timeline above, it is confirmed that PALA is considering seriously CDM mechanism for the decision to implement and develop the proposed project activity. In fact, as it is described in the additionality analysis, the benefits of the CDM are a decisive factor in the decision to proceed with the project activity.

The *"Tool for the demonstration and assessment of additionality Version 5.2.1"* was used in this PDD demostrate the project aditionality.

Step 1: **Identification of alternatives to the project activity consistent with current laws and regulations.**
Sub-step 1a. Define alternatives to the project activity:

As it is indicated in ACM0001 V.11, among other scenarios, the following will be included:

- LFG 1: The landfill operator would invest in landfill gas collection system of high efficiency as well as high efficiency power generator to supply the power to the national grid system without being registered as a CDM project activity.
- LFG 2: The business as usual scenario. Atmospheric release of the landfill gas with partial capture of landfill gas and destruction to comply with regulations and to address safety and odor concerns.

These options are the most common and realistic alternatives for the context of the project activity.

It was mentioned before that the project activity proposes to generate electricity. In this case, the ACM0001 V.11 proposes to include the following alternatives, among others:

- P1: Power generated from landfill gas undertaken without being registered as a 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.

It is not intended for the project any renewable source that could be available (if any) around the region, then options P3 and P5 are dismissed. For fossil-fuel based captive power plants or cogeneration plants, the comparison with purchasing the electricity from the grid is remarkable, even better than any fossil fuel power plant, because it would require to acquires, transport and install them within the equipment for a plant of this magnitude; therefore P2 and P4 can be dismissed.

The only remaining options for plausible baselines are then P1 “Power generated from landfill gas undertaken without being registered as a CDM project activity”, and P6 “Power plants connected to the grid”.

The project does not include thermal energy generation because the project activity only proposes to generate electricity with LFG.

Thus the options listed above (LFG1 and LFG2; P1 and P6) are the only realistic alternatives to be considered as possible alternative baselines. These alternatives will be considered below and further analyzed, in Section B.5.

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

Regulation NOM-083-SEMARNAT-2003[10] defines the specifications for environmental protection from the selection, design, construction and operation, monitoring and closure of final disposal sites for urban and special solid waste, in Mexico. The regulation provides guidelines for the construction and operation of landfills, and also provides guidance regarding LFG, including recommendations for the collection, utilization and/or flaring of the LFG. However, the regulation does not specify minimum requirements regarding the amount of gas to be collected and utilized or flared.

The NOM- 083-SEMARNAT-2003 is not enforced in Mexico, for the following circumstance, NOM-083-SEMARNAT-2003 is a federal law, however, management and waste disposal are the responsibility of the municipalities as is state in the Political Constitution of the Mexican United States[11]. Thus, NOM-083-SEMARNAT- 2003 would only be legally binding if the local authorities adopt it.

NOM-083-SEMARNAT-2003 has become more of a document outlining policy guidance than a mandatory requirement.

The General Law for Ecologic Equilibrium and Environmental Protection[12], its rule[13], the General Law of Prevention and Complete Waste Management[14], its rule[15], the Law for Ecologic Equilibrium and Environmental Protection of the Coahuila of Zaragoza State[16] and the Law of prevention and complete waste management for Coahuila State[17] does not include any specific guide for LFG projects.

Since the publication of NOM-083-SEMARNAT-2003, no new active LFG collection and flaring or utilization systems have been developed in the Host Country without carbon revenues. Until 2003, there were only two landfill gas to energy projects in Mexico: Monterrey, Nuevo León funded with subsidies from the Global Environment Facility: Simeprode Landfill[18] and a project in Prados de la Montaña. In the Step 4. Common practice analysis of the *"Tool for the demonstration and assessment of additionality Version 5.2.1"* this item will be further explained.

As stated in the *"Tool for the demonstration and assessment of additionality Version 5.2.1"*, only laws that are systematically enforced and widespread in the Host Country need to be considered in the determination of the baseline scenario legal compliance. Therefore NOM-083-SEMARNAT-2003 shall not be taken into account in the establishment of the legal compliance of a baseline scenario for LFG projects in Mexico.

So, both considered alternatives above (LFG1 and P1; LFG2and P6) comply with the laws and regulations. The current situation at Intermunicipal Matamoros-Torreón landfill corresponds to Option II, meaning, LFG2 and alternative P6.

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[10] http://www.profepa.gob.mx/innovaportal/file/1306/1/nom-083-semarnat-2003.pdf
[11] *http://www.diputados.gob.mx/LeyesBiblio/pdf/1.pdf*
[12] *http://www diputados.gob.mx/LeyesBiblio/pdf/148.pdf*
[13] *http://www diputados.gob.mx/LeyesBiblio/regley/Reg_LGEEPA_MPCCA.pdf*
[14] *http://www.diputados.gob.mx/LeyesBiblio/pdf/263.pdf*
[15] *http://www.diputados.gob.mx/LeyesBiblio/regley/Reg_LGPGIR.pdf*
[16] *http://sgob.sfpcoahuila.gob.mx/admin/uploads/Documentos/modulo24/Ley_del_Equilibrio_Ecologico_y_la_Proteccion_al_Ambiente.pdf*
17http://www.coahuila.gob.mx/archivos/filemanager/leyes/Leyes_Estatales_Vigentes/L_parala_Prevencion_y_Gestion_Integral_de_Residuos.pdf
[18] *http://gefonline.org/projectDetailsSQL.cfm?projID=784*

Step 2: Identify the fuel for the baseline choice of energy source taking into account the national and/or sectoral policies as applicable.

For power generation, there were two scenarios remaining:

- P1: Power generated from landfill gas undertaken without being registered as a CDM project activity, and
- P6: Power plants connected to the grid.

The fuels in the power plants connected to the grid are defined by the corresponding company (Federal Commission Electricity - CFE[19]), and their emission factor is determined by the *"Tool to calculate the emission factor for an electricity system V.2.2.1"*, that would be generated in the grid in the baseline.

The baseline scenario in this particular case is the atmospheric release of the landfill gas (venting for security reasons) and its partial passive capture and burned in an open flare, but in most of the existing landfills in the Host Country the common situation is the passive flare of the biogas without flaring[20]. There is no incentive to utilize the LFG to produce thermal energy, since there are no potential off-takers for thermal energy.

Step 2. Investment Analysis

Sub-step 2a: Determine appropriate analysis method

The "*Tool for the demonstration and assessment of additionality V.5.2.1"*states: "If the CDM project activity and the alternatives identified in Step 1 generate no financial or economic benefits other than CDM related income, then apply the simple cost analysis (Option I). Otherwise, use the investment comparison analysis (Option II) or the benchmark analysis (Option III). Proposed baseline scenario does not involve an investment"

Sub-step 2b: Option III - Apply benchmark analysis

For the benchmark analysis, the IRR is considered the most suitable indicator for the project type. The project IRR will be used, since it includes all in and out cash flows.

Based on the above and according to the "*Tool for the demonstration and assessment of additionality V.5.2.1"* the financial/economic analysis shall be based on parameters that are standard in the market, considering the specific characteristics of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer.

For this project activity the "option a)" was chose to determine the most suitable discount rate and benchmark value to be used for the benchmark analysis.

(a) Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert or documented by official publicly available financial data;

In order to estimate an adequate discount rate to evaluate the project activity financial feasibility the following was considered by PALA:

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[19] CFE is a national company that provides services of generation, transmission and distribution of electrical power services. http://www.cfe.gob.mx/en/

[20] http://www.semarnat.gob.mx/programas/Documents/PNPGIR.pdf

- *Government bond rates:* The Bank of Mexico indicates fixed rate bonds of 10 years in annual percentage for Mexico. Taking into consideration the data before the management decision (December 22, 2008), the value of November 20th. 2008 for government fixed rate bonds of 10 years founded was 9.82%[21].
- Country risk: There are several methods for estimating the country risk premium such as the utilization of the relative volatilities of the U.S. and foreign stock markets or the utilization of the default spread on country bonds and the relative volatilities of the foreign equity and debt markets, depending on the methods used the country risk premium can vary. However, based on a country risk classification carried out by the "Organization for Economic Co-operation and Development (OECD)" the country risk premium for Mexico[22] is 2.00% (average 2008).

Hence, the benchmark rate of return involved can be set at least at 11.82%. The project is considered as a project IRR (after taxes), since all the required investment will be proportioned by PALA.

Sub-step 2c: Calculation and comparison of financial indicators

The calculation of the financial indicator for the project activity includes the initial investments costs, the operation and maintenance cost and revenues associated with the operation of the project activity. The timeline includes the crediting period (2012-2033).

The financial analysis was carried out using two scenarios:

1. Without carbon credit revenues.
2. With carbon credit revenues

The results of the financial analysis are:

1. Without carbon credit revenues and assuming an average of electricity price of 84.97 USD/MWh, the IRR is 0.75%.
2. With carbon credit revenues assuming an average of electricity price of 84.97 USD/MWh, and CERs prices of $12.00 USD/tonnes CO_2e, the IRR is 26.83%.

The electricity price has been calculated with the average of the 21 years of the crediting period with an annual inflation of 3%.

The following table shows a summary of the project's feasibility.

Table 5. Summary project

[21] 18.Bond_rates_mexico
[22] http://www.oecd.org/dataoecd/9/12/35483246.pdf, page 40

SUMMARY PROJECT	
Key parameter	**Value**
Annual Electricity Production	17,449 MWh/year
Average Sale Price	84.97 USD/MWh
Average Annual Electricity Income	1,459,744 USD
Average Annual CERs Income	1,068,452 USD
Total Investment	7,064,550 USD
Average annuall operational cost	980,794 USD
Project duration	21 Years
IRR without CERs sales	0.75% %
IRR with CERs sales	26.83% %

The results of the financial analysis were obtained taking into consideration the data shown in table 3, and trying to obtain the best IRR scenario possible. Without the carbon credit revenues the project is under the IRR benchmark indicated.

Sub-step 2d: Sensitivity analysis

A sensitivity analysis was conducted changing the following parameters:

- Increasing and decreasing the total investment costs.
- Increasing and decreasing the energy price.
- Increasing and decreasing the operating and maintenance cost.
- Increasing and decreasing the amount of electricity generated.

Variation in the carbon credit prices was not considered. Financial analyses were performed varying the parameters 10%, and assessing what the impact on the project IRR would be:

Table 6. Sensitivity Analysis

	Variation	
	(+10%)	(-10%)
	IRR	IRR
Investment cost	-2.91%	4.48%
Electricity tariff	4.13%	-3.32%
O&M cost	-1.89%	3.08%
Electricity production	5.35%	-1.98%

In conclusion, in all cases the project IRR remains lower than the benchmark value (11.82%). Therefore it is not feasible for a risky enterprise such as the construction and operation of a landfill gas to energy project. Consequently, the Project cannot be considered as financially attractive without CDM revenues.

Step 3: Barrier analysis:

Sub-step 3a. Identify barriers that would prevent the implementation of the proposed CDM project activity:

N/A

Step 4: Common practice analysis

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

Since the publication of NOM-083-SEMARNAT-2003, no new active LFG collection and flaring or utilization systems have been developed in the Host Country- Mexico without carbon revenues. A research done by the World Bank showed that the common practice in Mexico is to vent the biogas.[23]

As it was explain in Sub-step 1b only the project in Prados de la Montaña and Simeprode Landfill has a gas to energy project in Mexico, these project activities are not under the CDM.

The next table shows that the common practice in Mexico for landfills that receive more than 400 tonnes of waste per day is to flare the biogas in a passive manner.

Table 7 Landfills common practice in the Host country

Municipality	Site	Tonnes/day	Landfill characteristics	Biogas recovery
Acapulco de Juárez	Landfill	750.00	Controlled open dump, waste cover with certain frequency.	No presence of capture of biogas and/or the biogas is vent.
Aguascalientes	Landfill	820.00	Landfill with not enough control in leachate and biogas management.	With capture of biogas system.
Benito Juárez	Landfill	480.00	Controlled open dump, waste cover with certain frequency.	With capture of biogas system.
Chihuahua	Landfill	1,057.00	Landfill with not enough control in leachate and biogas management.	No presence of capture of biogas and/or the biogas is vent.
Culiacán	Landfill	774.00	Open dump without control.	No presence of capture of biogas and/or the biogas is vent.
Distrito Federal	Landfill	12,010.00	Landfill with not enough control in leachate and biogas management.	With capture of biogas system.

[23] http://siteresources.worldbank.org/INTUWM/Resources/340232-1208964677407/Veolia_4-9-08.pdf

Municipality	Site	Tonnes/day	Landfill characteristics	Biogas recovery
Durango	Landfill	494.00	Landfill, 75% of the NOM03 is fulfilled. Site controlled with cover of waste.	No presence of capture of biogas and/or the biogas is vent.
Guadalajara	Controlled open dump	1,994.00	Landfill with not enough control in leachate and biogas management.	With capture of biogas system.
Hermosillo	Landfill	590.00	Landfill with not enough control in leachate and biogas management.	No presence of capture of biogas and/or the biogas is vent.
Irapuato	Controlled open duma	450.00	Landfill with not enough control in leachate and biogas management.	No presence of capture of biogas and/or the biogas is vent.
Metepec	Controlled open dump	750.00	Landfill with not enough control in leachate and biogas management.	With capture of biogas system.
Monterrey	Landfill	4,107.00	Landfill, 75% of the NOM03 is fulfilled. Site controlled with cover of waste.	With recovery and/or use of biogas.
Morelia	Controlled open dump	650.00	Controlled open dump, waste cover with certain frequency.	No presence of capture of biogas and/or the biogas is vent.
Puebla	Landfill	1,532.00	Open dump without control.	With capture of biogas system.
Saltillo	Landfill	600.00	Landfill with not enough control in leachate and biogas management.	No presence of capture of biogas and/or the biogas is vent.
San Luis Potosí	Landfill	890.00	Landfill with not enough control in leachate and biogas management.	No presence of capture of biogas and/or the biogas is vent.
Tlaquepaque	Landfill	455.00	Open dump without control.	No presence of capture of biogas and/or the biogas is vent.
Toluca	Controlled open dump	739.00	Open dump without control.	No presence of capture of biogas and/or the biogas is vent.
Zapopan	Landfill	1,263.00	Open dump without control.	No presence of capture of biogas and/or the biogas is vent.

Currently, in Mexico, only in the LFG CDM registered or requesting registration projects the biogas is actively burn or use. In the CDM web site this information can be consulted[24].

Is is possible to say that the common practice in Mexico is the passive vent of the biogas without active capture, and that the exceptions to this practice are:

- The demonstrative Landfill to Energy Project subsided by the Global Environmental Facility in Simeprode Monterrey Landfill and project Prados de la Montaña
- The CDM projects that are registered or requesting registration.

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

The Simeprode LFG Project is one of the two similar activities that occurred without the CDM revenues, this project was financed through a GEF grant.

The collect, partially flare and electricity generation with the biogas of Prados the la Montaña landfill, that closed in 1994 and currently is a public park, is a consecuense of the grow of the urban zone around the closed landfill as prime real estate investment opportunity at the time. The landfill was

[24] http://cdm.unfccc.int/ date: July 25, 2009.

closed and "cleaned up" (i.e., to avoid nuisances and risks to nearby buildings) in order to encourage investment there. Needless to say, the Prados de la Montaña landfill now sits amongst the most prized real estate in the entire country, flanked by headquarters of important Mexican and international corporations, top-level academic institutions, and highly valued residential properties and commercial centres. The small amount of the electricity generated in the landfill is used to iluminate the park.

Some few projects of biogas collection and flaring/use are currently under development in Mexico, all these projects are being presented under the CDM and are happening due to carbon credits revenues.

For all the reasons above the project is considered to be additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices[25]:

Baseline emissions

To estimate the baseline scenario the ACM0001 V.11 uses:

$$BE_y = \left(MD_{project,y} - MD_{BL,y}\right) * GWP_{CH_4} + EL_{LFG,y} * CEF_{elec,BL,y} + ET_{LFG,y} * CEF_{ther,BL,y} \quad \textbf{(1)}$$

Where:

Variable		Definition	Comments
BE_y	=	Baseline emissions in year *y* (tCO_2e)	
$MD_{project,y}$	=	The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH_4) 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 (tCH_4)	Regulatory or contractual requirements do not exist, an Adjustment Factor (AF) will not be used.
GWP_{CH4}	=	Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4	
$EL_{LFG,y}$	=	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)	
$CEF_{elecy,BL,y}$	=	CO_2 emissions intensity of the baseline source of electricity displaced, in tCO_2e/MWh	

[25] The nomenclature used to name the equations in this section corresponds to the same nomenclature used in the ACM0001 V.11 and the tools it recommends.

$ET_{LFG,y}$	=	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	The project activity will not generate thermal energy from landfill gas, this implies $ET_{LFG,y}= 0$
$CEF_{ther,BL,y}$	=	CO_2 emissions intensity of the fuel used by boiler/air heater to generate thermal energy which is displaced by LFG based thermal energy generation, in tCO_2e/TJ.	Because the project activity will not generate thermal energy from landfill gas, $CEF_{ther,BL,y}=0$

AF estimation

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

The specific system for collection and destruction of methane is not mandated by regulatory or contractual requirements nor is undertaken for other reasons; for this, the ratio of the destruction efficiency of the baseline system to the destruction efficiency of the system used in the project activity is zero.

Ex-ante estimation of the amount of methane destroyed during the year, in tonnes of methane (MDproject,y)

Ex-ante baseline emissions are estimated as per "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" version 05.1.0, where $BE_{CH4,SWDS,y}$ represents the methane emissions generated during the year y from the disposal of waste at the solid waste disposal site during the period from the start of the project activity to the end of the year y (tCO2e).

As per the tool, $MD_{project,y}$ is evaluated by the following equation:

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

Variable		Definition	Comments
$BE_{CH4,SWDS,y}$	=	Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)	
GWP_{CH4}	=	Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4	

Ex-post estimation of the amount of methane destroyed during the year, in tonnes of methane (MDproject,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 ($MD_{project,y}$) during a year is determined by monitoring the quantity of methane actually flared and gas used to generate electricity and/or produce thermal energy and/or supply to end users via natural gas distribution pipeline, if applicable, and the total quantity of methane captured. The sum of the quantities fed to the flare(s), to the power plant(s), to the boiler(s)/air heater(s)/heat generating equipment(s) and to the natural gas distribution network (estimated using equation 3) must be compared annually with the total quantity of methane generated. The lowest value of the two must be adopted as $MD_{project,y}$..

The following procedure applies when the total quantity of methane generated is the highest.

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y} + MD_{PL,y} \quad \textbf{(8)}$$

Variable		Definition	Comments
$MD_{flared,y}$	=	Quantity of methane destroyed by flaring (tCH_4)	
$MD_{electricity,y}$	=	Quantity of methane destroyed by generation of electricity (tCH_4)	
$MD_{thermal,y}$	=	Quantity of methane destroyed for the generation of thermal energy (tCH_4)	There is no thermal use for the LFG, therefore $MD_{thermal,y} = 0$
$MD_{PL,y}$	=	Quantity of methane sent to the pipeline for feeding to the natural gas distribution network (tCH_4)	No LFG will be sent to pipeline for feeding to the natural gas distribution Network, therefore $MD_{PL,y}= 0$

Moreover, in a conservative practice in section B.6.3 has been compared the values ex ante and ex post, to determine which are the most conservative values.

The working hours of the energy plants and the generating equipments should be monitored and no emission reduction could be claimed for methane destruction in the energy plant during non-operational hours.

The supply to each point of methane destruction, through flaring or use for energy generation, shall be measured separately. For methane destroyed by flaring (**$MD_{flared,y}$**) ACM0001 V.11 uses:

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

Variable		Definition	Comments
$LFG_{flare,y}$	=	Quantity of landfill gas fed to the flare(s) during the year measured in cubic meters (m^3)	
$w_{CH4,y}$	=	Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3 CH_4/m^3 LFG)	Methane fraction of the landfill gas and LFG flow has to be measured on same basis (either wet or dry). In case the "Tool to determine project emissions from flaring gases containing methane" V.1 is used, follow the standard approaches to convert the flow on wet basis to dry basis.
D_{CH4}	=	Methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m_3CH_4)	At standard temperature and pressure (0 degree Celsius and 1,013 bar) the density of methane is 0.0007168 tCH_4/m_3CH_4.
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year *y* (tCO_{2e}) determined following the procedure described in the "Tool to determine project emissions from flaring gases containing methane" V.1. If methane is flared through more than one flare, the $PE_{flare,y}$	The project will be use an enclosed flare because they are more effective in destroying methane.

		shall be determined for each flare using the tool.	

To determine the flare efficiency option b) of the tool is selected, continuous monitoring of the methane destruction efficiency of the flare. If there is no record of the temperature of the exhaust gas of the flare or if the recorded temperature is less than 500 °C for any particular hour, it shall be assumed that during that hour the flare efficiency is zero.

For ex-ante purposes, the project is likely to use an efficiency of 90% according as a default value.

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

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

Variable	**SI Unit**	**Description**
$FM_{RG,h}$	kg/h	Mass flow rate of the residual gas in hour *h*
$\rho_{RGn,h}$	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*

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

Vari ble	**SI Unit**	**Description**
ρRGn,h	kg/m^3	Density of the residual gas at normal conditions in hour *h*
Pn	Pa	Atmospheric pressure at ormal conditions 101 325)
Ru	Pa.m3/kmol.K	Universal deal gas co stant (8 314)
MMRG,h	kg/kmol	Molecular mass of the residual gas in hour *h*
Tn	K	Temperature at normal conditions (273.15)

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

Variable	**SI Unit**	**Description**
MMRG,h	kg/kmol	Molecular mass of the residual gas in hour *h*
$fv_{i,h}$	-	Volumetric fraction of component *i* in the residual gas in the hour *h*
MMi	kg/kmol	MMi kg/kmol Molecular mass of residual gas component *i*
I		The components CH_4 ,CO, CO_2, O_2, H_2, N_2

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

While this leads to minor errors, the simplified approach greatly simplifies measurements, and does not significantly affect the estimate of flare efficiency.

With this simplification, Tool Equation (3) becomes:

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

Variable	SI Unit	Description
MMRG,h	kg/kmol	Molecular mass of the residual gas in hour *h*
$fv_{i,h}$	-	Volumetric fraction of component *i* in the residual gas in the hour *h*
MMi	kg/kmol	MMi kg/kmol Molecular mass of residual gas component *i*
i		The components CH_4, N_2 (Note that only CH_4 would be measured and N_2 determined as the balance).

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:

$$fm_{j,y} = \frac{\sum_i fv_{i,h} * AM_j * NA_{j,i}}{MM_{RG,h}} \qquad \textit{Tool Equation (4)}$$

Where:

Variable	SI Unit	Description
$fm_{i,y}$	-	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
$NA_{j,i}$		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. Note that the simplified approach, involving measurement of methane and assuming the balance to be nitrogen, implies that there is no elemental oxygen in the gas, and that all the carbon is in the form of methane. The only hydrogen is also in methane, but this does not involve any simplification, since there is no H2 in the other components that might be present in landfill gas: CO_2 and O2.
i		The components are CH_4 and N_2 (Note that with the simplified approach, the concentrations of other gases would not be determined).

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

Since the methane combustion efficiency is to be continuously measured in the proposed project, this step is applicable.

Determine the average volumetric flow rate of the exhaust gas in each hour *h* based on a stoichiometric calculation of the combustion process, which depends on the chemical composition of the residual gas, the amount of air supplied to combust it and the composition of the exhaust gas, as follows:

$$TV_{n,FG,h} = V_{n,FG,h} * FM_{RG,h}$$ *Tool Equation (5)*

Where:

Variable	**SI Unit**	**Description**
$TV_{n,FG,h}$	m3/h	Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour h
$V_{n,FG,h}$	m3/kg residual gas	Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in hour h
$FM_{RG,h}$	kg residual gas/h	Mass flow rate of the residual gas in hour h

$$V_{n,FG,h} = V_{n,CO2,h} + V_{n,O2,h} + V_{n,N2,h}$$ *Tool Equation (6)*

Where:

Variable	**SI Unit**	**Description**
$V_{n,FG,h}$	m_3/kg residual gas	Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in the hour *h*
$V_{n,CO2,h}$	m_3/kg residual gas	Quantity of CO_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
$V_{n,N2,h}$	m_3/kg residual gas	Quantity of N_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
$V_{n,O2,h}$	m_3/kg residual gas	Quantity of O_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*

$$V_{n,O_2,h} = n_{O_2,h} \times MV_n$$ *Tool Equation (7)*

Where:

Variable	**SI Unit**	**Description**
$V_{n,\,O2,\,h}$	m_3/kg residual gas	Quantity of O_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in hour *h*
$n_{O2,\,h}$	kmol/kg residual gas	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*
MV_n	m_3/kmol	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 litres/mol)

The Tool states:

$$V_{n,N_2,h} = MV_n * \left\{ \frac{fm_{N,h}}{200AM_N} + \left(\frac{1 - MF_{O_2}}{MF_{O_2}} \right) * \left[F_h + n_{O_2,h} \right] \right\}$$ *Tool Equation (8)*

Where:

Variable	SI Unit	Description
$V_{n,N2,h}$	m^3/kg residual gas	Quantity of N_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
MV_n	m^3/kmol	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 m^3/Kmol)
$fm_{N,h}$	-	Mass fraction of nitrogen in the residual gas in the hour *h*
AM_n	kg/kmol	Atomic mass of nitrogen
MF_{O2}	-	O_2 volumetric fraction of air
F_h	kmol/kg residual gas	Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h*
$n_{O2,h}$	kmol/kg residual gas	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*

$$V_{n,CO2,h} = \frac{fm_{C,h}}{AM_C} * MV_n$$ *Tool Equation (9)*

Where:

Variable	SI Unit	Description
$V_{n,CO2,h}$	m^3/kg residual gas	Quantity of CO_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
$fm_{C,h}$	-	Mass fraction of carbon in the residual gas in the hour *h*
AM_C	kg/kmol	Atomic mass of carbon
MV_n	m^3/kmol	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 m^3/Kmol)

$$n_{O_2,h} = \frac{t_{O_2,h}}{\left(1-(t_{O_2,h}/MF_{O_2})\right)} \times \left[\frac{fm_{C,h}}{AM_C} + \frac{fm_{N,h}}{2AM_N} + \left(\frac{1-MF_{O_2}}{MF_{O_2}}\right) \times F_h\right]$$ *Tool Equation (10)*

Where:

Variable	SI Unit	Description
$n_{O2,h}$	kmol/kg residual gas	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*
$t_{O2,h}$	-	Volumetric fraction of O_2 in the exhaust gas in the hour *h*
MF_{O2}		Volumetric fraction of O_2 in the air (0.21)
F_h	kmol/kg residual gas	Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h*
$fm_{j,h}$	-	Mass fraction of element *j* in the residual gas in hour *h* (from equation

Variable	SI Unit	Description
		4)
AM_j	kg/kmol	Atomic mass of element *j*
j	-	The elements carbon (index C) and nitrogen (index N)

$$F_h = \frac{fm_{C,h}}{AM_C} + \frac{fm_{H,h}}{4AM_H} - \frac{fm_{O,h}}{2AM_O}$$ *Tool Equation (11)*

Where:

Variable	SI Unit	Description
F_h	kmol O_2/kg residual gas	Stoichiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h*
$fm_{j,h}$	-	Mass fraction of element *j* in the residual gas in hour *h* (from equation 4)
AM_j	kg/kmol	Atomic mass of element *j*
j	-	The elements carbon (index C), hydrogen (index H) and oxygen (index O)

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

$$TM_{FG,h} = \frac{TV_{n,FG,h} * fv_{CH4,FG,h}}{1{,}000{,}000}$$ *Tool Equation (12)*

Where:

Variable	SI Unit	Description
$TM_{FG,h}$	kg/h	Mass flow rate of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h*
$TV_{n,FG,h}$	m^3/h exhaust gas	Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour *h*
$fv_{CH4,FG,h}$	mg/m^3	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in hour *h*

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

The Tool states:

"The quantity of methane in the residual gas flowing into the flare is the product of the volumetric flow rate of the residual gas ($FV_{RG,h}$), the volumetric fraction of methane in the residual gas ($fv_{CH4,RG,h}$) and the density of methane ($\rho_{CH4,n,h}$) in the same reference conditions (normal conditions and dry or wet basis)."

The Tool further elaborates:

"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)."

$$TM_{RG,h} = FV_{RG,h} * fv_{CH4,RG,h} * \rho_{CH4,n}$$ *Tool Equation (13)*

Where:

Variable	SI Unit	Description
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*
$FV_{RG,h}$	m^3/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 $fv_{i,RG,h}$ where *i* refers to methane)
$\rho_{CH4,n}$	kg/m^3	Density of methane at normal conditions (0.716)

Step 6: Determination of the hourly flare efficiency

The Tool states:

"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)."

"In case of enclosed flares and continuous monitoring of the flare efficiency, the flare efficiency in the hour h (ηflare,h) is:

- *0% if the temperature of the exhaust gas of the flare (Tflare) is below 500 °C during more than 20 minutes during the hour h.*
- η *determined as follows in cases where the temperature of the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour h :*

$$\eta_{Flare,h} = 1 - \frac{TM_{FG,h}}{TM_{RG,h}}$$ *Tool Equation (14)*

Where:

Variable	SI Unit	Description
$\eta_{flare,h}$	-	Flare efficiency in hour *h*
$TM_{FG,h}$	kg/h	Mass flow methane rate in exhaust gas averaged in hour *h*
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*

STEP 7. Calculation of annual project emissions from flaring

The Tool states:

"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 (TMRG,h) and the flare efficiency during each hour h (η flare,h), as follows:"

$$PE_{flare,h} = \sum_{h=1}^{8760} TM_{RG,h} * (1 - \eta_{flare,h}) * \frac{GWP_{CH4}}{1000}$$ …………………*Tool Equation (15)*

Where:

Variable	SI Unit	Description
$PE_{flare,y}$	tCO_2e	Project emissions from flaring of the residual gas stream in year
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*
$\eta_{flare,h}$		Flare efficiency in hour *h*
GWP_{CH4}	tCO_2e/tCH_4	Global Warming Potential of methane valid for the commitment period

For methane used for electricity generation purposes (MDelectricity,y) ACM0001 V.1. uses:

$$MD_{electricity,y} = LFG_{electricity,y} * w_{CH4,y} * D_{CH4} \qquad \textbf{(10)}$$

Variable		Definition	Comments
$MD_{electricity,y}$	=	Quantity of methane destroyed by generation of electricity	
$LFG_{electricity,y}$	=	Quantity of landfill gas fed into electricity generator	

It should be noted that for landfill gas flows captured either for flaring or electrical purposes (LFGflare,y and LFGelectricity,y) the annual hours of plant operation need to be taken into account.

The *ex ante* estimation of the the amount of methane that would have been destroyed/combusted during the year, in tonnes of methane ($MD_{project,y}$) was done as per the version 5.1.0 of the approved “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” , considering the following additional equation:

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

Variable		Definition	Comments
$BE_{CH4,SWDS,y}$	=	Methane generation from the landfill in the absence of the project activity at year *y* (tCO_2e), calculated as per the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” V 5.1.0. 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.	• In the tool, x will refer to the year since the landfill started receiving wastes [x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)]; • A study developed by the project participant reports the waste composition.[26]

[26] Due Dilligence Report Torreón Landfill, Coahuila, México. SCS Engineers.

Table 8. *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site. V.5.1.0*

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

Where:

$BE_{CH4,SWDS,y}$	=	Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
Φ	=	Model correction factor to account for model uncertainties (0.9)
f	=	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	=	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	=	Fraction of degradable organic carbon (DOC) that can decompose
MCF	=	Methane correction factor
$W_{j,x}$	=	Amount of organic waste type j prevented from disposal in the SWDS in the year x (t)
DOC_j	=	Fraction of degradable organic carbon (by weight) in the waste type j
k_j	=	Decay rate for the waste type j
j	=	Waste type category (index)
x	=	Year since the landfill started receiving wastes [x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)] Note: this definition represents a correction of the Tool as given in ACM0001, V.11.
y		Year for which methane emissions are calculated

ACM0001, V.11 further clarifies that "*Sampling to determine the different waste types is not necessary; the waste composition can be obtained from previous studies*."

ACM0001, V.11 also states: "*The efficiency of the degassing system which will be installed in the project activity should be taken into account while estimating the ex-ante estimation*." This is taken into consideration through the utilization of a 64% capture efficiency value for the total of biogas generated..

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

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

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

Net quantity of electricity produced using LFG ($EL_{LFG,y}$)

Since the project activity has as it purpose to generate electricity using LFG, during the crediting period, it will be measured the electricity produced in power plant station at the site. In the absence of the project activity, this electricity would have been produced by power plants connected to the grid.

Determination of $CEF_{elec,BL,y}$

In the baseline the electricity is generated by plants connected to the grid, the emission factor is calculated according to "*Tool to calculate the emission factor for an electricity system V.2.2.1*". The details of the calculations have been included in the Annex 3.

Quantity of thermal energy generated using LFG ($ET_{LFG,y}$)

The purpose of this project activity does not involve thermal generation using LFG. Therefore, $ET_{LFG,y}$ = 0 .

Project Emissions from flaring:

Project emissions from flaring will be calculated and monitored according to the procedures described in "*Tool to determine project emissions from flaring gases containing methane V.1*", using the option for continuous monitoring of the methane destruction efficiency of the flare. As per the tool the *ex-ante* calculations of emission reductions is not required. Moreover, in conservative way, the ex-ante calculation will be calculated with a 90% of efficiency for the project (according to the flare´s manufacturer specifications).

Project emissions:

Possible CO_2 emissions coming from other fuels than the recovered methane (contained in the landfill gas), should be accounted for as project emissions.

The general equation for Project emissions is stated as follows:

$$PE_y = PE_{EC,y} + PE_{FC,j,y} \quad \textbf{(16)}$$

Variable		Definition	Comments
$PE_{EC,y}$	=	Emissions from consumption of electricity in the project case. The project emissions from electricity consumption ($PE_{EC,y}$) will be calculated following the latest version of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption. V.1". If in the baseline a part of LFG was captured then the electricity quantity used in calculation is electricity used in project activity net of that consumed in the baseline	The tool is applicable because the source of electricity consumption is the scenario A: Electricity consumption from the grid.

$PE_{FC,j,y}$	=	Emissions from consumption of heat in the project case. The project emissions from fossil fuel combustion ($PE_{FC,j,y}$) will be calculated following the latest version of "*Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion*". For this purpose, the processes j in the tool corresponds to all fossil fuel combustion in the landfill, as well as any other on-site fuel combustion for the purposes of the project activity. If in the baseline part of a LFG was captured then the heat quantity used in calculation is fossil fuel used in project activity net of that consumed in the baseline. The principal source of consumption of fuel in the project will be the fuel to start the ignition of the flare. Moreover, when the generator will be installed, the fuel will be used to avoid any problems in the operation in case of electricity outages.	

Table 9. Tool to calculate baseline, project and/or leakage emissions from electricity consumption. V.1

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

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

$PE_{EC,y}$ Are the project emissions from electricity consumption by the project activity during the year y (tCO_2 / yr)

$EC_{PJ,y}$ Is the quantity of electricity consumed by the project activity during the year y (MWh),

$EF_{grid,y}$ Is the emission factor for the grid in year y (tCO_2/MWh)

TDL_y Are the average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

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

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

A default 20% was used for the ex-ante calculation (option A1) for the **TDL_y**.

$PE_{FC,y}$ will be calculated using the "*Tool to calculate project or leakage CO2 emissions from fossil fuel combustion*". *V.2.*

Table 10. Tool to calculate project or leakage CO2 emissions from fossil fuel combustion. V.2"

CO2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO2 emission coefficient of those fuels, as follows:

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

Where:

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

The CO_2 emission coefficient $COEF_{i,y}$ will be calculated using option B based on net calorific value and CO_2 emission factor of the fuel(s) type(s) used. Option A can not be applied because the necessary data is not available.

The type(s) of fossil fuel(s) to be used will depend on the choice of the developer (i.e. natural gas, fuel oil, diesel, etc.), and the corresponding emission factors will be taken from the IPCC 2006 default values, in case there is no data available.

Leakage

No leakage effects need to be accounted under this methodology.

Emission Reduction

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \textbf{(17)}$$

Variable		Definition	Comments
ER_y	=	Emission reductions in year *y* (tCO_2e/yr)	
BE_y	=	Baseline emissions in year *y* (tCO2e/yr)	
PE_y		Project emissions in year *y* (tCO_2/yr)	

B.6.2. Data and parameters that are available at validation:

Data and parameters not monitored

Data / Parameter:	**Regulatory requirements relating to landfill gas**
Data unit:	--
Description:	Regulatory requirements relating to landfill gas
Source of data used:	Publicly available information provided by Mexican government
Value applied:	NA
Justification of the choice of data or description of measurement methods and procedures actually applied :	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 will explain how regulations are translated into that amount of gas.
Any comment:	This value should be renewed according to the applicable regulations at the moment of the baseline renew.

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential of CH_4
Source of data used:	IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	Shall be updated accordingly to any future COP/MOP decisions
Any comment:	N/A

Data / Parameter:	**D_{CH4}**
Data unit:	tCH_4/m^3CH_4
Description:	Methane density
Source of data used:	IPCC
Value applied:	0.0007168
Justification of the choice of data or description of measurement methods and procedures actually applied :	At standard T and P (0 degrees C and 1,013 bar)
Any comment:	N/A

Data / Parameter:	**$BE_{CH4, SWDS,y}$**
Data unit:	tCO_2e
Description:	Methane generation from the landfill in the absence of the project activity at year
Source of data used:	Calculated as per the *"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" –Version 5.1.0*
Value applied:	**Start year** / **$BE_{CH4,SWDS,y}$ (t CO_2e)** **2012** / 114,080 **2013** / 122,358 **2014** / 130,598 **2015** / 138,817 **2016** / 147,032 **2017** / 155,259 **2018** / 163,512 **Total** / **971,658**
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per the *"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" –Version 5.1.0*
Any comment:	Used for ex-ante estimation of the amount of methane that would have been destroyed/combusted during the year

Start year	$BE_{CH4,SWDS,y}$ (t CO_2e)
2012	114,080
2013	122,358
2014	130,598
2015	138,817
2016	147,032
2017	155,259
2018	163,512
Total	**971,658**

Data / Parameter:	**MD_{Hist}**
Data unit:	tCH_4
Description:	Amount of methane destroyed historically for the previous year before the start of project activity.
Source of data used:	Project proponent
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Estimated using the actual amount of waste disposed in the landfill as per the version 5.1.0 of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Any comment:	This parameter could be used for the estimation of AF

Data / Parameter:	**MG_{Hist}**
Data unit:	tCH_4
Description:	Amount of methane generated historically for the previous year before the start of project activity
Source of data used:	Project proponent
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Estimated using the actual amount of waste disposed in the landfill as per the version 5.1.0 of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Any comment:	This parameter could be used for the estimation of AF

Data / Parameter:	**φ**
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	As per the *"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" –Version 5.1.0*
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	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 emission reductions in a conservative manner, a discount of 10% is applied to the model results.
Any comment:	

Data / Parameter:	**F**
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually	According to the *"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site". –Version 5.1.0*
Any comment:	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC.

Data / Parameter:	$\mathbf{CE_{project,y}}$
Data unit:	-
Description:	The efficiency of the degassing system which will be installed in the project activity, in year y
Value applied:	65%
Justification of the choice of data or description of measurement methods and procedures actually applied :	The efficiency of the planned LFG collection, flaring, and utilization system is estimated based on site conditions and the proposed system design by applying the methodology for estimating collection efficiency published by U.S. EPA, Landfill Methane Outreach Program (www.epa.gov/lmop/index.htm) in the Users Manual for the Central America Landfill Gas Model
Any comment:	The efficiency of the planned LFG collection, flaring, and utilization system is taken into account for the ex ante estimation of emission reductions.

Data / Parameter:	**OX**
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	As per the "*Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" version 5.1.0*
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the "*Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" version 5.1.0. for managed solid waste disposal sites"* this value has been used for conservative reasons since the landfill has been using soil as cover.
Any comment:	

Data / Parameter:	**MCF**
Data unit:	-
Description:	Methane correction factor
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the "*Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" version 5.1.0 for managed solid waste disposal sites"* this value is to be applied to Torreon Landfill as it is "anaerobic managed solid waste disposal sites".
Any comment:	

Data / Parameter:	**AF**
Data unit:	Dimensionless
Description:	Adjustment factor (for methane destruction in the baseline)
Source of data used:	Local information on existing facilities at the landfill and information regarding host country regulations
Value applied:	0%
Justification of the choice of data or description of measurement methods and procedures actually applied :	There is no methane destruction occurring at the landfill currently, only passive venting of methane to the atmosphere. Furthermore, regulations in Mexico do not require landfills to install an active LFG collection and flaring system or to produce electricity at the landfill.
Any comment:	

Data / Parameter:	DOC_j	
Data unit:	-	
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j* .	
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)	
Value applied:	The following values for the different waste types *j* are applied:	
	Waste type j	**DOC_j (%wet waste)**
	Wood and wood products	43
	Pulp, paper and cardboard (other than sludge)	40
	Food, food waste, bevarages and tobacco (other thansludge)	15
	Textiles	24
	Garden, yard and park waste	20
	Glass, plastic, metal, other inert waste	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	In accordance with *"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site", version 05.1.0*	
Any comment:	The values applied are for wet waste.	

Data / Parameter:	DOC_f
Data unit:	-
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the "*Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" version 05.1.0*
Any comment:	

<table>
<tr><td>Data / Parameter:</td><td>kj</td></tr>
<tr><td>Data unit:</td><td>-</td></tr>
<tr><td>Description:</td><td>Decay rate for the waste type j .</td></tr>
<tr><td>Source of data used:</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)</td></tr>
<tr><td>Value applied:</td><td>The following values for the different waste types j are applied:
<table>
<tr><td></td><td></td><td colspan="2">Boreal/Temperate (MAT<20C)</td><td colspan="2">Tropical/Temperate (MAT>20C)</td></tr>
<tr><td></td><td></td><td>Dry (MAP/PET<1)</td><td>Wet (MAP/PET>1)</td><td>Dry (MAP<1000mm)</td><td>Wet (Dry (MAP>1000mm)</td></tr>
<tr><td rowspan="2">Slowly Degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.04</td><td>0.06</td><td>0.045</td><td>0.07</td></tr>
<tr><td>Wood,wood products and straw</td><td>0.02</td><td>0.03</td><td>0.025</td><td>0.035</td></tr>
<tr><td>Moderately Degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.05</td><td>0.1</td><td>0.065</td><td>0.17</td></tr>
<tr><td>Rapidly Degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.06</td><td>0.185</td><td>0.085</td><td>0.4</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>The Torreon Landfill is located in Coahuila, which has a mean annual temperature (MAT) of 22.1ºC and mean annual precipitation (MAP) of 228 mm. Given that temperature and precipitation the decay rate has to considere for dry climates (less tha 1000 mm/year) with tropical temperatures (MAT exceeds 20ºC). The k values for the category (listed in bold in this table) will be applied for Torreon Landfill.</td></tr>
<tr><td>Any comment:</td><td>http://www.worldweather.org/179/c01208.htm</td></tr>
</table>

Data / Parameter:	**Carbon Emission Factor (CEFelectricity,y)**
Data unit:	tCO2/MWh
Description:	CO2 emissions intensity of the electricity displaced
Source of data used:	As per “Tool to calculate the emission factor for an electricity system” version 02.2.1
Value applied:	0.4643
Justification of the choice of data or description of measurement methods and procedures actually applied :	”Tool to calculate the emission factor for an electricity system” (Version 2.1.1)
Any comment:	The value will be keep fixed for the entire crediting period.

Data / Parameter:	**$FC_{i,j,y}$**
Data unit:	Mass or volume unit
Description:	Quantity of fuel type i combusted in process j during the year y
Source of data used:	Based on monitored values on similar project of the Project Proponent
Value applied:	0.6714
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the "Tool to calculate the emission factor for an electricity system".
Any comment:	

Data / Parameter:	**$NCV_{i,y}$**
Data unit:	GJ / mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type i in year y
Source of data used:	Official data published by the Mexican DNA (SENER)
Value applied:	26.3
Justification of the choice of data or	According to the "Tool to calculate the emission factor for an electricity system".
Any comment:	The Mexican DNA provides the composition of gas LP in Mexico

Data / Parameter:	**$EF_{CO2,i,y}$**
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type i in year y
Source of data used:	IPCC default values as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value applied:	0.0656
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the "Tool to calculate the emission factor for an electricity system".
Any comment:	

Data / Parameter:	**MM_{CH4}**
Data unit:	kg/kmol
Description:	Molecular mass of methane
Source of data used:	Constant
Value applied:	16.04
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1.*
Any comment:	

Data / Parameter:	**MM_{CO}**
Data unit:	kg/kmol
Description:	Molecular mass of carbon monoxide
Source of data used:	Constant
Value applied:	28.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1* .
Any comment:	

Data / Parameter:	**MM_{CO2}**
Data unit:	kg/kmol
Description:	Molecular mass of carbon dioxide
Source of data used:	Constant
Value applied:	44.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1* .
Any comment:	

Data / Parameter:	**MM_{O2}**
Data unit:	kg/kmol
Description:	Molecular mass of oxygen
Source of data used:	Constant
Value applied:	32
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1* .
Any comment:	

Data / Parameter:	**MM_{H2}**
Data unit:	kg/kmol
Description:	Molecular mass of hydrogen
Source of data used:	Constant
Value applied:	2.02
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1* .
Any comment:	

Data / Parameter:	**MM_{N2}**
Data unit:	kg/kmol
Description:	Molecular mass of nitrogen
Source of data used:	Constant
Value applied:	28.02
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1* .
Any comment:	

Data / Parameter:	**AM_c**
Data unit:	kg/kmol
Description:	Atomic mass of carbon
Source of data used:	Constant
Value applied:	12
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1* .
Any comment:	

Data / Parameter:	**AM_H**
Data unit:	kg/kmol
Description:	Atomic mass of hydrogen
Source of data used:	Constant
Value applied:	1.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1* .
Any comment:	

Data / Parameter:	**AM_O**
Data unit:	kg/kmol
Description:	Atomic mass of oxygen
Source of data used:	Constant
Value applied:	16
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1* .
Any comment:	

Data / Parameter:	**AM_N**
Data unit:	kg/kmol
Description:	Molecular mass of nitrogen
Source of data used:	Constant
Value applied:	14.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1* .
Any comment:	

Data / Parameter:	**P_n**
Data unit:	Pa
Description:	Atmospheric pressure at normal conditions
Source of data used:	Constant
Value applied:	101,325
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1* .
Any comment:	

Data / Parameter:	**R_u**
Data unit:	Pa.m^3/kmol.K
Description:	Universal ideal gas constant
Source of data used:	Constant
Value applied:	8,314.472
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1* .
Any comment:	

Data / Parameter:	**T_n**
Data unit:	K
Description:	Temperature at normal conditions
Source of data used:	Constant
Value applied:	273.15
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per *"Tool to determine project emissions from flaring gases containing methane" version1* .
Any comment:	

Data / Parameter:	**MF_{O2}**
Data unit:	Dimensionless
Description:	O_2 volumetric fraction of air
Source of data used:	Constant
Value applied:	0.21
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per “*Tool to determine project emissions from flaring gases containing methane” version1 .*
Any comment:	

Data / Parameter:	**MV_n**
Data unit:	m^3/Kmol
Description:	Volume of one mole of any ideal gas at normal
Source of data used:	Constant
Value applied:	22.414
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per “*Tool to determine project emissions from flaring gases containing methane” version1*
Any comment:	

B.6.3. Ex-ante calculation of emission reductions:

Ex ante calculation of emission reductions was done using the “*Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site*” –Version 5.1.0. The actual emission reductions will be monitored ex-post.

<u>Baseline Emissions</u>

Ex-ante estimation of baseline emissions

$BE_y = (MD_{project,y} – MD_{BL,Y})* GWP_{CH4} + EL_{LFG,Y}*CEF_{elec,BL,y}$

Calculation of $MD_{Project,y}$

a) As discussed in section B.6.1, conservatively, $MD_{project,y}$ has been calculated with the ex ante and ex post values to choose the most conservative value.

The ex-ante estimation of the amount of methane generated by the disposal of waste at a solid waste disposal site during the year ($MD_{Project,y}$) are calculated by:

$$MD_{project,y} = BE_{CH4,SWDS,y} / GWP_{CH4}$$

And the $MD_{project,y}$ ex post are calculated by:

$$MD_{project,y} = MD_{flared,y} + MD_{Elect,y} + MD_{thermal,y} + MD_{PL,y}$$

Table 11: Annual calculation for $MD_{Project,y}$

Period			$MD_{project,y}$ (ex ante) (t CH4)	$MD_{project,y}$ (ex post) (t CH4)
Period Year	Start Date	End Date		
1	01/12/2012	30/11/2013	5,793	3,095
2	01/12/2013	30/11/2014	6,186	3,305
3	01/12/2014	30/11/2015	6,577	3,900
4	01/12/2015	30/11/2016	6,987	4,119
5	01/12/2016	30/11/2017	7,360	4,318
6	01/12/2017	30/11/2018	7,753	4,528
7	01/12/2018	30/11/2019	8,148	4,739
Total MD project,y (tCH4)			**48,804**	**28,004**
Annual average			**6,972**	**4,001**

Therefore, conservatively, in that situation $MD_{project,y}$ has been defined with the ex post calculations.

b) The $MD_{BL,y}$ is given/defined in the regulation and/or contract as a quantity that quantity will be used, and is calculated by:

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

Table 12: Annual calculation for $MD_{BL,Yy}$

Period			$MD_{BL,Y}$ (t CH4)
Period Year	Start Date	End Date	
1	01/12/2012	30/11/2013	0
2	01/12/2013	30/11/2014	0
3	01/12/2014	30/11/2015	0
4	01/12/2015	30/11/2016	0
5	01/12/2016	30/11/2017	0
6	01/12/2017	30/11/2018	0
7	01/12/2018	30/11/2019	0
Total $MD_{BL,Y}$(tCH4)			**0**
Annual average			**0**

Table 13: Annual calculation for $ELE_{LFG,y}$

Period			$ELE_{LFG,y}$ (MWh)
Period Year	Start Date	End Date	
1	01/12/2012	30/11/2013	0
2	01/12/2013	30/11/2014	0
3	01/12/2014	30/11/2015	23,693
4	01/12/2015	30/11/2016	23,693
5	01/12/2016	30/11/2017	23,693

6	01/12/2017	30/11/2018	23,693
7	01/12/2018	30/11/2019	23,693
Total $EL_{ELFG,y}$ (MWh)			**118,465**
Annual average			**16,924**

Table 14: Annual calculation for $BE_{,y}$

Period			**$BE_{,y}$ (tCO2e)**
Period Year	**Start Date**	**End Date**	
1	01/12/2012	30/11/2013	64,994
2	01/12/2013	30/11/2014	69,398
3	01/12/2014	30/11/2015	92,900
4	01/12/2015	30/11/2016	97,505
5	01/12/2016	30/11/2017	101,684
6	01/12/2017	30/11/2018	106,092
7	01/12/2018	30/11/2019	110,522
Total BE,y (tCO2e)			**643,095**
Annual average			**91,871**

<u>Project Emissions</u>

$PEy = PE_{EC\,y} + PE_{FC\,j\,y}$,

For Project emissions from electricity consumption, we have that according to the "*Tool to calculate baseline, project and/or leakage emissions from electricity consumption*" version 1, under scenario A "Electricity consumption from the grid" $PE_{EC,y}$ is calculated as follows:

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

Thus since the grid emission factor for Mexico is 0.4643 tCO2/MWh, the electricity consumption per year by the equipment amounts to 234.9 MWh and according to the tool TDLy is 20%, then we have that yearly project emissions amount to:

$PE_{EC,y}$ = 234.9 MWh * 0.4643 tCO2/MWh * (1+0.2) = 131 tCO_2e

Table 15: Annual calculation for $PE_{EC,y}$

Period			**$PE_{EC,y}$ (tCO2)**
Period Year	**Start Date**	**End Date**	
1	01/12/2012	30/11/2013	131
2	01/12/2013	30/11/2014	131
3	01/12/2014	30/11/2015	131
4	01/12/2015	30/11/2016	131
5	01/12/2016	30/11/2017	131

6	01/12/2017	30/11/2018	131
7	01/12/2018	30/11/2019	131
Total $PE_{EC,y}$ (tCO2)			**917**
Annual average			**131**

On the other hand, for Project emissions from fossil fuel combustion we have that annual emissions are:

$PE_{FC,y}$ = 0.6714* 1.7252 = 1.1584tCO_2e

Where

0.6714 has been obtained by the consumption of fuel in similar projects for the PP in the year (m^3), and

1.7252 has been calculated by multiplying NCV_y * EF_{CO2y} (tCO_2/m^3)

Where

NCVy Is the weighted average net calorific value of the fuel type (26.30 GJ/m^3)

EF_{CO2y} Is the weighted average CO_2 emission factor of fuel type (0.0656 tCO_2/GJ)

Table 16: Annual calculation for $PE_{FC,y}$

Period			**$PE_{FC,y}$ (tCO2)**
Period Year	**Start Date**	**End Date**	
1	01/12/2012	30/11/2013	1
2	01/12/2013	30/11/2014	1
3	01/12/2014	30/11/2015	1
4	01/12/2015	30/11/2016	1
5	01/12/2016	30/11/2017	1
6	01/12/2017	30/11/2018	1
7	01/12/2018	30/11/2019	1
Total $PE_{FC,y}$ (tCO2)			**7**
Annual average			**1**

Thus in summary we have that:

Project emissions

Table 17: Annual calculation for $PE_{,y}$

Period			**PE,y (tCO2)**
Period Year	**Start Date**	**End Date**	
1	01/12/2012	30/11/2013	132
2	01/12/2013	30/11/2014	132
3	01/12/2014	30/11/2015	132
4	01/12/2015	30/11/2016	132
5	01/12/2016	30/11/2017	132

6	01/12/2017	30/11/2018	132
7	01/12/2018	30/11/2019	132
Total PE,y (tCO2)			**924**
Annual average			**132**

B.6.4 Summary of the ex-ante estimation of emission reductions:

Table 18: Annual calculation for ER_y

Period		**Estimation of project activity emissions (tonnes of CO2e)**	**Estimation of baseline emissions (tonnes of CO2e)**	**Estimation of overall emission reductions (tonnes of CO2e)**
Start Date	**End Date**			
01/12/2012	30/11/2013	132	64,994	64,862
01/12/2013	30/11/2014	132	69,398	69,266
01/12/2014	30/11/2015	132	92,900	92,768
01/12/2015	30/11/2016	132	97,505	97,372
01/12/2016	30/11/2017	132	101,684	101,552
01/12/2017	30/11/2018	132	106,092	105,960
01/12/2018	30/11/2019	132	110,522	110,390
Total		**924**	**643,095**	**642,170**
Annual average		**132**	**91,871**	**91,739**

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

The following variables are monitored as required ACM0001. V11.

Data / Parameter:	$LFG_{total,y}$	
Data unit:	Normalized Cubic meters (Nm^3)	
Description:	Total amount of landfill gas captured at Normal Temperature and Pressure	
Source of data to be used:	Measured by a flow meter	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Year Period	LFGtotal,y
	1	9,594,954
	2	10,245,100
	3	10,893,479
	4	11,573,182
	5	12,190,158
	6	12,840,928
	7	13,494,889
Description of measurement methods and procedures to be applied:	Continuous (average value in a time interval not greater than an hour shall be used in the calculations of emission reductions). Data will be recorded electronically, and will be kept during the crediting period and two years after. Data will also be aggregated monthly/yearly	
QA/QC procedures to be applied:	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy	
Any comment:	Methane fraction of the landfill gas and LFG flow have to be measured on same basis (either wet or dry). No separate monitoring of temperature and pressure is necesseary since flowmeters that automatically express LFG volumes in normalized cubic meters will be used.	

Data / Parameter:	**$LFG_{flare,y}$**	
Data unit:	Normalized Cubic meters (Nm^3)	
Description:	Amount of landfill gas flared at Normal Temperature and Pressure	
Source of data to be used:	Measured by a flow meter	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Year Period	LFGflare,y
	1	9,594,954
	2	10,245,100
	3	118,250
	4	797,954
	5	1,414,929
	6	2,065,699
	7	2,719,660
Description of measurement methods and procedures to be applied:	Continuous (average value in a time interval not greater than an hour shall be used in the calculations of emission reductions) Data will be recorded electronically, and will be kept during the crediting period and two years after. Data will also be aggregated monthly/yearly	
QA/QC procedures to be applied:	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy	
Any comment:	Methane fraction of the landfill gas and LFG flow have to be measured on same basis (either wet or dry). No separate monitoring of temperature and pressure is necesseary since flowmeters that automatically express LFG volumes in normalized cubic meters will be used.	

Data / Parameter:	$LFG_{electricity,y}$	
Data unit:	Normalized Cubic meters (Nm^3)	
Description:	Amount of landfill gas combusted in power plant at Normal Temperature and Pressure	
Source of data to be used:	Measured by a flow meter	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Year Period	LFGelectricity,y
	1	0
	2	0
	3	10,775,229
	4	10,775,229
	5	10,775,229
	6	10,775,229
	7	10,775,229
Description of measurement methods and procedures to be applied:	Continuous (average value in a time interval not greater than an hour shall be used in the calculations of emission reductions) Data will be recorded electronically, and will be kept during the crediting period and two years after. Data will also be aggregated monthly/yearly	
QA/QC procedures to be applied:	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy	
Any comment:	Methane fraction of the landfill gas and LFG flow have to be measured on same basis (either wet or dry). No separate monitoring of temperature and pressure is necesseary since flowmeters that automatically express LFG volumes in normalized cubic meters will be used.	

<table>
<tr><td>Data / Parameter:</td><td colspan="2">$PE_{flare,y}$</td></tr>
<tr><td>Data unit:</td><td colspan="2">tCO_2e</td></tr>
<tr><td>Description:</td><td colspan="2">Project emissions from flaring of the residual gas stream in year y</td></tr>
<tr><td>Source of data to be used:</td><td colspan="2">On-site measurements / calculations</td></tr>
<tr><td rowspan="10">Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td colspan="2"></td></tr>
<tr><td>Year Period</td><td>PEflare,y</td></tr>
<tr><td>1</td><td>7,222</td></tr>
<tr><td>2</td><td>7,711</td></tr>
<tr><td>3</td><td>89</td></tr>
<tr><td>4</td><td>601</td></tr>
<tr><td>5</td><td>1,065</td></tr>
<tr><td>6</td><td>1,555</td></tr>
<tr><td>7</td><td>2,047</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td colspan="2">See section B.6.3</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td colspan="2">The parameters used for determining the project emissions from flaring of the residual gas stream in year y (PEflare,y) will be monitored as per the “Tool to determine project emissions from flaring gases containing methane”. The parameters used for the determination of PEflare are LFGflare, wCH4, fvi,h and tO2,h</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td colspan="2">Regular maintenance will ensure optimal operation of the flare. Analyzers will be calibrated annually according to manufacturer’s recommendations.</td></tr>
<tr><td>Any comment:</td><td colspan="2">Note: A determination of PEflare,y using the flaring tool requires the measurements of a number of additional parameters. These are listed and described following the variables specifically mentioned in ACM0001.</td></tr>
</table>

Data / Parameter:	w_{CH4}
Data unit:	Nm^3 CH_4 / Nm^3 LFG
Description:	Methane fraction in the landfill gas
Source of data to be used:	Measured continuously by the project participant using certified equipment
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50%
Description of measurement methods and procedures to be applied:	It 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. It will be measured by continuous gas quality analyzer
QA/QC procedures to be applied:	Methane content will be measured using a continuous gas analyzer. The gas analyzer should be subject to a regular maintenance and testing regime to ensure accuracy
Any comment:	Methane fraction of the landfill gas and LFG flow has to be measured on same basis (either wet or dry).

<table>
<tr><th>Data / Parameter:</th><th colspan="2">$EL_{LFG,y}$</th></tr>
<tr><td>Data unit:</td><td colspan="2">MWh</td></tr>
<tr><td>Description:</td><td colspan="2">Net quantity of electricity generated using LFG</td></tr>
<tr><td>Source of data to be used:</td><td colspan="2">Electricity meter</td></tr>
<tr><td rowspan="10">Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td colspan="2"></td></tr>
<tr><td>Year Period</td><td>ELLFG,y</td></tr>
<tr><td>1</td><td>0</td></tr>
<tr><td>2</td><td>0</td></tr>
<tr><td>3</td><td>23,693</td></tr>
<tr><td>4</td><td>23,693</td></tr>
<tr><td>5</td><td>23,693</td></tr>
<tr><td>6</td><td>23,693</td></tr>
<tr><td>7</td><td>23,693</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td colspan="2">Electricity meters will be used</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td colspan="2">Data will be measured continuously, recorded electronically, and data will be kept during the crediting period and two years after.
Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy</td></tr>
<tr><td>Any comment:</td><td colspan="2">The electricity produced will be cross-checked with the invoices received from net electricity sold to the grid. This parameter will be measured once the electricty generation is installed (expected 1-12-2014)</td></tr>
</table>

Data / Parameter:	**Operation of the flare station**	
Data unit:	Hours	
Description:	Hours of operation of the flare station	
Source of data to be used:	Records on-site by the personnel	
Value of data applied for the purpose of calculating expected emission reductions in section B.5		
	Year Period	Operation of the flare station
	1	8,000
	2	8,000
	3	8,000
	4	8,000
	5	8,000
	6	8,000
	7	8,000
Description of measurement methods and procedures to be applied:	Data will be recorded annually by the Project Implementer to ensure methane destruction is claimed for methane used in electricity plant when it is operational.	
QA/QC procedures to be applied:	Equipment will be maintained in line with manufacturer's recommendations	
Any comment:	Data will be kept for at least two years after the end of the crediting period	

Data / Parameter:	**Operation of the energy (electrical) plant**	
Data unit:	Hours	
Description:	Hours of operation of the electrical energy plant	
Source of data to be used:	Records on-site by the personnel.	
Value of data applied for the purpose of calculating expected emission reductions in section B.5		
	Year Period	Operation of the energy (electrical)
	1	0
	2	0
	3	8,000
	4	8,000
	5	8,000
	6	8,000
	7	8,000
Description of measurement methods and procedures to be applied:	Data will be recorded annually by the Project Implementer to ensure methane destruction is claimed for methane used in electricity plant when it is operational.	
QA/QC procedures to be applied:	Equipment will be maintained in line with manufacturer's recommendations	
Any comment:	Data will be kept for at least two years after the end of the crediting period	

Data / Parameter:	**$PE_{EC,y}$**
Data unit:	tCO_2
Description:	Project emissions from electricity consumption by the project activity during the year *y*
Source of data to be used:	Calculated as per the “Tool to calculate baseline, project and or leakage emissions from electricity consumption”.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Year Period / PEEC,y: 1: 131 2: 131 3: 131 4: 131 5: 131 6: 131 7: 131
Description of measurement methods and procedures to be applied:	The calculation procedures and methods will be defined according to the case presented during the crediting period for the project activity, according to one of the following possible scenarios: a) Electricity consumption from the grid; or b) Electricity consumption from (an) off-grid captive power plant(s); or c) Electricity consumption from the grid and (a) captive power plant(s).
QA/QC procedures to be applied:	As per the latest version of the “Tool to calculate baseline, project and or leakage emissions from electricity consumption”.
Any comment:	For ex-ante purposes, it was followed case a) in order to estimate project emissions from electricity consumption from the grid.

Year Period	PEEC,y
1	131
2	131
3	131
4	131
5	131
6	131
7	131

Data / Parameter:	$PE_{FC,j,y}$	
Data unit:	tCO_2	
Description:	Project emissions from fossil fuel combustion in process j during the year y .	
Source of data to be used:	Calculated as per the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion".	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Year Period	PEFC,j,y
	1	1
	2	1
	3	1
	4	1
	5	1
	6	1
	7	1
Description of measurement methods and procedures to be applied:	As per the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion".	
QA/QC procedures to be applied:	As per the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion".	
Any comment:	For ex-ante calculation purposes, the fossil fuel consumption at project scenario is based on similar projects developed by PALA. Any eventual fossil fuel consumption during project activity will be accounted based on purchase receipts or invoices.	

The following variables are monitored, as required to use the "**Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"** V. 5.1.0.

Data / Parameter:	f
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data to be used:	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	All the methane generated was directly vented to the atmosphere prior to the project activity. Upon the implementation of the project activity, methane captured will only be flared.
QA/QC procedures to be used:	-
Any comment:	-

The following variables are monitored, as required to determine flare efficiency using the **Tool to determine project emissions from flaring gases containing methane”** V. 1. (**$PE_{flare,y}$**).

<table>
<tr><td>Data / Parameter:</td><td>$FV_{RG,h}$</td></tr>
<tr><td>Data unit:</td><td>Nm3/hr</td></tr>
<tr><td>Description:</td><td>Volumetric flow rate of the residual gas in a dry basis at normal conditions in the hour h .</td></tr>
<tr><td>Source of data to be used:</td><td>Measurements by project participants using a flow meter</td></tr>
<tr><td>Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td><table><tr><td>Year Period</td><td>FVRG,h</td></tr><tr><td>1</td><td>1,199</td></tr><tr><td>2</td><td>1,281</td></tr><tr><td>3</td><td>15</td></tr><tr><td>4</td><td>100</td></tr><tr><td>5</td><td>177</td></tr><tr><td>6</td><td>258</td></tr><tr><td>7</td><td>340</td></tr></table></td></tr>
<tr><td>Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td>See section B.6.3.
(See parameter LFGflare,y)</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>Data will be stored electronically and will be kept during the crediting period and two years after. Values to be averaged hourly or at a shorter time interval .
Data will also be aggregated monthly/yearly.</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td>Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy.</td></tr>
<tr><td>Any comment:</td><td>FVRG,h is considered the equivalent of the variable LFGflared,y (Amount of landfill gas flared at normal temperature and pressure).
Monitoring of this parameter is due to continuous monitoring of the flare efficiency. Data will be kept for two years after end of crediting period</td></tr>
</table>

Data / Parameter:	**$\eta_{flare,h}$**
Data unit:	--
Description:	Flare efficiency in hour h based on measurements
Source of data to be used:	Calculated as per the “Tool to determine project emissions from flaring gases containing methane.”
Value of data applied for the purpose of calculating expected emission reductions in section B.5	No value was estimated, 90% of flare efficiency is considered for ex-ante estimations in this CDM-PDD.
Description of measurement methods and procedures to be applied:	As per the “Tool to determine project emissions from flaring gases containing methane.”
QA/QC procedures to be applied:	As per the “Tool to determine project emissions from flaring gases containing methane.”
Any comment:	

Data / Parameter:	**fvi,h**
Data unit:	%
Description:	Volumetric fraction of component i in the residual gas in the hour h where i = CH4, CO, CO2, O2, H2, N2
Source of data to be used:	An estimation of 0.50 was taken into account for the volumetric fraction of CH4 according to IPCC 2006 Guidelines for National Greenhouse Gas Inventories. (See parameter wCH4)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The gas analysing system is a modular construction and designed for stationary operation for measuring directly the fraction of methane in the landfill gas. The gas analyser provides three analogue signals, CH4, CO2 and O2. The values are measured continuously. The proportion of the data to be monitored is 100%. The same basis (dry or wet) is considered for this measurement and the measurement of the volumetric flow rate of the residual gas (FVRG,h) when the residual gas temperature exceeds 60 C.
Description of measurement methods and procedures to be applied:	Methane concentration would be measured at least once per hour using a continuous gas analyzer, and data records will be kept during the crediting period and two years after. Same basis (dry or wet) is considered for this measurement and the measurement of the volumetric flow rate of the residual gas (FVRG,h) when the residual gas temperature exceeds 60 ºC
QA/QC procedures to be applied:	The gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy and will be calibrated according to manufacturer's specifications.
Any comment:	Note this parameter would measure the same concentration as it thus w_{CH4}.. Therefore it would be expected the same instrument for this purpose.

Data / Parameter:	$t_{O2,h}$
Data unit:	%
Description:	Volumetric fraction of O2 in the exhaust gas of the flare in the hour *h* .
Source of data to be used:	On-site measurements using a continuous gas analyzer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	No value was estimated, 90% of flare efficiency is considered for ex-ante estimations in this CDM-PDD.
Description of measurement methods and procedures to be applied:	The gas analysing system is a modular construction and designed for stationary operation for measuring directly the fraction of methane in the landfill gas. The gas analyser provides two analogue signals, CH4 and O2. The values are measured continuously. The proportion of the data to be monitored is 100%. The sample should be made it at the 80% of the height of the flare. A temperature above 700°C in the sample point could indicate that the equipment is not correctly operated or that its capacity or is not the most adequate for the actual flow. It should have a maintenance program of calibration.
QA/QC procedures to be applied:	Analyzers will be periodically calibrated according to the manufacturer's recommendation.
Any comment:	This parameter will be monitored as it will be used an enclosed flare and it will be a continuous monitoring of the flare efficiency.

Data / Parameter:	$fv_{CH4,FG,h}$
Data unit:	mg/m^3
Description:	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour h
Source of data to be used:	Gas analyser
Value of data applied for the purpose of calculating expected emission reductions in section B.5	No value was estimated, 90% of flare efficiency is considered for ex-ante estimations in this CDM-PDD.
Description of measurement methods and procedures to be applied:	The gas analysing system is a modular construction and designed for stationary operation for measuring directly the fraction of methane in the landfill gas. The gas analyser provides two analogue signals, CH4 and O2. The values are measured continuously. The proportion of the data to be monitored is 100%. The sample should be made it at the 80% of the height of the flare. A temperature above 700°C in the sample point could indicate that the equipment is not correctly operated or that its capacity or is not the most adequate for the actual flow. It should have a maintenance program of calibration.
QA/QC procedures to be used:	The gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy. This device will be calibrated according to manufacturer`s specifications.
Any comment:	The used high efficiency flare is enclosed flare and the flare efficiency will be monitored continuously. One gas analyser will be implemented for monitoring the exhaust gas.

Data / Parameter:	$\mathbf{T_{flare}}$
Data unit:	°C
Description:	Temperature in the exhaust gas of the flare.
Source of data to be used:	On-site measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	No value was estimated.
Description of measurement methods and procedures to be applied:	Measure the temperature of the exhaust gas stream in the flare by a thermocouple. A temperature above 500 ºC indicates that a significant amount of gases are still being burned and that the flare is operating,
QA/QC procedures to be used:	Thermocouples will be replaced or calibrated every year.
Any comment:	

The following variables are monitored, as required to use the **Tool to calculate project emissions from electricity consumption”** V. 1.

Data / Parameter:	$\mathbf{TDL_y}$
Data unit:	%
Description:	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.
Source of data to be used:	Use as default values of 20% for project or leakage electricity consumption sources as per “*Tool to calculate project emissions from electricity consumption” version 01.*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	20%
Description of measurement methods and procedures to be applied:	TDL should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g. commercial losses/theft).
QA/QC procedures to be used:	
Any comment:	

The following variables are monitored, as required to use the **Tool to calculate project or leakage CO2 emissions from fossil fuel combustion”** V.2.

Data / Parameter:	FCy
Data unit:	Nm^3/yr
Description:	Onsite combustion of fossil fuels attributable to the project activity during the year y
Source of data to be used:	Project Developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.6714
Description of measurement methods and procedures to be applied:	Gas will be employed as per the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" version 02. There will be a book of control for recording the measurements.
QA/QC procedures to be used:	The flow meter will be calibrated as per manufacturer specifications. The metered fuel consumption quantities will be cross-checked with available purchase invoices from the financial records.
Any comment:	It could take place during the project activity as the combustible that will be used to start the flame in the flare or the fuel that could be used for emergency power engines in case of grid shortages.

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ/Nm3
Description:	Weighted average net calorific value of fuel type I (LPG) in year y
Source of data to be used:	Fuel supplier
Value of data applied for the	26.3
Description of measurement methods and procedures to be applied:	Values provided by the fuel supplier. Undertaken in line with national or international fuel standards The NCV will be obtained for each fuel delivery, from which weighted average annual values should be calculated
QA/QC procedures to be used:	Values will be verified to check that they are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines.
Any comment:	

Data / Parameter:	$EF_{fuel,BL}$
Data unit:	tCO_2/mass or volume
Description:	CO_2 emission factor of fossil fuel.
Source of data to be used:	Fuel supplier
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0656
Description of measurement methods and procedures to be applied:	Values provided by the fuel supplier. Undertaken in line with national or international fuel standards The NCV will be obtained for each fuel delivery, from which weighted average annual values should be calculated
QA/QC procedures to be used:	Values will be verified to check that they are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines.
Any comment:	

Data / Parameter:	$CEF_{elecy,BL,y}$
Data unit:	tCO2/MWh
Description:	Carbon emission factor of electricity
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.4643
Description of measurement methods and procedures to be applied:	Emission factor will be estimated as described in the “Tool to calculate the emission factor for an electricity system”
QA/QC procedures to be used:	As per the “Tool to calculate the emission factor for an electricity system”
Any comment:	Required to estimate baseline CO2 emissions to calculate emission reductions from electricity generation from LFG

Data / Parameter:	$EC_{PJ,y}$
Data unit:	MWh
Description:	Quantity of electricity that would be consumed by the baseline electricity
Source of data to be used:	Flare manufacturer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	234.94
Description of measurement methods and procedures to be	Use electricity meters
QA/QC procedures to be used:	As per the “Tool to calculate baseline, project and/or leakage emissions from
Any comment:	Required to estimate the project emissions from electricity consumption in year y

B.7.2. Description of the monitoring plan:

As described in ACM0001 (v. 11), "*the monitoring methodology is based on direct measurement of the amount of landfill gas captured and destroyed at the flare platform(s), the natural gas pipelines and the electricity generating/thermal energy unit(s) to determine the quantities as shown in Figure 1. 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), the quantity of methane used to generate electricity (MDelectricity,y)/thermal energy (MDthermal,y), the quantity of methane sent to the pipeline to the natural gas distribution network (MDPL,y), and the quantity of methane generated (MDtotal,y). The methodology also measures the energy generated by use of LFG (ELLFG,y, ETLFG,y) and energy consumed by the project activity that is produced using fossil fuels.*"
The parameters to be monitored to determine these variables are described in Section B.7.1 above.
Because the project involves flaring and electricity generation from LFG, but no production of thermal energy or delivery of LFG to a pipeline, simplifies to Figure below.

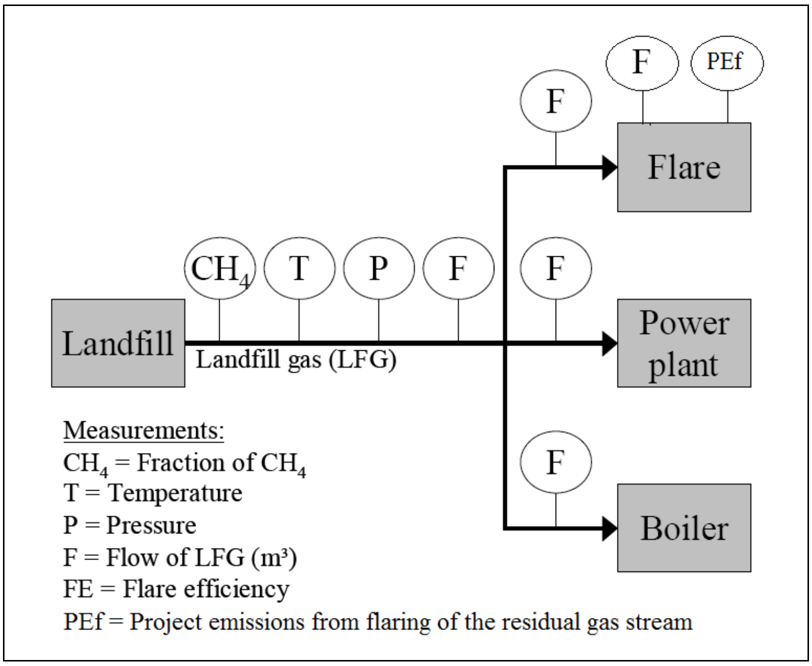


Figure 4– Monitoring Plan (For complete details on required equipment for the measurement of each parameter, please see section B.7.1 above)

Project management responsibility. Information on the Monitoring Manager, the project team, and internal inspection of the LFG capture and flare program are addressed below.

- Monitoring Manager. A competent manager will be assigned responsibility for the monitoring plan and supervision on the collected data. The manager will report monthly about project performance and data. Additionally, the manager will report immediately to senior company management if non-conformance in the performance is detected such as flow meters not working.

- Project Team. The LFG project team will gather, at least monthly, to discuss the performance of the LFG capture and flaring project. Members of the project team will include the Monitoring Manager and the General Manager of the Torreon landfill. Meetings of the project team can be part of regular meetings, but meeting minutes will be recorded as required. In case of non-conformance, each members of the team will be called in for a project team meeting.

- Internal inspection. The monitoring plan including all defined procedures, reports, data, and personnel will be inspected internally to ensure the monitoring activities are in-compliance. Especially in the beginning of the crediting period, these internal inspections should take place, to guarantee the monitoring procedures.

Training. A training program will be developed for all employees involved in the landfill gas capture and flaring project. The program will define the type and frequency of training. The site's General Manager will ensure that only trained and skilled staff will work in the project. The training program's content will depend on the trainees' background and the function to which each will be assigned. Depending on each staff member's assignment, they will receive comprehensive information on the general and technical aspects of the gas capture and flaring project.

The technology suppliers will be requested to provide instructions and training to the project staff on the instalment, operation, maintenance and calibration of monitoring equipment. Over time, as staff members change, new employees will be trained by existing staff on these topics.

Data management - Quality control and quality assurance procedures. The project will establish a quality management system that will ensure the quality and accuracy of the measured data, including corrective measures in case of non-conformity. The quality management system will include:

- Gas field monitoring records
  - Daily readings of all field meters will be filled out on paper worksheets or electronically and filed consecutively. All data collected will also be entered on electronic worksheets and stored on a computer system immediately and on discs periodically.
  - Periodic controls of the LFG field monitoring records will be carried out to check any deviations from the estimated ERs following the guidelines for the LFG flare operation and monitoring for correction or future references.
  - Periodic reports to evaluate performance and assist with performance management will be elaborated.

- Monitoring data evaluation
  - Following the main criteria such as use and strict adherence to standard methods, use of non-standard methods only after approved validation, use of standard reporting forms including process measures as well as emission data, etc. to guarantee the data reliable and accurate.
  - A procedure will be developed to define the responsibility of how critical data parameters and possible adjustments or uncertainties will be evaluated and performed.

- Equipment calibration and maintenance.
  - Flow meters, gas analyzers, other critical CDM project equipment will be subject to regular maintenance and testing according to the technical specifications from the manufactures to ensure accuracy and good performance.

- Calibration of equipment will be conducted periodically according to manufacturer's technical specifications.

- Corrective actions
  - Actions to correct deviations from the Monitoring Plan and the guidelines for LFG capture and flare operation and monitoring will be implemented as these deviations are observed either by the operator or during internal audits.
  - Corrective actions also will be set down in case of equipment or systems malfunction or breakdown.

- Site audits
  - The company's management team for this project will make regular site audits to ensure that monitoring and operational procedures are being observed in accordance with the monitoring plan and the guideline for LFG capture and flare operation and monitoring activities.

- Documents storage
  - List of monitoring equipment (flow meters, gas analyzers, thermometers, etc.), including their numbers, names, manufacturers, specifications, use requirements, etc.
  - Calibration lists and reports, including equipment or parts calibrated, date, method and procedures of calibration, their precision after these procedures, personnel, devices needed, etc.
  - Maintenance lists and reports, including equipment or parts maintained, date, method and procedures of maintenance, their performance after these procedures, personnel, devices needed, etc.
  - Operational manual of the proposed project
  - Meeting minutes of CDM project team meeting
  - Non-conformance reports
  - Worksheets, monthly and yearly
  - Training plan
  - Internal audit/inspection reports, including personnel, time, findings, corrective actions, follow-up inspections
  - Annual monitoring review

- Emergency preparedness for unintended emissions
  - In case of equipment malfunction or breakdown, the timely corrective actions will be carried out to minimize the unintended consequences.
  - Project staff will be trained to appropriately cope with the emergent situations. They will be able to effectively judge an abnormal situation and make a prompt response such as fixing malfunctioned equipment, recording and reporting to the management team in a timely manner.
  - The plant operator will inspect the gas capture and flare system, at least once per week, including all methane-containing parts of the plant (on the surface). All findings will be documented. In case a leakage is found, the leakage will be repaired according to the manufacturer's recommendations.

Verification. Verification is the focal point of a CDM project and all relevant documents will be in place, archived and accumulated in a Monitoring Report or on-site review by the DOE (verifier), who is verifying the project. The project management team will work closely with the verifier and answer all questions raised by the DOE for the emission reduction verification.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

The baseline study and monitoring methodology was updated in 13/06/2012, to reflect the conditions in ACM0001, Version 11. The responsible person(s) to apply the baseline study and monitoring methodology are Sergi Cuadrat (Climate Change Mitigation Consultant at ClimaLoop) and Xavi Soria (CDM Consultant at ClimaLoop). ClimaLoop is an independent environmental consultancy firm and is not considered as a Project Participant.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

01/08/2012[27] which as per the Glossary of Terms is the date when "the project participant has committed to expenditures related to the implementation or related to the construction of the project activity".

C.1.2. Expected operational lifetime of the project activity:

21 years

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period or registration date whichever is later:

01/12/2012.or registration date, whichever is later.

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Left Blank on purpose

C.2.2.2. Length:

27 PROGRAMME OF CONSTRUCTION WORK 2012

Left Blank on purpose

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

Landfill gas collection, treatment and flaring are measured to improve the environmental management of waste in landfills[28]. The project implementation would provide a number of local environmental benefits in addition to climate change mitigation:

- Destruction of non-methane hydrocarbons that contribute to photochemical smog in the local area will be burn in high-temperature flare as a result of the capture of the landfill gas generated in the site.
- The use of an enclosed flare (with highly efficient) will be reduce the emission of NOx (nitrogen oxides), CO (carbon monoxide) and/or VOCs (volatile organic compounds) that occurs when the biogas is burn in an open flare or in a passive burn.
- Destruction of air pollutants, such as hydrogen sulphide, that are sometimes present in landfill gas in trace quantities;
- Reduced fire risk through improved management of landfill gas.
- Reduced odour as landfill gas is captured and flared;
- Avoidance of methane leaking through the landfill cover.

In a landfill close up the landfill usually is to cover with local vegetation, this project activity will avoid the oxygen displace in the soil. A low concentration of oxygen in the soil harms the roots of plants that protect the cover soil from erosion.

Currently, the landfill has permission for its operation, given by the General Direction of Ecology of Coahuila state.

At present, the Project Participant expects only to flare the LFG collected. If the studies demonstrate the feasibility for the LFG to generate electricity, the Project Participant will request all the necessary permits prior to electricity generation. If all that requests and feasibility fits with the necessities of Project Participants, the engines will be operating at 1st December 2014.

The project would use enclosed flares specially designed to reduce these emissions to levels below that of an open flame. Note, however, that since the main fuel is methane, the emissions of particulate matter would be minimal. On the other hand a LFG flare is specially designed to operate at high temperature in order to burn the volatile organic compounds. The project proponent recognizes that the current permits do not include power generation. If at some point PALA decides to generate electricity, it will solicit all necessary permits to national and local authorities prior to electricity generation.

[28] Guidance on Landfill Gas Flaring. http://www.environment-agency.gov.uk/static/documents/Business/lfg_flaring_guidance_1101730.pdf

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

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

SECTION E. Stakeholders' comments

On March 3rd, 2009, a letter was sent by Jesus Gerardo Puentes Balderas (Secretary of City Council) and Susana Estens de la Garca (Environment Director of Torreón Municipality) in order to invite persons to attend the 1st stakeholders presentation meeting.

The sectors are listed below:
(5) Non-governmental organizations and/or consultancies and academic sector
(7) Local and Federal government
(8) Private sector
(7) Additional persons, representing the surrounding communities
(7) Press

The 1st public event was held on March 6rd at the Torreón 1 Hall in Crowne Plaza Hotel, Torreón, Coahuila State, México. This event was also open to the public in general, permitting an opportunity for all persons and institutions that feel affected by the project to provide their input to the proposed project activity.

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

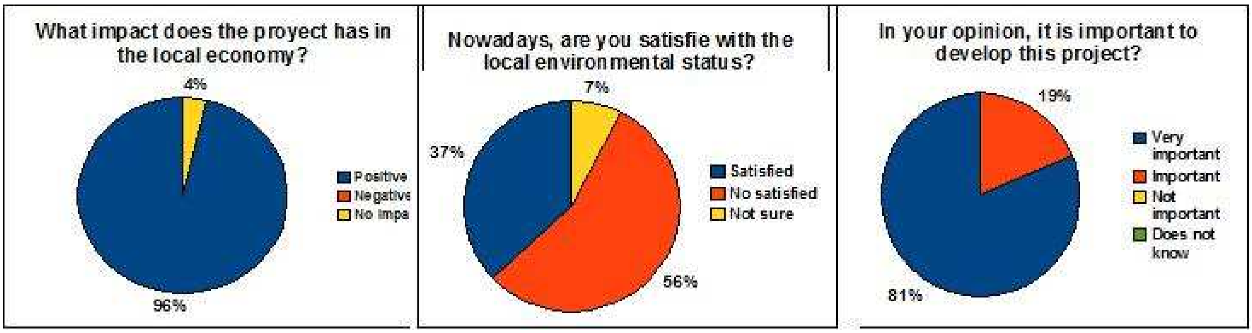
Table 19: List of assistance of stakeholders participants

Name	Charge	Company/Institution
Jose Reyes Castañon	Worker	M. Matamoros city
Heriberto Alvarado	Day laborer	M. Matamoros city
Graciano Rangel Lira	Day laborer	M. Matamoros city
Heriberto Dominguez Maciel	Day laborer	M. Matamoros city
Guiomara Alvarado Cruz	Comunication Center Coordinator	Universidad Iberoamericana
Jesus Alcalá	Day laborer	M. Matamoros city
Juán Hernández	Day laborer	M. Matamoros city
Arturo Vaca Durán	Employee	Peñoles
Fransico Valdés Perezgasga	Professor/Researcher	I.T.L.
Agustín Gonzalez Grant	Consultor	Stratinnovac
María del Regudio Valdez Benitez	Ecology Director	Ecology Direction of Matamoros Municipality
Fernando Gutierrez	Government employee	SEMARNAT (Secretariat of Environment and Natural Resources)
Rodrigo Torres Reyes	Reporter	La Prensa
José Borrego	Government employee	SEMARNAT
Sergio Armando Barrios Dávila	Employee	SIENA
Magdalena Briones	Environmentalist	Biodesert A.C.
Susana Estens	Director of Environment Municipality of Torreón	Environment Office of Municipality of Torreón
Antonio Gutierrez González	Representative and Trader	CANACOTO
Pedro Avila Aguilera	Government employee	City Council of Municipality of Torreón
Gerardo Iván García Colmenero	Government employee	City Council
J. Gullermo Beick	Adviser and Businessman	CANACINTRA
Alfredo Martín del Campo Carrillo	Professor/Researcher	Ciclo Verde A.C.
Ma. Guadalupe del Río Villa	Government employee	Environment Office of Municipality of Torreón
Catalina Arguelles	Professor	ITESM Campus Laguna
Amparo Rodriguez Vasquez	Engineering	Peñoles
Jesús Gerardo Puentes Balderas	City Council Secretary	City Council of Municipality of Torreón
Alejandro Larrañana de León	Businessman	CORPOCENTRO
Victor M. Solis Vega	Editor	No Available
Nancy Salazar Alvarado	Reporter	Televisa Laguna
Maira Flores	Reporter	Radio México
Lorena Herrera Landeros	Reporter	Radiorama

Name	Charge	Company/Institution
Manuel Serrano	Reporter	GREM
Magdalena Gonzalez	Reporter	Periódico La I
Gema Cardiel	Reporter	Coahuilteca Medios

The following figures summarize the local community perception about the project activity proposed by the project participant.

Figure 5. Summarized surveys applied for stakeholders meeting.



Received comments show that stakeholders agree that the project generates benefits to the local communities, and general environmental protection.

E.2. Summary of the comments received:

Summary of most common comments reflected in the surveys are presented as follows:

1. Most of the stakeholders understand that the project will bring environmental, social and health benefits to local community. Since it will allow reducing GHG emissions from LFG emitted to atmosphere.

2. Electric production is an important issue and benefit to the public system.

3. It is necessary to spread information regarding the project to the community. Data shall be presented in a simple way in order to help the understanding of it.

4. MDL projects are important to improve the environment and shall be applied to other productive activities.

The local stakeholders concluded that the proposed CDM project activity will contribute to improve life quality of the community as well as environmental benefits.

E.3. Report on how due account was taken of any comments received:

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

1. ***Could you let us know the amount of the investment for this project?***

R= It will be near 1.4 million of dollars

2. ***Is this the first project where you are getting an extra value of landfill disposal?***

R= No, we have many other projects inside Mexico, one of them is registered.

3. ***Does the municipality will have revenues?***

R= It is possible, depend in the agreements we can reach.

4. ***How we will be obtain with the execution of this project?***

R= Local odours will be reduced, and we will generate electricity that could be sold to the municipality with a low price. The CO2 emissions will be reduce, contributing to the mitigation of global climate change.

5. ***Are the any other benefits?***

R= Yes, the industry, the universities will be benefit, with this kind of projects our professionals and students can learn how to develop environmental projects. These kinds of project have been given good results in 5 states of Mexico.

6. ***How many carbon bonuses will be generated?***

R= An average of 60 thousand per year if the things go as we expected.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Promotora Ambiental de la Laguna, S.A. de C.V.
Street/P.O.Box:	Blvd. Antonio L. Rdz. N. 1884 Pte.
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State/Region:	Nuevo León
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E-Mail:	rlopezlo@pasa.mx
URL:	http://www.pasa.mx/
Represented by:	
Title:	Manager of landfills
Salutation:	Mr.
Last name:	Loredo
Middle name:	Lopez
First name:	Ricardo
Department:	Landfills
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

NA.

Annex 3

BASELINE INFORMATION

General Information of the Torreon Landfill Gas Project

Landfill Information	
Location	Torreón, Coahuila
Country	Mexico
Area of the site	48,4 ha
Year of starting operations	2001
Estimated total of tons of waste accumulated until 2008	1,690,131 tons

Waste Filling History

The historical filling rates were provided by the Landfill's personnel. At the time, it will have reached a capacity of approximately 1.96million tonnes. The historical data registered by landfills personnel is presented in the table below:

Waste filling rate per year in the landfill until 2009

Waste deposition data	
Year	**Domestic waste load (tons)**
2001	77,391
2002	242,406
2003	217,849
2004	231,687
2005	224,437
2006	225,513
2007	241,758
2008	229,090
2009	235,963

Energy generation (MW Projection)

Period		$LFG_{project,y}$ (m3/year)	$MD_{project,y}$ (tonnes of CH4)	$LFG_{electricity,y}$ (m3/year)	Electricity (MWh/year)
Start Date	End Date				
01/12/2012	30/11/2013	9,594,954	3,095	0	0
01/12/2013	30/11/2014	10,245,100	3,305	0	0
01/12/2014	30/11/2015	10,893,479	3,900	10,775,229	23,693
01/12/2015	30/11/2016	11,573,182	4,119	10,775,229	23,693
01/12/2016	30/11/2017	12,190,158	4,318	10,775,229	23,693
01/12/2017	30/11/2018	12,840,928	4,528	10,775,229	23,693
01/12/2018	30/11/2019	13,494,889	4,739	10,775,229	23,693
Total		**80,832,690**	**28,004**	**53,876,145**	**118,465**
Annual average		**11,547,527**	**4,001**	**7,696,592**	**16,924**

Emissions reductions

Emissions reductions result mainly from methane destruction resulting from the capture and burning of landfill gas.

A derivation of the parameters used to estimate landfill gas generation from solid waste using the *"tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"*. Version 5.1.0 of the Tool was used in this PDD. These parameters are only used in the ex-ante estimation of emissions reductions; and

<u>1) Methane emissions reductions from landfill gas capture</u>

Landfill gas is generated by the anaerobic decomposition of solid waste within a landfill. It is typically composed of approximately 40 to 60 percent methane, with the remainder primarily being carbon dioxide. The rate at which LFG is generated is largely a function of the type of waste buried and the moisture content and age of the waste. It is widely accepted throughout the industry that the LFG generation rate generally can be described by a first-order decay equation.

The k-parameters needed as input in the "**Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"** model are based on IPCC recommendations (2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 5).

The tool states:
"The amount of methane that would in the absence of the project activity be generated from disposal of waste at the solid waste disposal site ($BECH_{4,SWDS,y}$) is calculated with a multi-phase model. The calculation is based on a first order decay (FOD) model. The model differentiates between the different types of waste j with respectively different decay rates kj and different fractions of degradable organic carbon (DOCj). The model calculates the methane generation based on the actual waste streams Wj,x disposed in each year x, starting with the first year after the start of the project activity until the end of year y, for which baseline emissions are calculated (years x with x=1 to x=y)."

The amount of methane produced in the year y (BECH4, SWDS,y) is calculated as follows:

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

Where:

$BE_{CH4,SWDS,y}$	=	Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
Φ	=	Model correction factor to account for model uncertainties (0.9)
f	=	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	=	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	=	Fraction of degradable organic carbon (DOC) that can decompose
MCF	=	Methane correction factor
$W_{j,x}$	=	Amount of organic type j prevented from disposal in the SWDS in the year x (tonnes)
DOC_j	=	Fraction of degradable organic carbon (by weight) in the waste type j
k_j	=	Decay rate for the waste type j
j	=	Waste type category (index)
x	=	Year since the landfill started receiving wastes [x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)] Note: this definition represents a correction of the Tool as given in ACM0001, ver. 11.
y		Year for which methane emissions are calculated

The tool used is usually for project activities that would avoid methane avoiding waste disposal at landfills. But in the same way, the methane generation can be estimated for landfills, only taking into account different years: the first year is the year of landfill opening and the last year is the last year of the project activity.
Hence, the above equation is used to estimate methane generation for a given year from all waste disposed up to that year. Multi-year projections are developed by varying the projection year and re-applying the equations.

The values choices for the variables according to the tool recommendations are the following:

Table A3-1.- Tool values choices

Var.	Value	Justification
ϕ	0.9	Default value recommended in methodology
f	0	Value corresponding to the characteristics of Culiacan Northern Landfill. As documented, currently there isn't any capture, combustion or flaring of the LFG presented on the site.
GWP_{CH4}	21	Global Warming Potential (GWP) of methane, valid for the first commitment period of the Kyoto Protocol (up to 2012).
OX	0.1	Oxidation factor in a well managed landfill with a good cover is not considerable and can be estimated as zero.
F	0.5	Most waste in SWDS generates a gas with approximately 50 percent of CH4. Only material including substantial amounts of fat or oil can

<table>
<tr><th>Var.</th><th>Value</th><th>Justification</th></tr>
<tr><td></td><td></td><td>generate gas with substantially more than 50 percent of CH4. Taking into account the 2006 IPCC default value, SCS estimates future methane content in landfill gas to be 50 percent.</td></tr>
<tr><td>DOCf</td><td>0.5</td><td>The decomposition of degradable organic carbon does not occur completely and some of the potentially degradable material always remains in the site even over a very long period of time. 2006 IPCC recommends that values should vary from 0.5 to 0.77. Default value recommended in methodology is used here.</td></tr>
<tr><td>MCF</td><td>1.0</td><td>The landfill is well managed, with daily cover with soil, leachate drainage system and waste thickness higher than 5 meters. The value is chosen according to 2006 IPCC table, cited in methodology:

MCF

Methane correction factor
IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Use the following values for MCF:
1.0 for anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e., waste directed to specific deposition ar degree of control of scavenging and a degree of control of fires) and will in at least one of the following: (i) cover material; (ii) mechanical compacting (iii) leveling of the waste.
0.5 for semi-aerobic managed solid waste disposal sites. These must hav controlled placement of waste and will include all of the following structur introducing air to waste layer: (i) permeable cover material; (ii) leachate dr system; (iii) regulating pondage; and (iv) gas ventilation system.
0.8 for unmanaged solid waste disposal sites – deep and/or with high wa table. This comprises all SWDS not meeting the criteria of managed SWD which have depths of greater than or equal to 5 meters and/or high water ta near ground level. Latter situation corresponds to filling inland water, such pond, river or wetland, by waste.
0.4 for unmanaged-shallow solid waste disposal sites. This comprises al SWDS not meeting the criteria of managed SWDS and which have depths than 5 metres.</td></tr>
<tr><td>Wj,x</td><td><table>
<tr><th colspan="2">Waste deposition data</th></tr>
<tr><th>Year</th><th>Domestic waste load (tons)</th></tr>
<tr><td>2001</td><td>77,391</td></tr>
<tr><td>2002</td><td>242,406</td></tr>
<tr><td>2003</td><td>217,849</td></tr>
<tr><td>2004</td><td>231,687</td></tr>
<tr><td>2005</td><td>224,437</td></tr>
<tr><td>2006</td><td>225,513</td></tr>
<tr><td>2007</td><td>241,758</td></tr>
<tr><td>2008</td><td>229,090</td></tr>
<tr><td>2009</td><td>235,963</td></tr>
</table></td><td>The historical filling rates were provided by landfill personnel and the total amount accumulated is around 1.96 million tonnes.</td></tr>
</table>

<table>
<tr><th>Var.</th><th>Value</th><th>Justification</th></tr>
<tr><td>DOCj</td><td>
<table>
<tr><th>Waste type j</th><th>DOCj (%wet waste)</th></tr>
<tr><td>Wood and wood products</td><td>43</td></tr>
<tr><td>Pulp, paper and cardboard (other than sludge)</td><td>40</td></tr>
<tr><td>Food, food waste, bevarages and tobacco (other thansludge)</td><td>15</td></tr>
<tr><td>Textiles</td><td>24</td></tr>
<tr><td>Garden, yard and park waste</td><td>20</td></tr>
<tr><td>Glass, plastic, metal, other inert waste</td><td>0</td></tr>
</table>
</td><td>Waste composition in the Landfill</td></tr>
<tr><td>k_j</td><td>
<table>
<tr><th>K (decay rate)</th><th></th></tr>
<tr><td>Wood and wood products</td><td>0.025</td></tr>
<tr><td>Pulp, paper and cardboard</td><td>0.045</td></tr>
<tr><td>Food waste</td><td>0.085</td></tr>
<tr><td>Textiles</td><td>0.045</td></tr>
<tr><td>Garden waste</td><td>0.065</td></tr>
<tr><td>Inert waste</td><td>0</td></tr>
</table>
</td><td>Default values from the Tool (according to the IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3), taking into considerations the weather conditions of the region (MAT above 20°C and MAP less than 1).</td></tr>
<tr><td>j</td><td>
<table>
<tr><th>Organic Waste type category j</th><th>% Composition</th></tr>
<tr><td>Glass, plastic, metal, other inert waste</td><td>24.11%</td></tr>
<tr><td>Pulp, paper, cardboard (other sludge)</td><td>18.54%</td></tr>
<tr><td>Textiles</td><td>4.71%</td></tr>
<tr><td>Wood and wood products</td><td>2.55%</td></tr>
<tr><td>Garden, yard and park waste</td><td>11.28%</td></tr>
<tr><td>Food, food waste, beverages and tobacco (other than sludge)</td><td>38.81%</td></tr>
<tr><td>TOTAL</td><td>100.00%</td></tr>
</table>
</td><td>Waste types and Organic Waste Fraction are contained in the study of waste[29] as well as indicated in the technical feasibility report.</td></tr>
<tr><td>x</td><td>2001</td><td>Start of landfill operations</td></tr>
<tr><td>y</td><td>2012-2021</td><td>Year for which methane emissions are calculated</td></tr>
</table>

LFG System Coverage or collection efficiency

The Landfill closed area is considered to be a well-managed landfill, the maximum gas collection efficiency is expected to be around 65%.

[29] SCS Due dilligence report, Torreon, Coahuila, México, March, 2008.

Project emissions due to electricity consumed on site

Project emissions reductions due to electricity displaced from the grid are estimated through the "Tool to calculate the emission factor for an electricity system"– Version 2.2.1. The official data published by the Mexican DNA[30] is used for such purpose.

Mexican Grid Emission Factor, $EF_{grid,CM,y}$

The Tool to Calculate the Emission Factor for an Electricity System (Version 02.2.1) is applied to calculate the combined margin emission factor. This section describes how the emission factor of the proposed project activity has been determined based on the instructions for calculating the emission factors of the operating margin (OM) and build margin (BM).

According to the tool the grid emission factor is calculated as per the following six steps:

STEP 1: Identify the relevant electricity systems.
STEP 2:Choose whether to include off-grid power plants in the project electricity system (optional).
STEP 3: Select a method to determine the operating margin (OM).
STEP 4: Calculate the operating margin emission factor according to the selected method.
STEP 5: Calculate the build margin (BM) emission factor.
STEP 6: Calculate the combined margin (CM) emissions factor.

Step 1 - Identify the relevant electricity systems

The proposed project activity will be connected to the national grid of *Mexico*. The national grid emission factor is calculated based on data developed by the Mexican Secretary of Energy (SENER).

The generated electricity is to be used either in the landfill or injected into the national grid. Thus the project electricity system is the national electricity grid.

Step 2 - Choose whether to include off-grid power plants in the project electricity system
The calculation of the operating margin and build margin emission factor will use the **option I** of the tool: *Only grid power plants are included in the calculation*.

Step 3 - Select a method to determine the operating margin (OM)
The Tool to Calculate the Emission Factor for an Electricity System, Version 02.2.1, provides the following four options to determine the operating margin:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or

[30] http://www.sener.gob.mx/webSener/res/476/Generation.pdf

(d) Average OM.

The methodology tool states that the Simple Operating Margin method can be used where low-cost/must run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

The methodology tool further states that low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear, and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants.

Electricity generation in Mexico is dominated by thermal power plants. Thus, for this project activity, in the calculation of the operating margin emission factor, **option (a) the Simple Operating Margin method has been selected from the four options proposed in the methodology.**

The following table presents the gross electricity generation in Mexico[31] by type:

Years	Hydro electric	Thermal	IPP's	Dual	Coal-fired	Nuclear	Geo thermal	Wind	Total
2004	25,076	94,512	45,855	7,915	17,883	9,194	6,577	6	207,019
2005	27,611	93,226	45,559	14,275	18,380	10,805	7,299	5	217,160
2006	30,305	84,432	59,428	13,875	17,931	10,866	6,685	45	223,568
2007	27,042	83,354	70,982	13,375	18,101	10,421	7,404	248	230,927
2008	38,892	79,185	74,232	6,883	17,789	9,804	7,056	255	234,096

The following table represents the electricity generation (GWh) for OM emission factor calculation with the low-cost/must-run sources for Mexico including hydro, geothermal, nuclear and wind and showing that the low-cost/must run resources in Mexico constitute less than 50% of the total grid generation in average of the five most recent years.

Year	Low-cost/must-rungeneration (GWh)	Generation excluding Low-cost/must-run source	Total Generation	Low-cost/must-run generation (%)	
2004	40,853	166,166	207,019	20%	<50%
2005	45,720	171,440	217,160	21%	<50%
2006	47,901	175,667	223,568	21%	<50%
2007	45,115	185,812	230,927	20%	<50%
2008	56,006	178,090	234,096	24%	<50%

For the Simple OM method, the emissions factor can be calculated using either *ex ante* option or *ex post* option. We choose *ex ante* option given the accessibility of data and simplification with respect to project monitoring and further emission reduction verification.

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

As explained in Step 3, the Simple OM emission factor has been calculated based on a 3-year vintage (2006-2008) and will be applied ex-ante. The OM is calculated as the generation-weighted emissions per electricity unit of all generating units serving the system, excluding low-operating cost and must-run power plants.

[31] Source: http://www.sener.gob.mx/webSener/res/476/Generation.pdf

Under this option, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must run resources and the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i \left(FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}\right)}{EG_y} \quad (6)$$

Where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$FC_{i,y}$ = Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
EG_y = Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh)
i = All fossil fuel types combusted in the project electricity system in year *y*
y = The relevant year as per the data vintage chosen in Step 3

According to the provisions in the monitoring tables of the Tool to Calculate the Emission Factor for an Electricity System (Version 02.2.1), $EG_{m,y}$ is determined once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (**ex ante option**).

The 3-year vintage OM was calculated using the data of all operational power fossil fuel fired plants supplying electricity to the grid for the years 2006, 2007 and 2008. The data of the plants used in the Operating Margin calculation were provided by SENER.

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

In terms of vintage of data, project participants has selected **Option 1:** For the first crediting period, calculate the build margin emission factor ex ante based on the most recent information available on units already built for sample group m at the time of submission to the DOE for validation.

The sample group of power units *m* used to calculate the build margin is determined as per the following procedures:

(a) The set of five power units that started to supply electricity to the grid most recently ($SET_{5-units}$) and their annual electricity generation ($AEG_{SET-5-units}$) are listed in the table below (excluding power units registered as CDM project activities).

$SET_{5-units}$	**$AEG_{SET-5-units}$** (MWh)
Humeros	321,000
El Cajón (Leonardo Rodríguez Alcaine)	1,829,000
Baja California Sur I	525,000

Tamazunchale	7,700,000
Río Bravo (Emilio Portes Gil)	268,000

(b) The annual electricity generation in 2008 of the project electricity system, excluding power units registered as CDM project activities is: AEG_{total} = 234,096,000 MWh[32]. The set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} are identified in table below as $SET_{\geq 20\%}$ along with their annual electricity generation ($AEG_{SET-\geq 20\%}$, in MWh).

<u>**$SET_{\geq 20\%}$**</u>	<u>**$AEG_{SET-\geq 20\%}$**</u> (MWh)
Humeros	321,000
El Cajón (Leonardo Rodríguez Alcaine)	1,829,000
Baja California Sur I	525,000
Tamazunchale	7,700,000
Río Bravo (Emilio Portes Gil)	268,000
Valladolid III	3,646,000
Tuxpan V	3,792,000
Altamira V	8,096,000
Chihuahua II	4,113,000
La Laguna II	3,566,000
Río Bravo IV	2,562,000
Chicoasén (Manuel Moreno Torres)	7,653,000
Rio Bravo III PIE	957,000
Tuxpan (Pdte. Adolfo López Mateos)	6,042,000
Total	**51,070,000** (equivalent to **21.8 %**)

(c) From $SET_{5-units}$ and $SET_{\geq 20\%}$, the set of power units that comprises the larger annual electricity generation (SET_{sample}) is identified as **$SET_{\geq 20\%}$**. Dates when the power unit in SET_{sample} started to supply electricity are identified the table below (all less than 10 years ago):

SET_{sample}	**Start date of operation**	**Technology used**
Humeros	2008	Geothermal
El Cajón (Leonardo Rodríguez Alcaine)	2007	Hydro
Baja California Sur I	2007	Internal Combustion Engines
Tamazunchale	2007	Combined Cycle
Río Bravo (Emilio Portes Gil)	2007	Combined Cycle
Valladolid III	2006	Combined Cycle
Tuxpan V	2006	Combined Cycle
Altamira V	2006	Combined Cycle
Chihuahua II	2006	Combined Cycle
La Laguna II	2005	Combined Cycle
Río Bravo IV	2005	Combined Cycle
Chicoasén (Manuel Moreno Torres)	2004	Hydro

[32] 2008 data, source: SENER

Rio Bravo III PIE	2004	Combined Cycle
Tuxpan (Pdte. Adolfo López Mateos)	2004	Turbine Gas

Sub-steps d) to f) do not apply since power units listed are all less than 10 years ago.

The Build Margin emissions factor (BM) is calculated as the generation-weighted average emission factor of the most recently built plants, using the following formula:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad \textbf{(12)}$$

Where

- $EF_{grid,BM,y}$ = Build margin CO2 emission factor in year *y* (tCO_2/MWh)
- $EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
- $EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
- m = Power units included in the build margin
- y = Most recent historical year for which power generation data is available

Step 6 - Calculate the combined margin emissions factor

The final step in applying the tool is to calculate the combined margin emissions factor. This has been calculated as the weighted average of the emissions factor of the OM and the BM. The formula that has been used to calculate this weighted average emission factor is as follows:

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

Where

- $EF_{grid,CM,y}$ = Combined margin CO_2 emission factor in year y (tCO_2/MWh)[33]
- $EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)
- $EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh)
- w_{OM} = Weighting of operating margin emissions factor (%)
- w_{BM} = Weighting of build margin emissions factor (%)

As recommended by the tool for projects other than wind and solar projects, the default values of weighted factors $w_{OM} = 0.5$ $w_{BM} = 0.5$ are used.

For the fuels NCVs, official values[34] when available and the latest default values recommended in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for fuels NCVs and emissions factors were used to derive the OM and the BM emission factors of the grid.

[33] Equivalent to $CEF_{elec,BL,y}$

The results of the EF calculation are summarized below:

Designation	EF in tCO2/MWh
« Operating Margin » (OM)	
2006	0.6236
2007	0.5939
2008	0.6300
Weighted average OM 2006-2007-2008	**0.6155**
« Build Margin » (BM) 2008	**0.3132**
Combined Margin (weighted average OM and BM)	**0.4643**

[34] Values published in the official national statistical book

Annex 4

MONITORING INFORMATION

Item	Variable	Unit	Measured (m) Calculated(c) Estimated (e)	Frequency of registration	Responsible	Form of registration (electronic / paper)	Internal Quality Control procedures	Comments
1	Total landfill gas captured ($LFG_{total,y}$)	Nm^3	m	Continuously (values to be averaged hourly or at a shorter time interval)	Project Developer	Both	Yes	Measured by a flow meter. Data to be aggregated in a monthly/yearly basis.
2	Total landfill gas flared ($LFG_{flare,y}$)	Nm^3	m	Continuously (values to be averaged hourly or at a shorter time interval)	Project Developer	Both	Yes	Measured by a flow meter. Data to be aggregated in a monthly/yearly basis.
3	Total landfill gas used for electricity generation ($LFG_{electricity,y}$)	Nm^3	m	Continuously (values to be averaged hourly or at a shorter time interval)	Project Developer	Both	Yes	Measured by a flow meter. Data to be aggregated in a monthly/yearly basis.
4	Methane fraction contained in the landfill gas ($w_{CH4,y}$)	Nm^3 CH_4 / Nm^3 biogas	m	Continuously (values to be averaged hourly or at a shorter time interval)	Project Developer	Both	Yes	It will be used a continuous analyzer. It will be subject to a strict program of maintenance and calibration.

Item	Variable	Unit	Measured (m) Calculated(c) Estimated (e)	Frequency of registration	Responsible	Form of registration (electronic / paper)	Internal Quality Control procedures	Comments
5	Net electricity generation (EL_{LFG})	MWh	m	Continuously (values to be averaged hourly or at a shorter time interval)	Project Developer	Both	Yes	For each electricity engine generator, the instrument will be subject to maintenance programs and test applications to accurate its exactitude.
6	Hours of operation of the electrical plant	Hours	m	Daily	Project Developer	Both	No	The real hours of operation of the electrical engine generators will be registered.
7	Hours of operation of the en flare station	Hours	m	Daily	Project Developer	Both	No	The real hours of operation of the electrical engine generators will be registered.
The following variables corresponds for the Project Emissions from flaring gases containing methane ($\mathbf{PE_{flare,y}}$) in the enclosed flare.								
8	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h. ($FV_{RG,h}$)	Nm^3/h	m	Continuously (values to be averaged hourly or at a shorter time interval)	Project Developer	Both	Yes	Measured by a flow meter. Data to be aggregated in a monthly/yearly basis. Note this parameter would measure the same flow as it does the parameter LFGflare,y ; except this is required in a dry basis. Therefore it would be expected the same instrument for this purpose, if possible.

Item	Variable	Unit	Measured (m) Calculated(c) Estimated (e)	Frequency of registration	Responsible	Form of registration (electronic / paper)	Internal Quality Control procedures	Comments
9	Volumetric fraction of component i in the gas in hour h where i = CH_4, CO, CO_2, O_2, H_2, N_2	(fraction)	m	Continuously (values to be averaged hourly or at a shorter time interval)	Project Developer	Both	Yes	As a simplified approach, only methane content of the residual gas will be measured and the remaining part will be considered as N_2
10	Volumetric fraction of oxygen in the exhaust gas ($t_{O2,h}$)	(fraction)	m	Continuously (values to be averaged hourly or at a shorter time interval)	Project Developer	Both	Yes	The parameter will be measured by a continuous exhaust gas analyser to calculate the flare efficiency.
11	Methane concentration in the exhaust gas (on the exit of the enclosed flare) ($fv_{CH4,FG,h}$)	mg / m^3 (Could be in ppmv or %)[35]	m	Continuously (values to be averaged hourly or at a shorter time interval)	Project Developer	Both	Yes	The parameter will be measured by a continuous exhaust gas analyser to calculate the flare efficiency.

Item	Variable	Unit	Measured (m) Calculated(c) Estimated (e)	Frequency of registration	Responsible	Form of registration (electronic / paper)	Internal Quality Control procedures	Comments
12	Temperature in the exhaust gas of the flare (T_{flare})	°C	m	Continuously (values to be averaged hourly or at a shorter time interval)	Project Developer	Both	Yes	It should be employed a thermocouple, N type. A temperature above 500°C in the sample point could indicate that considerable quantities of gases are still being flared. The thermocouples will be replaced and/or calibrated each year.
The following variables corresponds for the Project Emissions for electrical consumption (**$PE_{EC,y}$**), such as blowers, use of the electrical grid, etc.								
13	Project emissions from fossil fuel combustion ($PE_{FC,j,y}$)	tCO2	m	Daily	Project Developer	Both	Yes	For ex-ante calculation purposes, there will be no fossil fuel consumption at project scenario, but any eventual fossil fuel consumption during project activity will be accounted for with purchase receipts or invoices.
14	Project emissions from electricity consumption (PE_{EC})	tCO2	m	Daily	Project Developer	Both	Yes	For ex-ante purposes, it was followed case a) in order to estimate project emissions from electricity consumption from the grid.

Item	Variable	Unit	Measured (m) Calculated(c) Estimated (e)	Frequency of registration	Responsible	Form of registration (electronic / paper)	Internal Quality Control procedures	Comments
15	Average technical transmission and distribution losses in the grid for the voltage level at which electricity is obtained from the grid at the project site (TDL_y)	%	e	Annual check	Project Developer	paper	No	Within the same type of voltage, it should be estimated for the electrical losses in the transmission and distribution of electricity in the grid. If there is no data during the year, it could be used any data that could be available in the previous 5 years. This data is intended to be updated if proper information is available, if not, it will be used the default data suggested by the “Tool to determine the project emissions from flaring gases containing methane”, which is 20%.
The following variables are relevant to determinate the project emissions coming from fossil fuel consumption using the Tool (**$PE_{FC,j,,y}$**), if applicable								
16	Quantity of fuel type i combusted in process j ($FC_{i,i,y}$)	Mass or volume unit per year (e.g. ton/yr or m^3/yr)	m	It will depend according to the type of fuel used.	Project Developer	Both	Yes	Any eventual fossil fuel consumption will be accounted.

Item	Variable	Unit	Measured (m) Calculated(c) Estimated (e)	Frequency of registration	Responsible	Form of registration (electronic / paper)	Internal Quality Control procedures	Comments
17	Project emissions from flaring of the residual gas stream ($PE_{flare,y}$)	tCO2e	c	Continuously (values to be averaged hourly or at a shorter time interval)	Project Developer	Both	No	For enclosed flares, either of the following two options can be used to determine the flare efficiency: • To use a 90% default value. Continuous monitoring of compliance with manufacturer's specification of flare must be performed. • Continuous monitoring of the methane destruction efficiency of the flare (flare efficiency).
18	Flare efficiency ($\eta_{flare,h}$)	%	c	Annually	Project Developer	Both	No	Use one of the following options to determine the efficiency: • Measured efficiency during monitoring; • Manufacturer.s information on the efficiency; or • Use a default value of 60%

Item	Variable	Unit	Measured (m) Calculated(c) Estimated (e)	Frequency of registration	Responsible	Form of registration (electronic / paper)	Internal Quality Control procedures	Comments
19	Fraction of methane captured at the SWDS and flared, combusted or used in another manner (f)	%	m	Continuously (values to be averaged hourly or at a shorter time interval)	Project Developer	Both	Yes	It will be used a continuous analyzer. It will be subject to a strict program of maintenance and calibration.