



**Project design document form  
(Version 12.0)**

*Complete this form in accordance with the instructions attached at the end of this form.*

**BASIC INFORMATION**

<b>Title of the project activity</b>	Aguascalientes EcoMethane Landfill Gas to Energy Project
<b>Scale of the project activity</b>	<input checked="" type="checkbox"/> Large-scale <input type="checkbox"/> Small-scale
<b>Version number of the PDD</b>	3.21
<b>Completion date of the PDD</b>	03/03/2022
<b>Project participants</b>	Biogas Technology Ltd Biogas Technology Group Ltd. EcoSecurities Ltd. EcoSecurities Carbon 1 Ltd. EcoSecurities Group Plc. ALLCOT AG
<b>Host Party</b>	Mexico
<b>Applied methodologies and standardized baselines</b>	ACM0001: "Flaring or use of landfill gas" Ver. 2 AMS-I.D: "Grid connected renewable electricity generation" Ver. 8
<b>Sectoral scopes</b>	Sectoral scope 1: Energy industries (renewable - / non-renewable sources) Sectoral scope 13: Waste Handling and Disposal
<b>Estimated amount of annual average GHG emission reductions</b>	1,625,926 tCO <sub>2e</sub>

## SECTION A. Description of project activity

### A.1. Purpose and general description of project activity

The Aguascalientes – EcoMethane Landfill Gas to Energy Project (hereafter, the “Project”) developed by Biogas Technology Ltd. (hereafter referred to as the “Project Developer”) is a landfill gas (LFG) collection and utilisation project taking place at the San Nicolas and Cumbres landfills in the city of Aguascalientes, Mexico, hereafter referred to as the “Host Country”. The project will have an electricity component with an installed capacity between 2 and 4 MW.

The Cumbres landfill was opened in 1986, operated as an open dump from 1986 until 1993, and then as a controlled dump from 1993 until 1997 receiving municipal waste from the City of Aguascalientes. Thereafter, this landfill was operated as a sanitary landfill until it was closed in 1998. The San Nicolas landfill opened in 1999 as a sanitary landfill and will remain operational until 2010. The municipal government owns and operates both landfills and currently there is no system in place to actively capture or flare the LFG generated and vented to the atmosphere at the landfills.

The objective of the Project is to collect and flare the LFG generated at the Cumbres landfill, and to utilise the LFG generated at the San Nicolas landfill. This will involve investing in a highly efficient gas collection system, flaring equipment, and once the project secures a power purchase contract, a modular electricity generation plant. The generators will combust the methane in the LFG to produce electricity for export to the grid. Excess LFG, and all gas collected during periods when electricity is not produced, will be flared.

This project is based on two complementary activities, as follows:

- The collection and flaring/combustion of LFG, thus converting its methane content into CO<sub>2</sub>, reducing its greenhouse gas effect; and
- The generation and supply of electricity to the regional grid, thus displacing fossil fuels used for electricity generation.

The baseline scenario is the continued uncontrolled release of LFG to the atmosphere, which is what generally occurs at landfills throughout the Host Country.

Given that the results of the financial analysis conducted clearly show that implementation of this type of project is not the economically most attractive course of action. In addition, there is no economic incentive or support to develop the project. Therefore, this kind of project is not part of the baseline scenario, it is concluded that the Project is additional.

The total emission reductions of the project over its crediting period of ten years are expected to be 1,625,926 tCO<sub>2</sub>e.

The Project is being developed through EcoMethane, an unincorporated joint venture dedicated to financing, constructing and operating projects that capture and make productive use of methane emissions. EcoMethane brings together investors, technology providers, engineers, and consultants to capitalise on the opportunities offered by the emerging market in greenhouse gas (GHG) emissions, particularly those related to activities that reduce emissions of methane to the atmosphere. EcoMethane works exclusively with Biogas Technology Ltd (Biogas) and the ENER\*G Group PLC (ENER\*G) for the financing, constructing and operation of LFG projects worldwide, and with EcoSecurities Ltd (EcoSecurities) for the development of these projects under the Clean Development Mechanism of the Kyoto Protocol. For their part, Biogas and ENER\*G (sister companies under the same ownership) have more than 20 years experience designing, installing and operating LFG collection and utilisation systems, and are respected leaders in the field. For example, Biogas has designed, installed and operated LFG collection systems on more than 100

landfills, and ENER\*G has more than 90 MW of installed electrical generation capacity. For its part, EcoSecurities is a leading CDM/JI project development company.

The Project will have several positive social and environmental impacts:

- First, properly collecting and destroying flammable LFG will reduce the risks associated with explosions in and around the landfill. This is particularly important as the LFG collection system will minimise the potential for LFG migration, which can infiltrate zones outside of the landfill's boundaries and pose dangers to the surrounding population and structures. Indeed, the area surrounding the Cumbres landfill has been subject to these dangers and the Project will serve to minimise these risks.
- Second, the destruction of the LFG will improve the local environment by reducing the amount of noxious air pollution arising from the landfill, resulting in a considerable reduction of nuisance caused by the odours and also health risks associated to these emissions, especially for the surrounding population located nearby the Cumbres landfill.
- Third, the project will provide a model for managing LFG, a key element in improving landfill management practices throughout the Host Country.
- Fourth, the project will act as a clean technology demonstration project, encouraging less dependency on grid-supplied electricity, and will represent a technology transfer from the UK to the Host Country.
- Fifth, the project will provide for both short- and long-term employment opportunities for local people. Local contractors and labourers will be required for construction, and long-term staff will be used to operate and maintain the system.
- Finally, by paying the local authority a royalty fee from the sale of the carbon credits, the project will be injecting capital into the local economy, and its use will be entirely decided upon by the local authority.

The Project is helping the Host Country fulfil its goals of promoting sustainable development. Specifically, the project:

- Increases employment opportunities in the area where the project is located;
- Diversifies the sources of electricity generation;
- Uses clean and efficient technologies, and conserves natural resources;
- Acts as a clean technology demonstration project, encouraging development of modern and more efficient generation of electricity using landfill gas throughout the Country;
- Optimises the use of natural resources; and
- Improves the overall management practices of the landfill.

## **A.2. Location of project activity**

The Cumbres landfill is located in the eastern part of the Municipality of Aguascalientes. The site is located at the following coordinates: 21°42'30" N and 102°16'0" W.

The San Nicolas landfill is located on kilometre 9.3 of the Jose Ma. Morelos y Pavon highway. The site is located at the following coordinates: 21°59' N and 102°21' W.

## **A.3. Technologies/measures**

### **Landfill Gas Collection System**

The Project Developer has over twenty years of practical experience in the design, installation and operation of LFG collection systems. The project activity involves the installation of state of the art LFG collection technology. This includes:

- Vertical gas wells drilled into waste to extract the LFG. The gas wells cover the area of the landfill available for gas extraction and are spaced on a site-specific grid to maximise LFG collection.
- The gas collection pipe work consists of pipes connecting groups of gas wells to the manifolds. Manifolds connect into a main pipe and then into the main header pipe delivering the gas to the extraction plant and the flare. The system is modular, so it is relatively easy to extend it on parts of the landfill available for gas extraction in the future.
- The gas collection pipe work allows for effective condensate management by employing dewatering points at strategic low points and returning the condensate back to landfill.
- The system operates at pressure slightly lower than atmospheric. A blower(s) draws the gas from the wells through the collection system and delivers it to the flare or gas fuelled internal combustion engine powering electricity generator. The system is optimised to address issues related to pressure losses.
- For efficient operation of the gas collection system, each landfill cell, where the gas is collected from, is covered by an impermeable material (high density polyethylene membrane or mineral material) to provide sufficient containment and prevent air ingress into landfill body.

### Installation

The gas collection field installation is closely managed and monitored by experienced project managers from the Project Developer in accordance with proven quality control procedures. Experienced key workers are employed to ensure that the gas collection system is installed correctly, and a large portion of the plant and labour is sourced locally. In addition, a comprehensive installation record is maintained to ensure that any future expansion or repair works can be located quickly and efficiently.

### Operation

Project Developer's trained personnel sets up the gas collection system for optimal long-term operation. Their engineers and technicians are involved in balancing the gas collection system on a regular basis in accordance with the monitoring plan.

Sophisticated portable gas monitoring equipment, fitted with in-built data logging facility and data retrieval to a PC is used in the day-to-day operation of the system. Collected data are emailed to the UK for review on a daily basis. Project Developer's senior management personnel provide technical support throughout the project to the local personnel employed on the ground.

### Flare Technology

The Project Developer has designed, manufactured and installed skid / base mounted and mobile gas flares for burning LFG for over twenty years. Enclosed stacks provide conditions for high temperature combustion to effectively destruct methane with other combustible LFG components and meet low emission regulations in accordance with latest best practice guidelines (UK Environment Agency: Guidance on Landfill Gas Flaring, 2002 - version 2.1).

The project activity involves the installation of a modular enclosed gas flare consisting of pipe work, valves, blower, stack with proprietary burners, instrumentation and control panel. The main features of the gas flare system are presented below.

- The pipe work connects all the elements of the flare from the mains header pipe to the burners via a demister with filter element, isolation and control valves, blower and instrumentation. All the pipe work has flanged or threaded connections and is fully galvanised. The demister element protects the fan from moisture and particulates that flow with the gas from the waste deposit. The pipe work has drainage valves for removal of condensate that may accumulate in it.
- Valves used are manual or automatically operated. They can isolate incoming gas or parts of the pipe work in accordance with operational requirements. They are also used to regulate the flow and pressure of the gas.
- The unit has a flame arrester for safety purposes. The flame arrester(s), which is of the deflagration type, is fitted on the main and pilot delivery lines. The arresters protect the blower and the field pipe work from flashback of the flame from the burners.
- The system includes a centrifugal electrically-powered blower, which is a pressure rising machine that generates suction in the gas collection system and positive pressure (above atmospheric) on the burners. The blower drives the gas from the gas wells into the burners.
- The flare stack is made of circular galvanised steel shroud with ceramic lining that maintains high combustion temperature inside. The dimensions of the stack are designed to guarantee safe and effective destruction of the LFG with minimal environmental impact (low emissions). At the bottom of the stack are a set of manual and automatic louvers that control air supply to the burners in order to maintain optimum combustion parameters. The stack is fitted with an igniter that starts the flame on the burners, and with a thermocouple (to measure temperature) and a flame detector.
- Burners of proprietary Biogas design ensure full destruction of combustible constituents found in LFG at high temperature in accordance with the UK Environment Agency guidelines.
- The unit includes sophisticated instrumentation, as follows:
  - pressure, vacuum and temperature gauges and transmitters fitted onto the pipe work that monitor the parameters of the LFG;
  - flow meter to measure accurately the flow of the gas through the system;
  - gas analyser (methane, carbon dioxide, oxygen) that measures the quality of the gas delivered to the flare, as well as gas flow rate and pressure (and other selected parameters);
  - sampling points for taking gas samples with portable instrumentation and for laboratory analysis;
  - ultraviolet camera fitted to the stack that monitors the presence of the flame;
  - thermocouple that monitors accurately the temperature of the flame in the stack and feeds back the signal to the automated air louver in order to maintain the temperature within the stack at desired level; and
  - data logging system that transmits the information via telemetry / satellite to the control centre managed by the Project Developer.
- The control panel houses all of the flare controls, motor starters, alarms and interlocks that ensure safe operation of the flare. The control panel enables:
  - powering the plant and its components;
  - manual, automated or remote start and shut down of the flare;
  - automated shutdowns and isolation of the gas supply if the safety devices (e.g. flame detector) indicate unsafe operating conditions;
  - automatic notification of the alarms and shutdowns to the operator via telemetry;
  - automated temperature control;
  - local readout of the flare operating parameters and alarms; and

- electrical isolation of the whole plant.

## Electricity Generation Technology

As and when the project secures a power purchase agreement that will enable the generation of electricity, a modular reciprocating engine facility will be installed. The Project Developer would develop the electricity generation component of the project activity through its relationship with the ENER\*G Group, whose subsidiary ENER\*G Natural Power has extensive experience in the design, building, and operation of generators using LFG.

The electricity generation project component will involve the construction of a suitable sized compound (50m x 80m) which will comprise of a level surface with concrete bases to support the engine units. The compound will have an electrical earthing blanket constructed below the surface to comply with electrical regulations. There will be an electrical sub-station constructed that will contain all suitable switching gear and metering equipment to facilitate a connection to the national grid network. There will be two small support buildings for offices and a workshop. A series of pipes and ducts will be laid to carry both electrical cabling and gas pipe work. There will also be three fully bunded tanks for clean oil, dirty oil and coolant storage. The whole area will be securely fenced.

The packaged generation system consists of an outdoor acoustic containerised generating set comprising an engine/alternator set. The engine units comprise of fully containerised Caterpillar (Cat 3516) 16 cylinder turbo charged gas engine, with a separate control room and housing for its own transformer and switch. These units are designed to be fully mobile. The containers are fully sealed (no floor penetrations) to ensure no leaks of oil to ground, therefore environmentally friendly. As the gas production increases or decreases (gas production curve) then containerised engine units can be easily added or taken away to match the gas production. These generators are designed and built by the ENER\*G Group in Manchester and the design incorporates the following key features:

- Fully enclosed oil-bunded engine compartment and control room;
- Extended oil sumps to increase oil change intervals and reduce downtime;
- Sealed oil pumping lines to make oil changes faster and safer with no risk of spillage;
- A comprehensive, patented, engine management system designed and built in-house, which allows for remote operation and monitoring and has been proven in over 600 applications;
- Sound proofed engine compartments, typically reducing sound levels to 69 dB(A) at 10m;
- Engine emissions that achieve current pre December 31st 2005 engine emission limits as detailed in "Guidance for Monitoring Landfill Gas Engine Emissions" (UK standards);
- EA Technical Guidance, compliant exhaust stacks with monitoring points and optional access platform (retrofitted on site).

All engine units are fitted with remote monitoring technology which is Internet based and allows engines to be started and stopped remotely as well as monitor engine performance, output and characteristics. Irrespective of this the generation facility will employ full time staff for operation, routen servicing and repairs.

The technology used in the project activity to collect, flare and utilise the landfill gas comes from the UK. Equipment will be imported and installed in Mexico, representing a transfer of technology.

**A.4. Parties and project participants**

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Mexico (host)	Biogas Technology S.A. de C.V.	Yes
United Kingdom of Great Britain and Northern Ireland	Biogas Technology Ltd	Yes
United Kingdom of Great Britain and Northern Ireland	Biogas Technology Group Ltd	Yes
United Kingdom of Great Britain and Northern Ireland	EcoSecurities Ltd	Yes
United Kingdom of Great Britain and Northern Ireland	EcoSecurities Carbon 1 Ltd	Yes
Switzerland	EcoSecurities Group Plc	Yes
Switzerland	ALLCOT AG	Yes

**A.5. Public funding of project activity**

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

**A.6. History of project activity**

The proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA). The proposed CDM project activity is not a project activity that has been deregistered.

The proposed CDM project activity was not a CPA that has been excluded from a registered CDM PoA and is not a registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired exists in the same geographical location as the proposed CDM project activity.

**A.7. Debundling**

Not applicable.

## SECTION B. Application of methodologies and standardized baselines

### B.1. References to methodologies and standardized baselines

For the landfill gas component, the latest version of [ACM0001 “Consolidated baseline methodology for landfill gas project activities \(Version 2\)”](#) will be used.

For the electricity generation component, the latest version of [AMS-I.D “Renewable electricity generation for a grid”](#) based on Appendix B of the simplified modalities and procedures for small-scale CDM project activities version 8 from March 3, 2006 will be used.

### B.2. Applicability of methodologies and standardized baselines

For the landfill gas component the chosen monitoring methodology is to be used in conjunction with baseline methodology ACM0001. The proposed project activity meets all the applicability requirements requested for this methodology.

ACM0001 recommends that for the electricity generation component, either the small-scale methodology I.D or the Approved Consolidated Methodology ACM0002 should be used. This project will use AMS-I.D as it is below the threshold size for small-scale projects

The methodology ACM0001 allows for the development of projects falling under 3 options:

- a) Landfill projects where the captured gas is simply flared;
- b) Landfill projects that use the gas to produce energy (e.g. electricity/thermal energy), but do not claim emission reductions from displacing or avoiding energy from other sources; and
- c) Landfill projects where the captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reductions are claimed for displacing or avoiding energy generation from other sources.

As previously described, the Project is based on two complementary activities, as follows:

- The collection and flaring or combustion of LFG, thus converting its methane content into CO<sub>2</sub>, reducing its greenhouse gas effect; and
- The generation and supply of electricity to the regional grid, thus displacing a certain amount of fossil fuels used for electricity generation.

The Project therefore fulfils the conditions of Option c (i.e., the captured landfill gas is used to produce electricity and reductions are claimed for displacing electricity generation from other sources), and thus ACM0001 was considered the most appropriate methodology for the Project.

ACM0001 states that in the case of c), the approved small-scale methodology for renewable electricity generation for a grid can be applied (Type I.D) if the amount of electricity generated is below the threshold for small scale projects (15MW). This category comprises renewable energy generation units that supply electricity to an electricity distribution system that is or would have been supplied by at least one fossil fuel or non-renewable biomass fired generating unit. This is therefore applicable to this project. Furthermore, the project activity is not financially viable without CER revenue. LFG revenues (gas, electricity and/or heat) alone are insufficient to recover project investments and operational costs.

The methodology ACM0001 requires that ‘Project proponents should provide an ex ante estimate of emissions reductions, by projecting the future GHG emissions of the landfill. In doing so, verifiable methods should be used’. In the case of this project, the US EPA’s first order decay model is used to determine estimated emissions reductions ex ante. This ex ante estimate is for



illustrative purposes, as emissions reductions will be monitored ex-post, according to the methodology.

The methodology will be applied using Option (c) of the Consolidated Methodology, where the gas captured is used for electricity generation and emission reductions are claimed for displacing or avoiding energy from other sources. The amount of credits for these sources will be calculated using the Methodology for Small Scale Electricity Type 1.D., as the generation component of the project is smaller than 15 MW installed capacity. The data used for the calculation of combined margins is shown in Annex 3 of this document. The main source of data is the Mexican Energy Ministry (SENER). The defaults used for the calculation of calorific values for fuel types and fuel oxidisation came from the IPCC GHG Gas Inventory Reference Manual (IPCC 1996).

The formulae used to calculate emissions reductions are detailed in section B.6

The following table provides the key information and data used to determine the emission reductions in the project scenario:

**Table:** Data used to determine the emission reductions in the project scenario

Variable	Unit	Data Source
Total amount of LFG captured	m <sup>3</sup>	Project developer
Amount of LFG flared	m <sup>3</sup>	Project developer
Amount of LFG combusted in power plant	m <sup>3</sup>	Project developer
Flare/combustion efficiency, determined by the operation hours (1) and the methane content in the exhaust gas (2)	%	Project developer
Methane fraction in the LFG	%	Project developer
Regulatory requirements relating to LFG projects	text	Host country legislation
Operating Margin Emissions Factor (EF_OM <sub>y</sub> )	tCO <sub>2</sub> /MWh	Calculated using data from the Host Country Energy Ministry
Build Margin Emissions Factor (EF_BM <sub>y</sub> )	tCO <sub>2</sub> /MWh	Calculated using data from the Host Country Energy Ministry
Electricity displaced by the Project (EG)	MWh	Project developer and Grid electricity company
Electricity Consumed by Project (EC)	MWh	Project developer and Grid electricity company

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

For the baseline determination, the project boundary is the site of the project activity where the gas will be captured and utilised/destroyed.

According to ACM0001 baseline methodology, the project boundary is the site of the project activity where the gas will be captured and destroyed/used. According to I.D of small-scale CDM

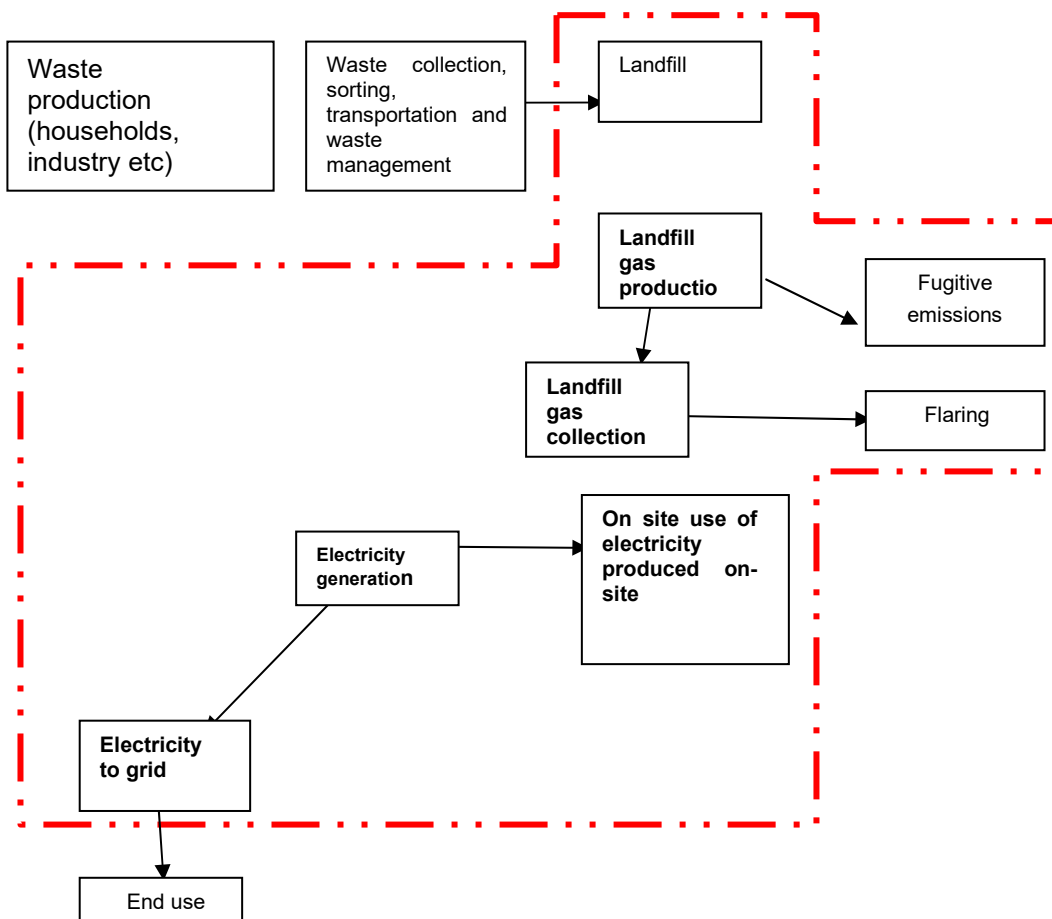
methodology, project boundary should encompass the physical, geographical site of the renewable generation source.

The following project activities and emission sources are considered within the project boundaries:

- CH<sub>4</sub> emissions from the un-recovered LFG liberated from the landfill sites. It is estimated that only 70% of LFG generated at the San Nicolas landfill and 50% of the LFG generated at the Cumbres landfill will be captured, which means that the remaining 30% and 50%, respectively, will be released as fugitive emissions.
- CO<sub>2</sub> from the combustion of landfill gas in the flares and electricity generator. When combusted, methane is converted into CO<sub>2</sub>. As the methane is organic in nature these emissions are not counted as project emissions. The CO<sub>2</sub> released during the combustion process was originally fixed via biomass so that the life cycle CO<sub>2</sub> emissions of LFG are zero. The CO<sub>2</sub> released is carbon neutral in the carbon cycle.
- Electricity required for the operation of the project activity should be accounted for in the project emissions and they need to be monitored. However, as the project activity involves electricity generation and uses electricity generated from LFG, only the net quantity of electricity fed into the grid should be used to account for emission reductions due to displacement of electricity in other power plants.

For the determination of baseline emissions of the electricity generation component of the project, the project boundary will account for the CO<sub>2</sub> emissions from electricity generation in fossil fuel power stations operating in the Project grid system, which will be displaced by the Project activity. The spatial extent of the project boundary is defined as the project site and the plants connected to the grid system to which the project will be connected.

A full flow diagram of the project boundaries is presented in the figure below. The flow diagram comprises all possible elements of the LFG collection systems and the equipment for electricity generation.



**Figure:** Flow chart of project boundaries (staggered line indicates boundaries)  
 The emission sources and GHGs included in the project boundary for the purpose of calculating project emissions and baseline emissions are the following:

	Source	GHG	Included?	Justification/Explanation
Baseline	Emissions from decomposition of waste at the SWDS site	CO <sub>2</sub>	Yes/No	The major source of emissions in the baseline
		CH <sub>4</sub>	Yes/No	N <sub>2</sub> O emissions are small compared to CH <sub>4</sub> emissions from SWDS. This is conservative
		N <sub>2</sub> O	Yes/No	CO <sub>2</sub> emissions from decomposition of organic waste are not accounted since the CO <sub>2</sub> is also released under the project activity
	Emissions from electricity generation	CO <sub>2</sub>	Yes/No	Major emission source if power generation is included in the project activity
		CH <sub>4</sub>	Yes/No	Excluded for simplification. This is conservative
		N <sub>2</sub> O	Yes/No	Excluded for simplification. This is conservative
Project activity	Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO <sub>2</sub>	Yes/No	May be an important emission source
		CH <sub>4</sub>	Yes/No	Excluded for simplification. This emission source is assumed to be very small
		N <sub>2</sub> O	Yes/No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from electricity consumption due to the project activity	CO <sub>2</sub>	Yes/No	May be an important emission source
		CH <sub>4</sub>	Yes/No	Excluded for simplification. This emission source is assumed to be very small
		N <sub>2</sub> O	Yes/No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from flaring	CO <sub>2</sub>	Yes/No	Emissions are considered negligible
		CH <sub>4</sub>	Yes/No	May be an important emission source
		N <sub>2</sub> O	Yes/No	Emissions are considered negligible

#### B.4. Establishment and description of baseline scenario

The baseline scenario is the continued uncontrolled release of LFG to the atmosphere, which is what generally occurs at landfills throughout the Host Country.

The determination of project scenario additionality is done using the CDM consolidated tool for demonstration of additionality. This process is explained in section B.5.

#### B.5. Demonstration of additionality

The determination of project scenario additionality is done using the CDM consolidated tool for demonstration of additionality, which follows the following steps:

##### Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

##### Sub-step 1a. Define alternatives to the project activity:

Alternative 1: The landfill operator could continue the current business as usual practice of passive venting (i.e., not collecting and flaring) LFG from the waste management operations directly to the atmosphere. In this case, no power would be generated at the sites and the Host Country power system would remain unaffected.

Alternative 2: The landfill operator could invest in a LFG collection system of high effectiveness, as well as a high efficiency flaring system for both Cumbres and San Nicolas landfills. In the case of San Nicolas landfill, the landfill operator would also invest in LFG power generation equipment. The operation would reduce GHG emissions and the generation of power from fossil-fired grid-connected sources. Alternative 2 represents the proposed project activity.

**Sub-step 1b. Enforcement of applicable laws and regulations:**

The proposed project activity complies with all the applicable laws and regulations. Regulation NOM- 083-SEMARNAT-2003 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. This comprehensive regulation defines guidelines for the construction and operation of landfills, and also provides guidance regarding LFG, including recommendations for the collection, utilisation and/or flaring of the LFG. As such, the regulation does not specify minimum requirements regarding the amount of gas to be collected and utilised or flared. The regulation notwithstanding, common practice demonstrates that existing landfills in the country do not capture and flare or utilise their landfill gas, as explained below in Step 4.

The tool for the demonstration and assessment of additionality clearly states that only laws that are enforced need to be considered in the determination of the baseline scenario. NOM-083-SEMARNAT- 2003 is clearly not enforced in Mexico:

- Norma 083 is a federal law that given the sovereignty of local authorities in this area (landfills are within the responsibility of the municipalities) only becomes legally binding if it is adopted by the local authorities. So far, no local authorities have adopted NOM-083-SEMARNAT-2003
- NOM-083-SEMARNAT-2003 has never been enforced since its adoption about one year ago. Even the earlier norm, which NOM-083-SEMARNAT-2003 replaced and which only required the active venting of LFG for safety reasons, was not enforced.
- Finally, NOM-083-SEMARNAT-2003 has more the character of a policy.

In short, NOM-083-SEMARNAT-2003 shall not be taken into account in the establishment of a baseline scenario for LFG projects in Mexico.

**Step 2. Investment Analysis**

**Sub-step 2a: Determine appropriate analysis method**

According to the tool for the demonstration and assessment of additionality, one of three options must be applied for this step: (1) simple cost analysis (where no benefits other than CDM income exist for the project), (2) investment comparison analysis (where comparable alternatives to the project exist), or (3) benchmark analysis.

In the case of the Cumbres landfill, the project activity involves only collection and flaring of the LFG and the only income of the project would come from the carbon revenues. Therefore option (1) simple cost analysis will be applied. The costs of the project activity for the Cumbres landfill are documented in the table below. Since there are no revenues other than CDM revenues, the project is demonstrably additional.

**Table:** Costs related to project activity in the Cumbres landfill.

Cost	Amount (US \$)	Frequency
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Capital costs	386,229	Once
Operational costs	56,683	Annually

By investing in a landfill gas collection and flaring systems, the Project would not generate any revenues in the absence of the CDM. Therefore, the project activity is not economically attractive and not a realistic baseline scenario.

In the case of the San Nicolas landfill, where the project activity involves collection and utilisation of the LFG for electricity generation, the most likely alternative to the project is to simply not install flaring and generation equipment at the site, i.e., the alternative does not involve investments of a similar scale to the project. Therefore, option (3) benchmark analysis will be applied.

### Sub-step 2b: Option III - Apply benchmark analysis- San Nicolas Landfill

The likelihood of development of this project, as opposed to the continuation of current activities (i.e., no collection and combustion of landfill gas), will be determined by comparing its IRR with the benchmark of interest rates available to a local investor. In January 2006, interest rates at local banks in Mexico were 8.22% and yields on government bonds were 7.92%. The benchmark rate of return on construction or projects with similar risks involved is commonly set at least at 15%.

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

The Table below shows the financial analysis for the project activity. As shown, the project IRR (without carbon revenues) is 3.5 %, lower than the interest rates provided by local banks or government bonds in the Host Country.

**Table:** Financial results of the project (Alternative 2) with and without carbon finance. NPV uses 12% discount rate. The electricity price is assumed to be US\$70/MWh, consistent with current prices, which are not expected to change substantially.

	With Carbon	Without Carbon
	Revenues	Revenues
Net Present Value (US\$)	2,416,205	-1,406,025
IRR	25.8%	3.2%
Discount rate	12%	12%

Summary of results of project analysis. Details made available to validators.

### Sub-step 2d: Sensitivity analysis

A sensitivity analysis was conducted by altering the following parameters:

- Increase in project revenue (price of electricity sold to the grid);
- Reduction in project capital (CAPEX) and running costs (Operational and Maintenance costs).

Those parameters were selected as being the most likely to fluctuate over time. Financial analyses were performed altering each of these parameters by 10%, and assessing what the impact on the project IRR would be (see Table below). As it can be seen, the project IRR remains lower than its alternative even in the case where these parameters change in favour of the project.

**Table:** Sensitivity analysis

Scenario	% change	IRR (%)	NPV \$US
Original		3.2%	-1,406,025
Increase in project revenue	10%	7.5%	-743,127
Reduction in project costs	10%	7.8%	-632,368

Note: NPV uses 12% discount rate.

In conclusion, the project IRR remains low even in the case where these parameters change in favour of the Project. Even though these numbers are similar to the risk free returns of government bonds, these are still too low for a risky enterprise such as the construction and operation of a landfill gas-to-energy project, and fairly lower than private equity investments such as 15%. Consequently, the Project cannot be considered as financially attractive.

#### Step 4. Common Practice Analysis

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

To date there has been very limited development of LFG projects in the Host Country. The table below presents information regarding a representative sample of landfills throughout the Host Country. As the table indicates, landfills in Host Country either have: (1) no system for collecting, venting or flaring LFG;

(2) a passive system for venting LFG only (no flaring); (3) a passive system for venting and flaring LFG; or (4) a system to actively collect and flare or utilise the LFG. As the table indicates, only two of the sites have LFG collection and flaring or utilisation systems. The Prados de la Montaña landfill collects and partially flares the LFG generated at the site because the area where its located was slated to become a prime real estate investment opportunity at the time, and the landfill was 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. Despite the completion of this system years ago, it is not surprising that it took Global Environment Facility financing to build the second LFG capture system in Mexico – this one at the Simeprodeso landfill in Monterrey completed in 2003 and designed specifically as a demonstration project to promote the development of CDM projects. Since then, no LFG collection and flaring or utilisation systems have been developed in Mexico without considering carbon revenues.

**Table:** The Project control group

Landfill Name	Location	Waste Deposition Rate (tonnes/day)	Current Status
Prados de la Montaña	Mexico City	Closed	System to actively collect and partially flare the LFG
Simeprodeso landfill (phase I)	Monterrey, Nuevo Leon	Closed	Landfill gas collection and utilisation project, funded with support from the GEF as demonstration project
Durango	Durango City, Durango	500	No system for collecting, venting or flaring LFG
Culiacan	Culiacan, Sinaloa	850	Passive system for venting of LFG only (no flaring)

Socavon San Jorge	Metepec, State of Mexico	500	Passive system for venting and flaring LFG
El Verde	Leon, Guanajuato	1,450	Passive system for venting and flaring LFG
Bordo Neza	State of Mexico	1,500	No system for collecting, venting or flaring LFG
Chiltepeque landfill	Puebla City, Puebla	1,595	No system for collecting, venting or flaring LFG
Santa Marta Chiconautla	Ecatepec, State of Mexico	1,600	Passive system for venting of LFG only (no flaring)
Bordo Poniente	Mexico City	12,000	No system for collecting, venting or flaring LFG

Thus, with the exception of the Prados de la Montaña and the first phase of the Simeprodeso landfills, none of the other landfills have proper LFG collection and flaring systems. In some cases, as in Aguascalientes (both at the Cumbres and the San Nicolas landfills), the LFG is vented passively to atmosphere for safety purposes, and if the vents are lit manually a small percentage of the LFG is combusted. Indeed, this is reflected in the Adjustment Factor (see section D.2.2.2). The reason for the lack of widespread LFG collection and combustion systems is that there currently is no economic incentive for capturing and utilising the LFG. In summary, the passive venting method is still a common practice in landfills throughout Mexico.

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

As mentioned above in sub-step 4a, only two landfills in the Host Country have collection and flaring or utilisation schemes on them, and the conditions for the development of each of these systems was quite special. There are some preliminary plans to install efficient gas collection and flaring systems in other landfills, but all of these are in the context of the CDM.

### **Step 5. Impact of CDM registration**

As shown in Step 2 above, the project is unlikely to move forward without the additional financial support of the CDM. If the developer were able to sell emission reduction credits from the project activity, the additional revenue generated by carbon sales would be sufficient to make the project go ahead (see Table in step 2c above).

#### **B.6. Estimation of emission reductions**

##### **B.6.1. Explanation of methodological choices**

The consolidated methodology for landfill projects uses an equation for calculating the amount of methane destroyed in the project and baseline scenarios, as opposed to the amount of methane emitted in these scenarios. We will use the convention established in the consolidated methodology and use this section to describe the amount of methane destroyed in the project and baseline scenarios.

For the methane destroyed in the project scenario, the equation is the following:



$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y}$$

Where:

$MD_{project,y}$ : amount of methane actually destroyed/combusted during the year “y” (tCH<sub>4</sub>).

$MD_{flared,y}$ : quantity of landfill gas flared during the year “y” (tCH<sub>4</sub>).

$MD_{electricity,y}$ : quantity of methane destroyed by generation of electricity during the year “y” (tCH<sub>4</sub>)

$MD_{thermal,y}$ : quantity of methane destroyed by generation of thermal energy (excluded, as no thermal energy will be used).

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

$$MD_{flared,y} = LFG_{flared,y} * W_{CH_4,y} * D_{CH_4} * FE$$

Where:

$MD_{flared,y}$ : quantity of methane destroyed by flaring flared during the year “y” (tCH<sub>4</sub>);

$LFG_{flared,y}$ : quantity of landfill gas flared during the year “y” (m<sup>3</sup>CH<sub>4</sub>);

$W_{CH_4,y}$ : the average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m<sup>3</sup> CH<sub>4</sub> / m<sup>3</sup> LFG);

$FE$ : the flare efficiency (the fraction of the methane destroyed).

The quantity of landfill gas flared by the project is estimated using the US EPA First Order Decay Model<sup>1</sup>, using Lo (methane generation potential) and k (methane generation rate constant) values appropriate for the Host Country and assuming that only 50% of the landfill gas generated in the Cumbres landfill and 70% from the San Nicolas Landfill is collected by the gas collection system (average for landfills in developing countries). In any case, as this projection is merely for illustrational purposes only, the precision of these values are not so important as the actual emissions reductions will be monitored directly. The details of the assumptions of the model are provided in annex 3.

The quantity of methane destroyed through combustion in the electricity generation engines is calculating using the following equation:

$$MD_{electricity,y} = LFG_{electricity,y} * W_{CH_4,y} * D_{CH_4}$$

Where:

$MD_{electricity,y}$ : quantity of methane destroyed by electricity generation during the year “y” (tCH<sub>4</sub>);

$LFG_{electricity,y}$ : quantity of landfill gas used for electricity generation during the year “y” (m<sup>3</sup>CH<sub>4</sub>);

$W_{CH_4,y}$ : the average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m<sup>3</sup> CH<sub>4</sub> / m<sup>3</sup> LFG) (the same as in the expression above);

$D_{CH_4}$ : the methane density expressed in tones of methane per cubic meter of methane (tCH<sub>4</sub>/m<sup>3</sup>CH<sub>4</sub>).

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

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<sup>1</sup> On this model, see US EPA manual “Turning a Liability into an Asset: A Landfill Gas to Energy Handbook for Landfill Owners and Operators” (December 1994).

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

Where:

$MD_{reg,y}$ : amount of methane that would have been destroyed/combusted during the year “y” in the absence of the project activity (tCH<sub>4</sub>);

$MD_{project,y}$ : amount of methane actually destroyed/combusted during the year “y” (tCH<sub>4</sub>);

$AF$  : Adjustment Factor (%).

The landfill operator is passively venting and minimally flaring the collected gas produced in the landfills, primarily for safety purposes. Because of the low volumes of LFG actually collected and the inefficient combustion of the LFG when the vents are lit (manually and only occasionally) the reduction of greenhouse gases is minimal. For this reason the Adjustment Factor for the project was fixed at 5% in order to provide a large enough conservative margin to what could have been flared in the baseline scenario.

The only emissions associated with the project are related to the electricity used for the operation of the flare pumps and other auxiliary equipment. Project emissions in tCO<sub>2</sub>e during a given year ‘y’ ( $PE_y$ ) are equal to the net amount of electricity used by the project in any given year in MWh ( $EC_y$ ), multiplied by a carbon emissions factor ( $CEF_{electricity,y}$ ) for the grid from which electricity is taken (tCO<sub>2</sub>e/MWh):

$$PE_y = EC_y * CEF_{electricity,y}$$

Total electricity used for the project will be deducted from the amount of electricity produced by the project, thus emissions reductions will only be claimed for the net electricity supplied to the grid. Net electricity generated by the project is therefore estimated using the following formula:

$$EG_y = EG_{EX,LFG} - EC_{IMP}$$

Where:

$$EG_y = EG_{EX,LFG} - EC_{IMP}$$

$EG_{EX,LFG}$ : net quantity of electricity exported during year y, produced using landfill gas, in megawatt hours (MWh).

$EC_{IMP}$ : Net electricity imported, defined as project electricity imports to meet the project requirements, in MWh

Project emissions are therefore accounted for in the formula for emissions reductions in section D.2.4 below.

In cases when the project is not generating electricity, the project emissions due to this electricity consumption, will be deducted from the project total emission reductions using the formula above. The calculations of the project emissions due to electricity consumption are presented in section E.4. For details on the emissions in the project scenario for each individual landfill site, see Annex 3.

Electricity required for the operation of the project activity should be accounted and monitored. Where the project activity involves electricity generation, only the net quantity of electricity fed into

the grid should be used in equation (1) below to account for emission reductions due to displacement of electricity in other power plants.

The emission reductions of the project are calculated using the following equation:

$$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + EG_y * CEF_{electricity,y} + ET_y * CEF_{thermal,y} \quad (1)$$

Where:

$ER_y$ : greenhouse gas emission reduction achieved by the project activity during a given year “y” (t CO<sub>2</sub>e).

$MD_{project,y}$ : amount of methane actually destroyed/combusted during the year “y” (tCH<sub>4</sub>).

$MD_{reg,y}$ : amount of methane that would have been destroyed/combusted during the year “y” in the absence of the project activity (tCH<sub>4</sub>).

$GWP_{CH4}$ : approved Global Warming Potential value for methane (21 t CO<sub>2</sub>e / tCH<sub>4</sub>).

$EG_y$ : net quantity of electricity displaced during the year “y” (MWh)

$CEF_{electricity,y}$ : emissions intensity of the electricity displaced during year “y” (tCO<sub>2</sub>e/MWh).

$ET_y$ : quantity of thermal energy displaced during the year “y” (TJ).

$CEF_{thermal,y}$ : CO<sub>2</sub> emissions intensity of the thermal energy displaced during year “y” (tCO<sub>2</sub>e/TJ).

As the project will not include a thermal energy component, this factor will be excluded from the overall equation.

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, if applicable.

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

Where:

$MD_{project,y}$ : amount of methane actually destroyed/combusted during the year “y” (tCH<sub>4</sub>).

$MD_{flared,y}$ : quantity of landfill gas flared during the year “y” (tCH<sub>4</sub>).

$MD_{electricity,y}$ : quantity of methane destroyed by generation of electricity during the year “y” (tCH<sub>4</sub>)

$MD_{thermal,y}$ : quantity of methane destroyed by generation of thermal energy (excluded, as no thermal energy will be used).

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

$$MD_{flared,y} = LFG_{flared,y} * w_{CH4,y} * D_{CH4} * FE \quad (3)$$

Where:

$MD_{flared,y}$ : quantity of methane destroyed by flaring flared during the year “y” (tCH<sub>4</sub>);

$LFG_{flared,y}$ : quantity of landfill gas flared during the year “y” (Nm<sup>3</sup>);

$w_{CH4,y}$ : the average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m<sup>3</sup> CH<sub>4</sub> / m<sup>3</sup> LFG);

Alternatively, for the fraction of methane in the LFG ( $w_{CH4}$ ), in occasions when continuous measurement was not effectively done, i.e., when values from the fixed CH<sub>4</sub> analyzers were not available, a calculated average value for this parameter was used, following the “Guidelines to

calculate the fraction of methane in the landfill gas from periodical measurements” version 01, released on the Annex 13 of the EB 48<sup>2</sup>.

The average wCH<sub>4</sub> value considered is the lower bound of the 95% confidence interval based on the number of samples and the analysis results. The calculation uses the following formulas:

$$\mu_{wCH_4} = \frac{\sum_{m=1}^{n_m} wCH_{4, m, y}}{n_m} \quad (4)$$

Where:

- $\mu_{wCH_{4,y}}$  Mean of the fraction of methane in the landfill gas in year y (m<sup>3</sup>CH<sub>4</sub>/m<sup>3</sup> LFG)
- $wCH_{4,m,y}$  Monitored fraction of methane in the landfill gas in measurement m in year y (m<sup>3</sup>CH<sub>4</sub>/m<sup>3</sup> LFG)
- $n_m$  Number of measurements m in year y (minimum is 4)

$$\sigma_{wCH_{4,y}} = \sqrt{\frac{\sum_{m=1}^{n_m} (wCH_{4, m, y} - \mu_{wCH_{4,y}})^2}{n_m - 1}} \quad (5)$$

Where:

- $\sigma_{wCH_{4,y}}$  Standard deviation of the fraction of methane in the landfill gas in year y (m<sup>3</sup>CH<sub>4</sub>/m<sup>3</sup> LFG)

$$wCH_{4, lb, y} = \mu_{wCH_{4,y}} - t \cdot \frac{\sigma_{wCH_{4,y}}}{\sqrt{n_m}} \quad (6)$$

Where:

- $t$  Value from standard t distribution for a confidence level of 95% with degrees of freedom  $n_m - 1$
- $wCH_{4, lb, y}$  Lower bound of the 95% confidence interval of fraction of methane in the landfill gas (m<sup>3</sup>CH<sub>4</sub>/m<sup>3</sup> LFG)
- $FE$ : the flare efficiency (the fraction of the methane destroyed).
- $D_{CH_4}$ : the methane density expressed in tones of methane per cubic meter (tCH<sub>4</sub>/m<sup>3</sup> CH<sub>4</sub>).

The quantity of landfill gas flared by the project is estimated using the US EPA First Order Decay Model<sup>3</sup>, using Lo (methane generation potential) and k (methane generation rate

<sup>2</sup> [http://cdm.unfccc.int/EB/048/eb48\\_repan13.pdf](http://cdm.unfccc.int/EB/048/eb48_repan13.pdf)

<sup>3</sup> On this model, see US EPA manual “Turning a Liability into an Asset: A Landfill Gas to Energy Handbook for Landfill Owners and Operators” (December 1994).

constant) values appropriate for the Host Country and assuming that only 50% of the landfill gas generated in the Cumbres landfill and 70% from the San Nicolas Landfill is collected by the gas collection system (average for landfills in developing countries). In any case, as this projection is merely for illustrational purposes only, the precision of these values are not so important as the actual emissions reductions will be monitored directly. The details of the assumptions of the model are provided in annex 4.

The quantity of methane destroyed through combustion in the electricity generation engines is calculating using the following equation:

$$MD_{electricity,y} = LFG_{electricity,y} * W_{CH4,y} * D_{CH4} \quad (7)$$

Where:

- $MD_{electricity,y}$ : quantity of methane destroyed by electricity generation during the year “y” (tCH<sub>4</sub>);
- $LFG_{electricity,y}$ : quantity of landfill gas used for electricity generation during the year “y” (Nm<sup>3</sup>);
- $W_{CH4,y}$ : the average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m<sup>3</sup> CH<sub>4</sub> / m<sup>3</sup> LFG) (the same as in the expression above);
- $D_{CH4}$ : the methane density expressed in tones of methane per cubic meter of methane (tCH<sub>4</sub>/m<sup>3</sup>CH<sub>4</sub>).

For this project, regulatory or contractual requirement do not specify  $MD_{reg,y}$  an “Adjustment Factor” (AF) shall be used and justified, taking into account the project context.

$$MD_{reg,y} = MD_{project,y} * AF \quad (8)$$

Where:

- $MD_{reg,y}$ : amount of methane that would have been destroyed/combusted during the year “y” in the in the absence of the project activity (tCH<sub>4</sub>);
- $MD_{project,y}$ : amount of methane actually destroyed/combusted during the year “y” (tCH<sub>4</sub>);
- $AF$  : Adjustment Factor (%).

The landfill operator is passively venting and minimally flaring the collected gas produced in the landfills, primarily for safety purposes. Because of the low volumes of LFG actually collected and the inefficient combustion of the LFG when the vents are lit (manually and only occasionally) the reduction of greenhouse gases is minimal. For this reason the Adjustment Factor for the project was fixed at 5% in order to provide a large enough conservative margin to what could have been flared in the baseline scenario.

The net quantity of electricity displaced during the year (EGy) is defined as follows:

$$EGy^4 = EG_{EXP} - EC_{IMP} \quad (9)$$

where:

- $EG_{EXP}$  quantity of electricity exported during year y, produced using landfill gas, in megawatt hours (MWh).
- $EC_{IMP}$  electricity imported, defined as project electricity imports to meet the project requirements, (MWh)
- Electricity required for the operation of the project activity should be accounted and monitored. Where the project activity involves electricity generation, only

<sup>4</sup> This parameter can be calculated as per formula indicated or measured, following the recommendations given by the clarification SSC\_371: <http://cdm.unfccc.int/methodologies/DB/Q3VOK1HPBFTLSP7ZXFMY8R8Y4BEVJX/view.html>

the net quantity of electricity fed into the grid should be used in equation (1) above to account for emission reductions due to displacement of electricity in other power plants.

The  $CEF_{electricity,y}$  for the grid will be calculated according to the equations for small scale electricity projects (Methodology for Small Scale Activities Type 1.D-Renewable Electricity Generation for a Grid ), as shown below. The carbon emissions factor ( $CEF_{electricity}$ ) is calculated according to option (a), the average of the “approximate operating margin” and the “build margin”, where:

- (i) The “approximate operating margin” is the weighted average emissions (in kg CO<sub>2</sub>equ/KWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low cost biomass, nuclear and solar generation;
- (ii) The “build margin” is the weighted average emissions (in kg CO<sub>2</sub>equ/KWh) of recent capacity additions to the system, which capacity additions are defined as greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants.

The carbon emissions factor of the grid ( $EF_y$ ) is therefore calculated according to the equation below.

$$EF_y = (\omega_{OM} * EF_{OM_y}) + (\omega_{BM} * EF_{BM_y})$$

Where the weights  $\omega_{OM}$  and  $\omega_{BM}$  are by default 0.5.

The equation for the operating margin emission factor is:

$$EF_{OM_y} (tCO_2 / MWh) = \frac{\sum_{i,j} F_{i,j,y} * COEF_{i,j}}{\sum_j GEN_{j,y}}$$

Where:

- $F_{i,j,y}$  is the amount of fuel  $i$  (in GJ) consumed by power source  $j$  in year  $y$ ;
- $j$  is the set of plants delivering electricity to the grid, not including low-cost or must-run plants and carbon financed plants;
- $COEF_{i,j,y}$  is the carbon coefficient of fuel  $i$  (tCO<sub>2</sub>/GJ);
- $GEN_{j,y}$  is the electricity (MWh) delivered to the grid by source  $j$ .

The equation for the build margin emission factor is:

$$EF_{BM_y} (tCO_2 / MWh) = \frac{[\sum_{i,m} F_{i,m,y} * COEF_{i,m}]}{[\sum_m GEN_{m,y}]}$$

where  $F_{i,m,y}$ ,  $COEF_{i,m}$  and  $GEN_m$  are analogous to the OM calculation above.

**B.6.2. Data and parameters fixed ex ante**

<b>Data/Parameter</b>	<b>D<sub>CH4</sub></b>
Data unit	Tonne/CH <sub>4</sub> /m <sup>3</sup>
Description	Density of Methane
Source of data	As per methodology ACM0001 (Version 02) specify.
Value(s) applied	0.0007168 (°C; 1,013 bar)
Choice of data or measurement methods and procedures	Not applicable
Purpose of data	Calculation of Baseline and Project Emissions
Additional comment	Not additional comments

<b>Data/Parameter</b>	<b>GWP<sub>CH4</sub></b>
Data unit	tCO <sub>2</sub> /tCH <sub>4</sub>
Description	Global Warming Potential Methane
Source of data	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	Until 31/12/2012 (first commitment period): 21 From 01/01/2013 (second commitment period): 25
Choice of data or measurement methods and procedures	Not applicable
Purpose of data	Calculation of Baseline Emissions
Additional comment	Not applicable

<b>Data/Parameter</b>	<b>AF</b>
Data unit	%
Description	Adjustment factor. Proportion of methane flared in Baseline
Source of data	First version of the registered PDD, pág 33.
Value(s) applied	Cumbres Landfill: 5% San Nicolas Landfill: 5%
Choice of data or measurement methods and procedures	This value is justified based on the fact that the regulatory requirements do not indicate any specific amount of gas collection and destruction or utilization and that in practice, minimal amounts of LFG are actually flared. Only a passive venting and inefficient combustion system is currently used at the landfill sites for safety purposes. Therefore, although the baseline for methane destruction is not quite 0%, the adoption of an adjustment factor of 5% is considered to be conservative for the baseline scenario.
Purpose of data	Calculation of Baseline Emissions
Additional comment	No additional comments

<b>Data/Parameter</b>	<b>CEF</b>
Data unit	tCO <sub>2</sub> /MWh
Description	CO <sub>2</sub> emission intensity of the electricity and/or other energy carriers.
Source of data	Calculated in registered PDD Annex 3
Value(s) applied	0.531
Choice of data or measurement methods and procedures	Not applicable
Purpose of data	Project Emissions calculations
Additional comment	According to the revised monitoring plan, this parameter is calculated at the beginning of the crediting period. Required to determine CO <sub>2</sub> emissions from use of electricity of other energy carriers to operate the project activity.

### B.6.3. Ex ante calculation of emission reductions

The consolidated methodology for landfill projects uses an equation for calculating the amount of methane destroyed in the baseline scenario, as opposed to the amount of methane emitted in this scenario. We will use the convention established in the consolidated methodology and use this section to describe the amount of methane destroyed in the baseline and project scenarios.

#### Landfill gas component

The amount of methane destroyed in the project scenario is calculated using the equation described in section B.7, which is simplified in our case:

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} \text{ (there is no thermal component)}$$

As described in section B.7, the quantity of methane destroyed by flaring is calculated using the following equation:



$$MD_{flared,y} = LFG_{flared,y} * W_{CH4,y} * D_{CH4} * FE,$$

where the landfill gas produced is calculated using the US EPA model.

The quantity of methane destroyed through the combustion in the electricity generation engines ( $MD_{electricity,y}$ ) would be calculated using the same equation as above, except for not reducing the amount of methane destroyed by using the adjustment factor related to flare efficiency (FE). Consequently, by assuming that all gas will be flared (as opposed to separating the amount to be flared from the amount used for electricity generation), this will lead to a more conservative analysis. This is the approach used in the estimation below.

The table below shows the emission reductions that would take place in the project scenario ( $MD_{project}$ ), using the equations described above.

**Table:** Emission reductions in the project scenario for the landfill component (amount of methane destroyed).

	Per year (average)	10 years
LFG <sub>flare</sub> (m <sup>3</sup> LFG)	21,022,611	210,226,108
CH <sub>4</sub> Concentration (%)	51%	51%
Density of CH <sub>4</sub> (t CH <sub>4</sub> /m <sup>3</sup> CH <sub>4</sub> )	0.0007168	0.0007168
Flare Efficiency (%)	98%	98%
<b>MD<sub>project</sub> = MD<sub>flared</sub> (tCH<sub>4</sub>)</b>	7,584	75,839
<b>MD<sub>project</sub> = MD<sub>flared</sub> (tCO<sub>2</sub>e)</b>	159,262	1,592,622

For details on the emission reductions in the project scenario for each individual landfill site, see Annex 3.

For the amount of methane destroyed in the baseline scenario, we use the other equation mentioned in section B.7:

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

where the adjustment factor AF was set at 5%. This value is justified based on the fact that the regulatory requirements do not indicate any specific amount of gas collection and destruction or utilization and that in practice, minimal amounts of LFG are actually flared. Only a passive venting and inefficient combustion system is currently used at the landfill sites for safety purposes. Therefore, although the baseline for methane destruction is not quite 0%, the adoption of an adjustment factor of 5% is considered to be conservative for the baseline scenario.

The table below shows the emission reductions that would have taken place in the baseline scenario ( $MD_{reg}$ ), using this equation.

**Table:** Emission reductions in the baseline scenario for the landfill component (amount of methane destroyed).

	Per year (average)	10 years
<b>MD<sub>project</sub></b>	7,584	75,839
AF (%)	5%	5%
<b>MD<sub>reg</sub> (tCH<sub>4</sub>)</b>	<b>379</b>	<b>3,792</b>
<b>MD<sub>reg</sub> (tCO<sub>2</sub>e)</b>	<b>7,963</b>	<b>79,631</b>

For details on the emission reductions in the baseline scenario for each individual landfill site, see Annex 3.

**Electricity component**

The emission reductions from the electricity component are calculated using the grid emission factor calculated in section D.2.4 and an estimation of the net quantity of electricity displaced by the project (EGy) based on the electricity calculation parameters provided in annex 3.

The table below shows the emission reductions from the displacement of grid electricity

**Table:** Emission reductions in the project scenario for the electricity component

	<b>Per year (average)</b>	<b>10 years</b>
EG (MWh)	21,528	215,280
CEF (tCO <sub>2</sub> /MWh)	0.531	0.531
<b>Emission reductions from electricity generation (tCO<sub>2</sub>e)</b>	11,433	114,331

**Table:** Project emissions in the project scenario for the electricity consumption

	<b>Per year (average)</b>	<b>10 years (project period)</b>
EC (MWh)	263	2,628
CEF (tCO <sub>2</sub> /MWh)	0.531	0.531
<b>Project emissions from electricity consumption(tCO<sub>2</sub>e)</b>	140	1,396

For details on the project emissions in the project scenario for each individual landfill site, see Annex 3.

The following table summarises the total net emission reductions of the project by components

**Table:** Summary of total net emission reductions from the project activity

	<b>Per year (average)</b>	<b>10 years</b>
Emission Reductions in Project Scenario – flaring (tCO <sub>2</sub> e)	159,262	1,592,622
Emission Reductions in Baseline Scenario – flaring (tCO <sub>2</sub> e)	7,963	79,631
Net Emission Reductions – flaring (tCO <sub>2</sub> e)	151,299	1,512,991
Emission Reductions in Project Scenario - electricity generation (tCO <sub>2</sub> e)	11,433	114,331

Project Emissions- electricity consumption (tCO <sub>2</sub> e)	140	1,396
Net Emission Reductions – electricity (tCO <sub>2</sub> e)	11,294	112,935
<b>Total Net Emission Reductions by the Project Activity (tCO<sub>2</sub>e)</b>	<b>162,593</b>	<b>1,625,926</b>

### Project emissions

Since the project generates electricity, there is a net export of electricity to the grid and the project emissions from its electricity use are deducted from the emission reductions from its electricity generation. Thus, the project emissions are zero. In cases when there is no electricity generated, like in the case of equipment maintenance, the project emissions will be accounted for and deducted from the total emission reductions of the project.

### Leakage emissions

No leakage needs to be accounted for by this methodology.

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

The emissions reductions of the project are calculated using the following equation:

$$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + EG_y * CEF_{electricity,y}$$

The estimated results are expressed in the following table. The actual emission reductions generated by this project will be measured directly after the project is operational.

Year	Baseline emissions (t CO <sub>2</sub> e)	Project emissions (t CO <sub>2</sub> e)	Leakage (t CO <sub>2</sub> e)	Emission reductions (t CO <sub>2</sub> e)
2006	169,711	8,493	-	161,218
2007	189,235	8,834	-	180,402
2008	195,285	9,136	-	186,149
2009	200,651	9,404	-	191,246
2010	205,410	9,642	-	195,767
2011	183,603	8,552	-	175,051
2012	164,262	7,585	-	156,677
2013	147,108	6,727	-	140,381
2014	131,894	5,966	-	125,927
2015	118,400	5,292	-	113,108
<b>Total</b>	<b>1,705,557</b>	<b>79,631</b>	<b>-</b>	<b>1,625,926</b>
<b>Total number of crediting years</b>	10			
<b>Annual average over the crediting period</b>	107,555.7	7,963.1	-	16,326

## B.7. Monitoring plan

### B.7.1. Data and parameters to be monitored

This section details the steps taken to monitor on a regular basis the GHG emissions reductions from the EcoMethane – Aguascalientes Landfill Gas to Energy Project. The main components covered within the monitoring plan (MP) are:

1. Parameters to be monitored, and how the data will be collected
2. The equipment to be used in order to carry out monitoring
3. Operational procedures and quality assurance responsibilities

The requirements of this MP are in line with the kind of information routinely collected by companies managing landfill gas collection and destruction systems, so internalising the procedures should be simple and straightforward. If necessary, the MP can be updated and adjusted to meet operational requirements, provided that a Designated Operational Entity approves such modifications during the process of verification.

Monitoring for EcoMethane – Aguascalientes Landfill Gas to Energy Project will begin with the start of operation in May 2006. The monitoring plan details the actions necessary to record all the variables and factors required by the methodology ACM0001, as detailed in section D of the PDD. All data will be archived electronically, and data will be kept for the full crediting period, plus two years.

Operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity.

An electronic data recording unit (data logger) automatically records periodic and simultaneous readings from the flow meter, methane analyzer and thermocouple. The data recording unit periodically transmits the recorded data to a central server. The monitoring data can be downloaded at anytime by connecting to the server through the Internet. The calculation of emission reductions is made using the downloaded monitoring data from the server in a spreadsheet. The spreadsheet is used to process the raw data in order to obtain the amount of Emission Reductions to be claimed.

**Permanent deviation of the monitoring plan:**

According to the originally registered PDD, the data recording unit periodically transmits the recorded data to a central server.

From March 2013, due to financial constraints, Biogas Technology didn't renew contract with their hosting provider of CDM data and technical support for the SCADA system making unable to automatically transmit the recorded data to a central server.

However, the biogas extraction and flaring/utilisation systems continue to operate and the Netrix box (data recording unit) continues to collect the complete data.

From March 2013, month in which the lack of continuous transmission began, the alternative established as permanent change is to *in-situ* download the collected data from the Netrix box in a CSV file and upload it to a central server owned by Biogas Technology, i.e. Biogas share point. Furthermore, the file is emailed to Keith Wake, Senior Technical Engineer in Biogas Technology Ltd and he extracts the data and feeds it into the in-house workbooks. To that extent, the data going into the workbooks is the same as it would have been if it was still hosted by the previous provider.

Due to the above, the PP decided the most conservative approach, which is to apply zero for baseline GHG emissions during the lack of data periods identified as an alternative monitoring to ensure that ERs will not be overestimated (P.S. v.3.0, par.231 (b) (i)). Thus, for the lack of data periods identified, when the SCADA synchronization failed, the emissions reductions have been accounted as zero.

This situation does not affect in any way the monitoring of the parameters or has no material impact on the applicability of the applied methodology or used tools, since every parameter and formula are still obtained and followed as stated in the PDD.

Operational procedures and responsibilities for monitoring and quality assurance of emissions reductions from the project activity

Task	Responsible
Collect data	Carbon Credit Data Controller BioGas
Enter data into Spreadsheet	Carbon Credit Data Controller BioGas
Make monthly reports	Carbon Credit Data Controller BioGas
Make annually reports	CDM Project Manager EcoSecurities
Archive data & reports	BioGas-EcoSecurities
Calibration/Maintenance, rectify faults	Site Operator and Regional Manager BioGas

(Monitoring Plan revised by Jaime Ramos [jaime.ramos@ecosecurities.com](mailto:jaime.ramos@ecosecurities.com) and Edouard Perroy [edouard.perroy@ecosecurities.com](mailto:edouard.perroy@ecosecurities.com))

<b>Data/Parameter</b>	<b>LFG<sub>total,y</sub></b>
Data unit	Nm <sup>3</sup>
Description	Total amount of landfill gas captured
Source of data	Flow meter
Value(s) applied	To be determined in Monitoring Report
Measurement methods and procedures	Measured by LFG Thermal Flow Meter
Monitoring frequency	Continuously. The unit will measure the flow of LFG continuously and reports will be presented and aggregated monthly and yearly.
QA/QC procedures	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy. Equipment will be calibrated following manufacturer's recommendations. In case of failure, if repair is not possible, equipment will be replaced by equivalent item.
Purpose of data	Calculation of baseline and projects emissions
Additional comment	No additional comments

<b>Data/Parameter</b>	<b>LFG<sub>flared,y</sub></b>
Data unit	Nm <sup>3</sup>
Description	Amount of landfill gas flared
Source of data	Flow meter
Value(s) applied	To be determined in Monitoring Report
Measurement methods and procedures	Measured by LFG Thermal Flow Meter
Monitoring frequency	Continuously. The unit will measure the flow of LFG continuously and reports will be presented and aggregated monthly and yearly.

QA/QC procedures	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy. Equipment will be calibrated following manufacturer's recommendations. In case of failure, if repair is not possible, equipment will be replaced by equivalent item.
Purpose of data	Calculation of baseline and projects emissions
Additional comment	No additional comments

<b>Data/Parameter</b>	<b>LFG<sub>electricity,y</sub></b>
Data unit	Nm <sup>3</sup>
Description	Amount of landfill gas combusted in power plant
Source of data	Flow meter
Value(s) applied	To be determined in Monitoring Report
Measurement methods and procedures	Measured by LFG Thermal Flow Meter
Monitoring frequency	Continuously. The unit will measure the flow of LFG continuously and reports will be presented and aggregated monthly and yearly.
QA/QC procedures	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy. Equipment will be calibrated following manufacturer's recommendations. In case of failure, if repair is not possible, equipment will be replaced by equivalent item.
Purpose of data	Calculation of baseline and projects emissions
Additional comment	No additional comments

<b>Data/Parameter</b>	<b>FE</b>
Data unit	%
Description	Flare/combustion efficiency
Source of data	Determined by the operation hours (1) and the methane content in the exhaust gas (2)
Value(s) applied	98% as annual average has been used for ex-ante estimation. Monitored values will be provided in Monitoring Report.
Measurement methods and procedures	1.Thermocouple 2.Flare emission test Measured or calculated by the operation hours (1) and the methane content in the exhaust gas (2)
Monitoring frequency	1.Continuous measurement of operation time of flare with temperature of combustion of the flare. 2. Quarterly, monthly if unstable. Periodic measurement of methane content of flare exhaust gas, which will provide a measure of the flare's efficiency.
QA/QC procedures	Equipment will be exchange or calibrated annually by qualified personnel Regular maintenance will ensure optimal operation of flares. Flare efficiency should be checked quarterly, with monthly checks if the efficiency shows significant deviations from previous values. In case of failure, equipment will be replaced.
Purpose of data	Calculation of baseline and projects emissions
Additional comment	No additional comments

<b>Data/Parameter</b>	<b>W<sub>CH<sub>4</sub>,y</sub></b>
Data unit	m <sup>3</sup> CH <sub>4</sub> / m <sup>3</sup> LFG
Description	Methane fraction in the LFG

Source of data	1. Fixed Gas Analyzer 2. Manual Gas Analyzer
Value(s) applied	51% has been used for ex -ante estimations. Monitored values will be provided in Monitoring report.
Measurement methods and procedures	Measured by Fixed Gas Analyzer
Monitoring frequency	1.- Measured by continuous gas analyser. 2.- Periodically. In case of failure of continuous measuring/recording, periodic measurement may be performed as per Guidelines to calculate the fraction of methane in the LFG from periodical measurements, ver01, EB48, Annex13 <sup>5</sup>
QA/QC procedures	The gas analyser should be subject to a regular maintenance and testing regime to ensure accuracy. In case of failure, if repair is not possible, equipment will be replaced by equivalent item. Equipment will be calibrated in accordance to manufacturer's recommendations by qualified personnel. Default value in case of failure will be determined in accordance to Guidelines to calculate the fraction of methane in the LFG from periodical measurements, ver01, EB48, Annex13 using a Manual gas analyzer duly calibrated as per manufacturer specification.
Purpose of data	Calculation of baseline and projects emissions
Additional comment	No additional comments

<b>Data/Parameter</b>	<b>T<sub>comb</sub></b>
Data unit	°C
Description	Temperature of combustion
Source of data	Thermocouple
Value(s) applied	To be determined during monitoring.
Measurement methods and procedures	Measured by Thermocouple. The temperature of the flare, critical to ensuring complete combustion of the methane, will be measured by thermocouple installed in the flare stack.
Monitoring frequency	Temperature of combustion will be measured continuously and data will be aggregated monthly and yearly.
QA/QC procedures	Equipment will be exchange or calibrated annually by qualified personnel. In case of failure, equipment will be replaced.
Purpose of data	Calculation of Emission Reductions
Additional comment	No additional comments

<b>Data/Parameter</b>	<b>T</b>
Data unit	°C
Description	Temperature of the landfill gas
Source of data	Not applicable
Value(s) applied	Not applicable
Measurement methods and procedures	According to clarification AM-CLA-023, "No separate monitoring of temperature is necessary since the projectuses flow meter(s) that automatically expresses LFG volumes in normalised cubic meters" <sup>6</sup> ,
Monitoring frequency	Continuously
QA/QC procedures	Not applicable
Purpose of data	Not applicable

<sup>5</sup> [http://cdm.unfccc.int/EB/048/eb48\\_repan13.pdf](http://cdm.unfccc.int/EB/048/eb48_repan13.pdf)

<sup>6</sup> [http://cdm.unfccc.int/filestorage/AM\\_CLAR\\_XURFEX9N1DBCDWH8IFJ47F4GGRLNZD/Clarifications%20to%20ACM0001%20ver.%202?t=TnN8MT15OTY5ODAxMy4xNg==f3Xk5IXVqez8v4EQE09QhCOtG48=](http://cdm.unfccc.int/filestorage/AM_CLAR_XURFEX9N1DBCDWH8IFJ47F4GGRLNZD/Clarifications%20to%20ACM0001%20ver.%202?t=TnN8MT15OTY5ODAxMy4xNg==f3Xk5IXVqez8v4EQE09QhCOtG48=)



Additional comment	No additional comments
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<b>Data/Parameter</b>	<b>P</b>
Data unit	Pa
Description	Pressure of the landfill gas
Source of data	Not applicable
Value(s) applied	Not applicable
Measurement methods and procedures	"No separate monitoring of pressure is necessary since the project uses flow meter(s) that automatically expresses LFG volumes in normalised cubic meters", according to AM-CLA-23 <sup>7</sup> .
Monitoring frequency	Continuously
QA/QC procedures	Not applicable
Purpose of data	Not applicable
Additional comment	No additional comments

<b>Data/Parameter</b>	<b>EC<sub>IMP</sub></b>
Data unit	MWh
Description	Total amount of electricity imported to meet project requirements
Source of data	Electricity meter
Value(s) applied	To be determined in monitoring report
Measurement methods and procedures	The amount of electricity imported will be released in an invoice by the grid company on a monthly basis. If the project is generating electricity, project developer can choose to measure ECIMP by either a separate energy meter or by a single bi-directional meter, as is indicated on clarification SSC_371. <sup>8</sup>
Monitoring frequency	Continuously. Monthly recorded. Required to determine CO <sub>2</sub> emissions from use of electricity or other energy carriers to operate the project activity.
QA/QC procedures	Equipment will be calibrated at a frequency of at least every 3 years. In case of failure, Failure is reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item. In case of lack of calibration, that would lead to inaccurate ECIMP data, a penalty equals to the maximum permissible error from manufacturer's specification will be deducted from actual readings.
Purpose of data	Calculation of project emissions
Additional comment	No additional comments

<b>Data/Parameter</b>	<b>EG<sub>EXP</sub></b>
Data unit	MWh
Description	Quantity of electricity exported during year y, produced using landfill gas, in megawatt hours
Source of data	Electricity meter

7

[http://cdm.unfccc.int/filestorage/AM\\_CLAR\\_XURFEX9N1DBCWDWH8IFJ47F4GGRLNZD/Clarifications%20to%20ACM0001%20ver.%202?t=TnN8MTI5O TY50DAxMy4xNg==|f3Xk5IXVqez8v4EQE09QhCotG48=](http://cdm.unfccc.int/filestorage/AM_CLAR_XURFEX9N1DBCWDWH8IFJ47F4GGRLNZD/Clarifications%20to%20ACM0001%20ver.%202?t=TnN8MTI5O TY50DAxMy4xNg==|f3Xk5IXVqez8v4EQE09QhCotG48=)

8

<http://cdm.unfccc.int/filestorage/0N7L59WTHK82DOUQABY3RCIZ4VGJP6/Final%20response.pdf?t=SEt8MTI5OTY50DMyOS44NA==|1QP3-3GLSQWdHqVuR1BMyEIDwRA=>

Value(s) applied	To be determined in monitoring report
Measurement methods and procedures	Project developer can choose to measure EG <sub>EXP</sub> by either a separate energy meter or by a single bi-directional meter, as is indicated on clarification SSC_371. <sup>9</sup> Checked with receipts of sales.
Monitoring frequency	Continuously. Monthly recorded. Required to estimate the emission reductions from electricity generation from LFG, if credits are claimed.
QA/QC procedures	Equipment will be calibrated at a frequency of at least every 3 years. In case of failure, Failure is reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item. In case of lack of calibration, that would lead to inaccurate EG <sub>EXP</sub> data, a penalty equals to the maximum permissible error from manufacturer's specification will be deducted from actual readings.
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

<b>Data/Parameter</b>	<b>EG<sub>y</sub></b>
Data unit	MWh
Description	Net quantity of electricity displaced during the year "y" (MWh)
Source of data	Electricity meter
Value(s) applied	To be determined in monitoring report
Measurement methods and procedures	Project developer can choose to monitor EG <sub>y</sub> by either a two separate electricity meters or by a single bi-directional meter, as is indicated on clarification SSC_371. <sup>10</sup> . In case when this parameter is calculated, the next formulae applies:  Total electricity used for the project will be deducted from the amount of electricity produced by the project, thus emissions reductions will only be claimed for the net electricity supplied to the grid. Net electricity generated by the project is therefore estimated using the following formula:  EG <sub>y</sub> <sup>11</sup> = EG <sub>EXP</sub> - EC <sub>IMP</sub>  Where:  EG <sub>EXP</sub> : quantity of electricity exported during year y, produced using landfill gas, in megawatt hours (MWh). EC <sub>IMP</sub> : electricity imported, defined as project electricity imports to meet the project requirements, in MWh
Monitoring frequency	Continuously. Monthly recorded.
QA/QC procedures	Equipment will be calibrated at a frequency of at least every 3 years. In case of failure, Failure is reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item. In case of lack of calibration, that would lead to inaccurate EC <sub>IMP</sub> data, a penalty equals to the maximum permissible error from manufacturer's specification will be deducted from actual readings.
Purpose of data	Calculation of baseline emissions

<sup>9</sup> <http://cdm.unfccc.int/filestorage/0N7L59WTHK82DOUQABY3RCIZ4VGJP6/Final%20response.pdf?t=SEt8MTI5OTY5ODMyOS44NA==|1QP3-3GLSQWdHqVuR1BMyEIDwRA=>

<sup>10</sup> <http://cdm.unfccc.int/filestorage/0N7L59WTHK82DOUQABY3RCIZ4VGJP6/Final%20response.pdf?t=SEt8MTI5OTY5ODMyOS44NA==|1QP3-3GLSQWdHqVuR1BMyEIDwRA=>

<sup>11</sup> This parameter can be calculated as per formula or measured, following the recommendations given by the clarification SSC\_371:

<http://cdm.unfccc.int/filestorage/0N7L59WTHK82DOUQABY3RCIZ4VGJP6/Final%20response.pdf?t=SEt8MTI5OTY5ODMyOS44NA==|1QP3-3GLSQWdHqVuR1BMyEIDwRA=>

Additional comment	No additional comments
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Data/Parameter	Regulatory requirements
Data unit	Test
Description	Regulatory requirements relating to LFG projects
Source of data	Project developer
Value(s) applied	Adjustment factor (AF) established: 5%
Measurement methods and procedures	N/A
Monitoring frequency	Annually
QA/QC procedures	Required for any changes to the adjustment factor (AF) or directly $MD_{reg,y}$
Purpose of data	Calculation of Emission Reductions
Additional comment	No additional comments

### B.7.2. Sampling plan

No sampling plan has been performed in the project activity.

### B.7.3. Other elements of monitoring plan

No other elements have been applied in the monitoring plan.

**SECTION C. Start date, crediting period type and duration**

**C.1. Start date of project activity**

01/06/2006

**C.2. Expected operational lifetime of project activity**

More than 20 years.

**C.3. Crediting period of project activity**

**C.3.1. Type of crediting period**

Fixed crediting period.

**C.3.2. Start date of crediting period**

01/07/2006.

**C.3.3. Duration of crediting period**

10 (ten) years

## SECTION D. Environmental impacts

### D.1. Analysis of environmental impacts

The project will collect and combust LFG, thereby improving overall landfill management and reducing adverse global and local environmental effects of uncontrolled releases of landfill gas. While the main global environmental concern over gaseous emissions of methane is the fact that it is a potent greenhouse gas and thus contributes importantly to global warming, emissions of LFG can also have significant health and safety implications at the local level. For example:

- Although the majority of LFG emissions are quickly diluted in the atmosphere, in confined spaces there is a risk of explosion and/or fire, either within the landfill or outside its boundaries.
- Another potential threat of concentrated emissions of LFG is asphyxiation and/or toxic effects in humans
- Landfill gas also contains over 150 trace components that can cause other local and global environmental effects such as odour nuisances, stratospheric ozone layer depletion, and ground-level ozone creation.

Indeed, there is evidence that LFG has migrated from the Cumbres landfill as, in the past, minor explosions have taken place in the nearby sewer network and the adjoining primary school has had to be shut down on occasion due to the excessive presence of LFG. The installation of a well-designed landfill gas collection and destruction/utilisation system, and its proper operation, will therefore reduce the risks faced by the surrounding communities.

Flaring LFG and/or using it in electricity generators can also produce nitrogen oxide emissions that vary widely from one site to another, depending on the type of flare/generator and the extent to which steps have been taken to minimise such emissions. Combustion of LFG can also result in the release of organic compounds and trace amounts of toxic materials, including mercury and dioxins, although such releases are at levels significantly lower than with continued uncontrolled release of landfill gas. However, it is worth noting that the Developer's flares and electricity generation units comply with stringent UK emission standards, thereby minimising the environmental impact from this particular source and suggesting that these emissions are significantly less harmful than the continued uncontrolled release of LFG. The Project will significantly reduce odour and greenhouse gas emissions.

The installation of the LFG collection and combustion systems is part of a broader effort by the Municipal Government to continue to improve its waste management practices. Overall, sustainable management of the landfills will result in accelerating waste stabilisation such that the full decomposition of the waste in the landfills will be largely complete within 30- 50 years.

### D.2. Environmental impact assessment

For the LFG flaring component of the project activity, no Environmental Impact Assessment is required by the Federal Government of the host country. However, a preventive report has been completed in accordance with the State regulations where the project is located to identify potential negative impacts of the project on the environment, local communities and economy, and develop mitigation measures. The outcome of this report was favourable, and the project was found to have no significant negative impacts, and many positive impacts as indicated above.

For the LFG utilisation component, only projects with an installed electricity generating capacity greater than 3 MW require an EIA. In this case, the electricity generation estimated at the San

Nicolas landfill is expected to range between 2 and 4 MW. However, the initial installed capacity will be 2 MW and will increase periodically, according to the LFG gas generation curve. If in any case the installed capacity exceeds 3 MW, an EIA will be carried over beforehand in order to comply with all the applicable regulations at a State and Federal level in the host country.

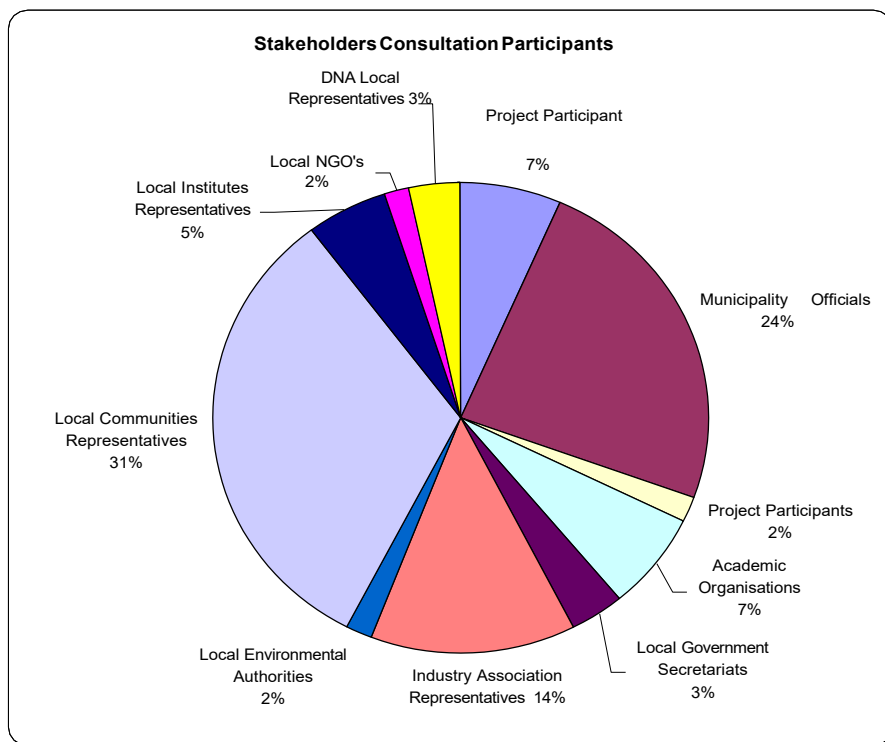
A copy of the preventive report will be provided to the Operational Entity validating the Project.

**SECTION E. Local stakeholder consultation**

**E.1. Modalities for local stakeholder consultation**

The stakeholder consultation took place on 12 January 2006 at the Aguascalientes offices of the Mexican Chamber of the Construction Industry (CMIC). The event allowed stakeholders to understand the basic concepts related to climate change, its consequences and the aims of the Kyoto Protocol, as well as the most important features of the Aguascalientes – EcoMethane Landfill Gas to Energy Project undertaken by Biogas Technology.

The event was properly announced in the main local newspaper “Hidrocálido” on January 8th until January 11th and it was well attended. Specifically, 59 people from local authorities, labour unions, academia, local media, and members of the community participated in the event which lasted approximately 70 minutes. The graph below illustrates the affiliation of the participants at the stakeholder consultation. As the graph shows, almost a third of the participants represented local communities. All participants were registered with appropriate formats kept in the Project Developer’s files.



The pictures below show participants at the stakeholder consultation where presentations included the following topics: climate change; how this project is mitigating climate change through the Clean Development Mechanism of the Kyoto Protocol; the technical details of the project; and a session aimed at addressing questions posed by the stakeholders.



## E.2. Summary of comments received

To date no formal comments have been received from stakeholders. However, during the public consultation stakeholders raised various questions regarding the project, and the Project Developer and representatives of the Municipality provided comments, as follows:



1. During waste decomposition in the landfills, leachate is generated, polluting the soil and underground water in the absence of a bottom liner. Citizens of the community wanted to know what is being done to manage such leachate in both landfills, especially at “Las Cumbres” landfill where the bottom liner is not covering the whole site.
  - The landfills’ manager and the Project Developer explained how both landfills (Las Cumbres and San Nicolas) comply with all environmental regulations (NOM-083), which contemplate the use of a plastic membrane to manage leachate in a waste water treatment facility on site or recycle it onto the landfill. In the case of “Las Cumbres” landfill, the municipality explained that studies are being undertaken by the University of Leon to determine the risk of leachate filtration into the soils, and to establish strategies to mitigate pollution effects.
2. Members of the community proposed to use the biogas not only for power generation but also to promote fuel switching activities in local industries.
  - The Project Developer explained it is usually difficult to compete against natural gas used in industrial facilities, and that is why power generation is the most feasible strategy for utilising the biogas. Nevertheless, these alternatives could be explored in the future.
3. Members of the Technologic Institute were interested in knowing how the generation of biogas was estimated, which method was used, what will happen to the CO<sub>2</sub> subproduct of the project, and how the risk of explosions will be managed in the project.
  - The Project Developer explained that the US EPA model was used, involving around 40 variables including amount and type of waste, climate conditions at the site, structure of the site, among others. Regarding the project, the objective is to reduce between 50 to 70% the amount of methane that is vented to the atmosphere – given the cover on the site, this represents the Project Developer’s best estimate of the amount LFG that can realistically be captured, otherwise called the “collection efficiency”. The Project Developer explained that the CO<sub>2</sub> from methane combustion will go to the atmosphere but causing 21 times less harm than the methane otherwise would have caused. The methane will not be stored; it will just be extracted and combusted, and thus the risk of explosion is minimum.
4. Representatives of COPARMEX (Labour and social representation of Mexican entrepreneurs) asked to know the electricity component of the project as an estimate of Aguascalientes Municipality’s demand.
  - The Project Developer explained that the project will have an electricity component with maximum installed capacity reaching 4 MW and Aguascalientes Municipality has a demand of 12 MW.
5. Members of the community Cañada Honda, next to the San Nicolás Landfill, wanted to know if with this project the smell of the waste, specially perceived during summer, will decrease.
  - The Project Developer and the operator of the landfill explained that the smell is part of the operations due to the waste that is being brought daily. However, if 50-70% of the biogas is captured, then the smell of this biogas will be reduced in the same proportion.

6. Some stakeholders were interested in reviewing the document of the project to have a better understanding of the project and their involvement of it.
  - The Project Developer and EcoSecurities explained that this project will be published on the internet. The link will be sent by email to the stakeholders when the project is open for comments.
7. Members of academia asked about the timeline of the project and the personnel required for its operation.
  - The Project Developer explained that the equipment has a life of, at least, 20 years and that there will be 4 people operating the project.

Members of the community expressed their satisfaction with the Clean Development Mechanism as a tool for reducing pollution at a local level. Also, members of academia were interested in using this project as an example for Environmental Education for the community.

Stakeholders, including community, academia, industry, local NGO's and local environmental authorities congratulated the Municipality and the Project Developer for this project implementation and the public consultation, which helped to inform the community about its operations.

### **E.3. Consideration of comments received**

As indicated in Section E.2 above, there have been no formal comments submitted by any of the stakeholders regarding this project. Many of them had questions about specific parts of the project and/or the future management of the landfills, and those were addressed at the meeting (as evidenced by the bullet point responses). Overall, the stakeholder consultation was a very positive event with stakeholders congratulating the Municipality and the Project Developer for undertaking the project.

**SECTION F. Approval and authorization**

The letter of approval (Number 25/2006) from the Intersecretarial Commission of Climate Change (ICCC) (Designated National Authority) was issued on 08/03/2006.

This letter authorizes the participation of the "Biogas Technology SA de CV, Biogas Technology Ltd. And EcoSecurities Ltd as Project Participants in the Project. The ICCC issues this Letter of Approval exclusively for the purposes outlined in Article 12 of Kyoto Protocol, as a requirement prior to the validation of the project by the Designated Operational Entity, and for its registration before the Executive Board of the CDM and the subsequent issuance and commercialization of Certified Emissions Reductions by the Project Participants.

## Appendix 1. Contact information of project participants

<b>Organization name</b>	Biogas Technology Ltd.
<b>Country</b>	Cambridgeshire, Sawtry, United Kingdom
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<b>Website</b>	<a href="http://www.biogas.co.uk">www.biogas.co.uk</a>
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## Appendix 2. Affirmation regarding public funding

This project will not receive any public funding.

### Appendix 3. Applicability of methodologies and standardized baselines

Not applicable.

<b>LANDFILL CALCULATION PARAMETERS</b>			
Parameter	Units	Cumbres Landfill	San Nicolas Landfill
<b>Landfill data</b>			
Year landfill started operation		1990	1999
Waste in place at the beginning of project	Tonnes	1,627,00	1,400,000
Density of waste	tonne/m <sup>3</sup>	1.0	0.7
Area of site	Ha	7.0	16.0
Average daily waste rate	Tonnes/day	Closed	850
Date gas collection project starts		01-June-06	01-June-06
<b>Operational data</b>			
Gas collection efficiency	%	50%	70%
Flare efficiency	%	98%	98%
<b>General data</b>			
Lo	m <sup>3</sup> /tonne	160	160
k	1/yr	0.12	0.12
Methane content of landfill gas	%	51%	51%
CH <sub>4</sub> GWP	T CO <sub>2</sub> /T CH <sub>4</sub>	21	21
Density of Methane	Tonne/CH <sub>4</sub> /m <sup>3</sup>	0.0007168	0.0007168
<b>Baseline data</b>			
Proportion of methane flared in Baseline (AF)		5%	5%

Input data for the Electricity Generation component of the Project Activity:

Input data	
<b>PROJECT DATA</b>	
Date project starts operating (year)	<b>2007</b>
Installed capacity (MW)	<b>2.99</b>
Estimated on-line availability of equipment (%)	<b>91%</b>
Operating period (h/yr)	<b>8,000</b>
<b>BASELINE DATA</b>	
Country	<b>Mexico</b>
CEF country (t CO <sub>2</sub> e/MWh)	<b>0.531</b>
Crediting period (years)	<b>10</b>

<b>FINANCIAL PARAMETERS</b>	
Electricity tariff (US cents/KWh)	<b>7.00</b>
Rate of increase of tariff (%/yr)	<b>1.5%</b>
Income tax	<b>32.0%</b>
Discount rate	<b>12.0%</b>
Depreciation	<b>10.0%</b>
Price of carbon (US\$/tCO <sub>2</sub> )	<b>7.00</b>

Table: US EPA decay model used to estimate emission reductions:

<b>US EPA exponential decay model</b>	<b><math>LFG=2LoR((e^{-(kc)})-(e^{-(kt)}))</math></b>
	t = time since landfill opened (years)
	c = time since landfill closure (years)
<b>US EPA</b>	<b><math>LFG=2LoR((e^{-(kc)})-(e^{-(kt)}))</math></b>
Lo (cf/lb) =	(mid value chosen from US EPA Landfill Gas to Energy Handbook for 'wet climate')
R=	t/day
k (1/year)=	(mid value chosen from US EPA Landfill Gas to Energy Handbook for 'wet climate')
t =	time since landfill opened (years)
c =	time since landfill closure (years)

Table: Emission reductions for each landfill site in the project scenario (LFG flaring):

<b>Average</b>	<b>Cumbres</b>	<b>San Nicolas</b>	<b>TOTAL per year</b>	<b>Total 10 years</b>
LFG <sub>flare</sub> (m <sup>3</sup> LFG)	2,268,487	18,754,124	<b>21,022,611</b>	<b>210,226,108</b>
CH <sub>4</sub> Concentration (%)	51%	51%	51%	51%
Density of CH <sub>4</sub> (t CH <sub>4</sub> /m <sup>3</sup> CH <sub>4</sub> )	0.0007168	0.0007168	0.0007168	0.0007168
Flare Efficiency (%)	98%	98%	98%	98%
<b>MD<sub>project</sub> = MD<sub>flared</sub> (tCH<sub>4</sub>)</b>	818	6,766	<b>7,584</b>	<b>75,839</b>
<b>MD<sub>project</sub> = MD<sub>flared</sub> (tCO<sub>2</sub>e)</b>	17,186	142,077	<b>159,262</b>	<b>1,592,622</b>

Table: Emission reductions for each landfill site in the baseline scenario:

	<b>Cumbres</b>	<b>San Nicolas</b>	<b>TOTAL per year</b>	<b>Total 10 years</b>
<b>MD<sub>project</sub> (tCH<sub>4</sub>)</b>	818	6,766	7,584	75,839
AF (%)	5%	5%	5%	5%
<b>MD<sub>reg</sub> (tCH<sub>4</sub>)</b>	41	338	379	3,792
<b>MD<sub>reg</sub> (tCO<sub>2</sub>e)</b>	859	7,104	7,963	79,631

Table: Breakdown of project emissions due to electricity consumption:

	<b>Cumbres Landfill</b>	<b>San Nicolas Landfill</b>	<b>TOTAL per year</b>	<b>Total</b>
EC (MWh)	88	175	263	2,628
CEF (tCO <sub>2</sub> /MWh)	0.531	0.531	0.531	0.531
<b>Project emissions from electricity consumption (tCO<sub>2</sub>e)</b>	47	93	140	1,396

Table: Emission reductions from LFG electricity generation:

Emission reductions	1	2	3	4	5	6	7	8	9	10
Calendar year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015

**Estimated Power Generation**

Installed capacity (MW)	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99
Estimated On-line availability of Equipment (%)	91%									
Number of operating hours per year/MW	8,000									
Operating capacity (MWh/year)	0	23,920	23,920	23,920	23,920	23,920	23,920	23,920	23,920	23,920
Project Electricity consumption (MWh/year)	262.8	263	263	263	263	263	263	263	263	263
<b>Annual Net Power Output: MW/yr</b>	<b>0</b>	<b>23,657</b>	<b>23,657</b>	<b>23,657</b>	<b>23,657</b>	<b>23,657</b>	<b>23,657</b>	<b>23,657</b>	<b>23,657</b>	<b>23,657</b>

**Baseline emissions**

CEF (tCO <sub>2</sub> /MWh)	0.531	0.531	0.531	0.531	0.531	0.531	0.531	0.531	0.531	0.531
<b>Baseline emissions (tCO<sub>2</sub>/year)</b>	<b>-</b>	<b>12,564</b>	<b>12,564</b>	<b>12,564</b>	<b>12,564</b>	<b>12,564</b>	<b>12,564</b>	<b>12,564</b>	<b>12,564</b>	<b>12,564</b>
Cummulative baseline emissions (tCO <sub>2</sub> )	-	12,564	25,128	37,692	50,255	62,819	75,383	87,947	100,511	113,075

**Project emissions**

CEF (tCO <sub>2</sub> /MWh)	0.531	0.531	0.531	0.531	0.531	0.531	0.531	0.531	0.531	0.531
<b>Project Emissions (tCO<sub>2</sub>/year)</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
Cummulative project emissions (tCO <sub>2</sub> )	-	-	-	-	-	-	-	-	-	-

**Emission reductions**

Crediting period (yrs)	10									
Emission reductions due to combustion of methane San Nicolas	134,939	144,406	152,803	160,251	166,856	147,988	131,254	116,412	103,248	91,573
Emission reductions due to electricity generation	-	12,564	12,564	12,564	12,564	12,564	12,564	12,564	12,564	12,564
<b>Net Emission Reductions (tCO<sub>2</sub>/yr)</b>	<b>134,939</b>	<b>156,970</b>	<b>165,367</b>	<b>172,815</b>	<b>179,420</b>	<b>160,552</b>	<b>143,817</b>	<b>128,975</b>	<b>115,812</b>	<b>104,136</b>
Cummulative (tCO <sub>2</sub> )	134,939	291,909	457,276	630,091	809,511	970,063	1,113,880	1,242,855	1,358,667	1,462,803



**Carbon Emission factors of the Mexican Electricity Grid**

<b>Operating Margin of the Mexican Electricity Grid</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>
Electricity Generation (GWh)	139,159	143,131	157,433
CO <sub>2</sub> Emissions (tonnes)	95,328,117	97,705,797	95,802,514
Operating Margin	0.685	0.683	0.609

<b>Build Margin of the Mexican Electricity Grid</b>			<b>2004</b>
Electricity Generation (GWh)			42,212
CO <sub>2</sub> Emissions (tonnes)			17,030,008
Operating Margin			0.403

<b>Carbon Emission Factor</b>	tCO <sub>2</sub> /MWh
Average Operating Margin 2002-2004	0.659
Average Build Margin 2004	0.403
Carbon Emission Factor	0.531

**Carbon Emission Factors used to calculate the Build Margin**

	Efficiency *	CEF (TCO <sub>2</sub> /MWh)
Combined cycle gas turbine powerplants (CCGT)	50%	<b>0.402</b>
Open cycle gas turbine powerplants (OCGT)	32%	<b>0.628</b>

**Calculations**

	Generation	Efficiency	Energy Consumption		Fuel Consumption	CO <sub>2</sub> emissions
	GWh	%	GWh	TJ	tonnes	T CO <sub>2</sub>
CCGT	1.0	50%	2.00	7.20	137.67	<b>401.90</b>
OCGT	1.0	32%	3.13	11.25	215.11	<b>627.97</b>

**Conversion Factors**

Fuel	Energy	CEF	CO <sub>2</sub> emissions	Net calorific value	Carbon oxidation
Unit	TJ/GWh	tC/TJ	tCO <sub>2</sub> /tfuel	TJ/t fuel	%
Natural gas (dry)	3.6	15.30	2.9194	0.0523	99.50

Source: 1996 IPCC Guidelines for national greenhouse gas inventories



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

Not applicable

## **Appendix 5. Further background information on monitoring plan**

Not applicable

## **Appendix 6. Summary report of comments received from local stakeholders**

Not applicable.

## **Appendix 7. Summary of post-registration changes**

Since the original PDD was performed in an old version of the PDD form (Version 02), some additional information has been provided without track changes to fill the new sections and content to be included in the current PDD form used in this PRC PDD (version 12.0).

The revised monitoring plan, dated 07/03/2011 has the following revisions (obtained from the PRC validation report issued by ERM Certification and Verification Services<sup>12</sup>):

1. Only Option 2 is used (section D.2.2) of the PDD rather than both Option 1 (section D.2.1) for the electricity component of the project and Option 2 for the LFG component, due to the understanding that it would be more appropriate to this project activity. As a result, equations used to calculate baseline/project/leakage emissions and emission reductions, were moved from section D.2.2.2 of the original monitoring plan to section D.2.4. Additionally, table D.2.2.1 of the original monitoring plan was removed and all of its content was incorporated in table 4.a, in Annex 4 of the revised monitoring plan, avoiding the repetition of the information that was present in the original monitoring plan. The information related to “proportion of data monitored” and “data archiving” was removed from the table and just mentioned in the 3rd paragraph of Annex 4, in page 14 of the revised monitoring report, stating that “all data will be archived electronically, and data will be kept for the full crediting period, plus two years”.
2. A separate formula was originally included to calculate project emissions ( $PE_y = E_{Gy} * CEF_{electricity,y}$ ), proposed in the original monitoring plan (“project emissions in tCO<sub>2</sub>e during a given year ‘y’ (PE<sub>y</sub>) are equal to the net amount of electricity used by the project in any given year in MWh (E<sub>Cy</sub>), multiplied by a carbon emissions factor (CEF electricity y) for the grid from which electricity is taken (tCO<sub>2</sub>e/MWh”). However, ACM0001 v2 states that: “Possible CO<sub>2</sub> emissions resulting from combustion of other fuels than the methane recovered should be accounted as project emissions. Such emissions may include fuel combustion due to pumping and collection of landfill gas or fuel combustion for transport of generated heat to the consumer locations. In addition, electricity required for the operation of the project activity, including transport of heat, should be accounted and monitored.

<sup>12</sup>

<https://cdm.unfccc.int/filestorage/N/3/X/N3XDWLA1F0V9ECZYI5R4BJGOKMSH28/Aguascalientes%20%20Revised%20Monitoring%20Plan%20Validation%20Opinion%20.pdf?t=S2F8cTh3Ymo2fDCI-46nExABiFMMrXck43wW>

Where the project activity involves electricity generation, only the net quantity of electricity fed into the grid should be used in equation (1) above to account for emission reductions due to displacement of electricity in other power plants. Where the project activity does not involve electricity generation, project participants should account for CO<sub>2</sub> emissions by multiplying the quantity of electricity required with the CO<sub>2</sub> emissions intensity of the electricity displaced (CEFelectricity,y).”

Since the project activity plans to generate electricity from the LFG, the proposed equation was not appropriate to this project activity. Project emissions associated with imported electricity to operate the project activity are considered in equation (9) in the revised monitoring plan:

$$EGy^{13} = EGEXP - ECIMP (9)$$

Therefore, the separate equation to calculate PE<sub>y</sub> was removed in the revised monitoring plan. This has no impact on the accuracy or completeness of reported project emissions associated with imported electricity and is in compliance with the methodologies ACM0001 and AMS-I.D.

3. The amount of electricity exported to the grid, in the proposed equation to calculate E<sub>Gy</sub>, had been represented by EGEX,LFG in the original monitoring plan. EGEX,LFG was corrected to EGEXP in the revised monitoring plan. This is merely a correction in nomenclature and it is the opinion of ERM CVS that the proposed revision to the monitoring plan is in accordance with the approved monitoring methodology applicable to the project activity and does not negatively impact the level of accuracy and completeness in the monitoring and verification process.
4. The actual monitoring activities consider the use of average values from periodic measurements of the fraction of methane in the LFG (wCH<sub>4</sub>,y). However, the considerations and equations related to the use of the “Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements” had not appropriately included in the original monitoring plan. Considerations and equations related to the use of the “Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements” are now included in section D.2.4 of the revised monitoring plan, which are in compliance with ACM0001 v02 (and not relevant to AMS-I.D v08).
5. Changes were introduced to correct issues identified with respect to the specifications contained in the original monitoring plan of the flow meters to monitor the Amounts of landfill gas (LFG): total (LFGTotal,y), flared (LFGFlared,y) and combusted in the power plant (LFGelectricity,y) in Table 4a.:

According to the original monitoring plan of the registered PDD, LFGTotal,y, LFGFlared,y and LFGelectricity,y would be measured by thermal mass flow meters, providing the data in kg; and it is stated in Table 4a in Annex 4 of the original monitoring plan, that “a thermal mass LFG flow meter will be used, and this unit will measure directly kilograms of total LFG collected – instead of a volumetric figure, so the calculation of temperature and pressure to determine the correct density will no longer be necessary. The unit will measure the flow of LFG continuously and reports will be presented daily, and aggregated monthly and yearly”. In reality, the flow meters that have been used to monitor LFGtotal,y, LFGflared,y and LFGelectricity,y in the project activity provide the flow data in Nm<sup>3</sup>. Therefore units for LFGTotal,y, LFGFlared,y and LFGelectricity,y in Table 4a of the revised monitoring plan were corrected to Nm<sup>3</sup> and the definitions for these parameters were adjusted in the comments section of Table 4a in Annex 4 of the revised monitoring plan which states: “The unit will measure the flow of LFG continuously and reports will be presented daily (working days), and aggregated monthly and yearly”.

Given that the flow meters actually used by the project activity express quantities of LFGTotal,y, LFGFlared,y and LFGelectricity,y in Nm<sup>3</sup> (i.e., flow is automatically corrected for temperature and pressure), both temperature (T) and pressure (p) of LFG have also

<sup>13</sup> This parameter can be calculated as per formula indicated or measured, following the recommendations given by the clarification SSC\_371:

<http://cdm.unfccc.int/methodologies/DB/Q3VOK1HPBFTLSP7ZXFMY8R8Y4BEVJX/view.html>

been revised in the revised monitoring plan (Table 4a) to comment that no separate monitoring of these parameters is necessary.

The revision of the monitoring plan reflects the actual monitoring activities in place during the fourth monitoring period, as confirmed by ERM CVS during the site visit and inspection of the new flow meters and their technical manual. The revision is confirmed to be in accordance with ACM0001 v2, and does not negatively impact the level of accuracy and completeness in the monitoring and verification process.

6. The following adjustments have been made to parameter Flare/combustion efficiency (FE) in Table 4a, in Annex 4 of the original monitoring plan:
  - a. The monitoring frequency and method, which, in the original monitoring plan, included only the statement “quarterly, monthly if unstable”, had the addition of “1. Continuously”, specifically with reference to the monitoring of operation hours of the flare;
  - b. “2. Flare emission test” was included in the monitoring equipment column, added to “1. Thermocouple”; and
  - c. The comment section was edited, from:
 

“The efficiency of the flare will be determined in two ways. First, the temperature of the flare will be used to determine operating hours of the flare. This variable is critical to ensuring complete combustion of the methane, will be continuously monitored and measured by a digital temperature sensor (and transmitter) installed in the flare stack. The unit will measure the temperature within the flare stack continuously and reports will be presented daily, and aggregated monthly and yearly. In addition, samples of the exhaust gas will be taken quarterly to measure the methane, which will provide a measure of the flare’s efficiency. The data can be monitored more frequently if there is an observed deviation from previous rating”;

to:

“1. Continuous measurement of operation time of flare with combustion temperature; 2. Periodic measurement of methane content of flare exhaust gas, which will provide a measure of the flare’s efficiency”.
7. The comment section/column for parameter Methane fraction in the LFG (wCH<sub>4</sub>,y) in Table 4a has been changed from “The methane fraction in the LFG will be measured with a fixed gas analyser though its infrared sensor” to “Measured by continuous gas analyzer”.
8. The parameter Temperature of the landfill gas to flare (temperature of combustion) (T) was changed to Temperature of combustion (Tcomb) in Table 4a of the revised monitoring plan, having its comment section changed from:
 

“The temperature of the flare, critical to ensuring complete combustion of the methane, will be measured by a digital temperature sensor (and transmitter) installed in the flare stack. The unit will measure the temperature within the flare stack continuously (twice per hour) and reports will be presented daily, and aggregated monthly and yearly”;

to:

“The temperature of the flare, critical to ensuring complete combustion of the methane, will be measured by thermocouple installed in the flare stack. Temperature of combustion will be measured continuously and data will be aggregated monthly and yearly”.
9. Parameter Temperature of the landfill gas (T) has been included Table 4a, in Annex 4 of the revised monitoring plan, which is in accordance with ACM0001 v2.
10. For both Temperature of the landfill gas (T) and Pressure of the landfill gas (p), it is explained in the Comment column that “No separate monitoring of temperature is necessary monitoring will be performed by using flow meter(s) that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters”. Previously, for Pressure of the landfill gas (p), the comment in the original monitoring plan was: “The pressure of the LFG delivered to the flare will be measured in the fixed gas analyser. However, the original intent of measuring the pressure was to be able to calculate the quantity (in kgs) of methane delivered to the flare by applying the correct density. Because the LFG flow meter will be measuring the quantity of LFG in kgs delivered to the flare, such a calculation will no longer be necessary, though pressure information will be used to verify the other readings”, which was not in line with the existing monitoring activities.

11. The following adjustments have been made to parameter Total amount of electricity imported to meet project requirements (ECIMP) in Table 4a, in Annex 4 of the original monitoring plan:
- Correction of the information in column 'Responsible Parties/ Individuals For Monitoring' was made, from "electronic" to "Project developer";
  - Correction of the information in column 'Monitoring Equipment' was made, from "During the crediting period and two years after" to "Electricity Meter";
  - Comment section has been changed from: "Required to determine CO2 emissions from use of electricity or other energy carriers to operate the project activity. Measured with an electricity meter only in periods when the project activity is not generating its own electricity. Otherwise, it will be monitored with ID 11. (EGy);  
to:  
"Required to determine CO2 emissions from use of electricity or other energy carriers to operate the project activity. The amount of electricity imported will be released in an invoice by the grid company on a monthly basis. If the project is generating electricity, project developer can choose to measure ECIMP by either a separate energy meter or by a single bi-directional meter, as is indicated on clarification SSC\_371".
  - 'Calibration procedures' was updated from "Equipment will be checked monthly by the Lead Engineer" in the original monitoring plan to "According to national regulations" in the revised monitoring plan.
12. The following adjustments have been made to parameter Total amount of electricity exported out of the project boundary (EGEXP) in Table 4a, in Annex 4 of the original monitoring plan:
- Description of the parameter in column 'Data Variable' was changed from "Total amount of electricity exported out of the project boundary" to "Electricity generated by the renewable technology", which is in line with AMS-I.D v8;
  - Correction of the information in column 'Monitoring Frequency and Method' was made, from "Hourly measured and monthly recording" to "Continuously";
  - Correction of the information in column 'Monitoring Equipment' was made, from "During the crediting period and two years after" to "Electricity Meter";
  - Comment has been changed from: "Required to estimate the emission reductions from electricity generation from LFG double checked with receipts of sales";  
to:  
"Required to estimate the emission reductions from electricity generation from LFG, if credits are claimed. Project developer can choose to measure ECEXP by either a separate energy meter or by a single bi-directional meter, as is indicated on clarification SSC\_371. Checked with receipts of sales".
13. The parameter "Net electricity supplied to a grid" (EGy) and formula to calculate EGy have been included.
14. The following adjustments have been made to the definitions of CO2 emission intensity of the electricity and/or other energy carriers in ID 8 (CEF) in Table 4a, in Annex 4 of the original monitoring plan:
- Description of the parameter in column Data Variable was added with a reference to ID 11;
  - Correction of the information in column Responsible Parties/ Individuals For Monitoring was made, from "electronic" to "Project participant";
  - Correction of the information in column Monitoring Equipment was made, from "During the crediting period and two years after" to "N/A";
  - Comment section has been changed from:  
"Required to update the CEF applied to the electricity consumption of the project, when the project activity is not generating its own electricity";  
to:  
"Carbon Emission Factor of electricity. Changes to the CEF are only required at the start of each crediting period, as indicated on clarification SSC\_032. Please refer to annex 3 – baseline determination, for how emission factor was determined".
15. The column 'Default value to use in case of failure' was revised in Table 4b for the flow meter, thermocouple, fixed methane analyzer and electricity meters. In the original

- monitoring plan, using the daily average historical values (previous month) minus a 5% discount was considered in case of equipment failures. However, this approach was not based on any relevant rule or guidance. Thus, this possibility has been removed in the revised monitoring plan for the flow meter, thermocouple, and electricity meters, which is a more conservative approach. In the case of the fixed gas analyzers, this column was changed to “Determination in accordance to Guidelines to calculate the fraction of methane in the LFG from periodical measurements, ver01, EB48, Annex13”.
16. The revised monitoring plan proposes the following changes in Table 4b to the calibration procedures:
    - a. Flow meter
      - i. Original: “Equipment will be calibrated 18-24 months after initial installation by the equipment supplier on site”;
      - ii. Revised: “Following manufacturer recommendations”
    - b. Thermocouple
      - i. Original: “Equipment will be calibrated annually by the equipment supplier on site”;
      - ii. Revised: “Equipment will be exchange or calibrated annually by qualified personnel”;
    - c. Fixed methane analyzer
      - i. Original: “Equipment will be calibrated annually by the equipment supplier on site”;
      - ii. Revised: “Equipment will be calibrated in accordance to manufacturer’s recommendations by qualified personnel”;
    - d. Electricity meters
      - i. Original: “Equipment will be checked monthly by the Lead Engineer”;
      - ii. Revised: “Equipment will be calibrated in accordance to meter supplier’s stipulations”;
  17. The column ‘Monitoring Variables’ for Electricity Meters in Table 4b of the original monitoring plan, which included “8 and 9. Total amount of electricity generated by the project and electricity consumed for gas pumping (not derived from the gas)”, has been revised to “9. ECIMP and 10. EGEXP” in the proposed revised monitoring plan.
  18. Table 4c of the Monitoring Report, related to “Operational procedures and responsibilities for monitoring and quality assurance of emissions reductions from the project activity”, was fully revised.

The proposed revision redistributes the responsibilities among the project participants and involved entities, which reflects the actual monitoring activities observed during the verification of the fourth monitoring period;
  19. Other minor editorial changes were made to the monitoring plan, including the removal of information from section D.2.1 and the replacement of the table of parameters in section D.2.2.1 by a reference to table 4a, in Annex 4.

The words “This section was left blank on purpose” were added in all blank section of the revised monitoring plan.

APPROVAL date: 02 Aug 11

Reference number of the post-registration changes: Not available.

The present revised monitoring plan, PDD version 3.20, dated 27/05/2021 has the following permanent deviations:

1. According to the registered PDD, the data recording unit periodically transmits the recorded data to a central server.

For the 7th Monitoring Period, due to financial constraints, Biogas Technology didn’t renew contract with their hosting provider of CDM data and technical support for the SCADA system making unable to automatically transmit the recorded data to a central server.

However, the biogas extraction and flaring/utilisation systems continue to operate and the Netrix box (data recording unit) continues to collect the complete data.



During the 7<sup>th</sup> monitoring period, from March 2013, month in which the lack of continuous transmission began, the alternative established as permanent change is to *in-situ* download the collected data from the Netrix box in a CSV file and upload it to a central server owned by Biogas Technology, i.e. Biogas share point. Furthermore, the file is emailed to Keith Wake, Senior Technical Engineer in Biogas Technology Ltd and he extracts the data and feeds it into the in-house workbooks. To that extent, the data going into the workbooks is the same as it would have been if it was still hosted by the previous provider.

1. For monitoring parameter EC<sub>imp</sub>, as per originally registered PDD QA/QC procedures:

- a) „Equipment will be calibrated according to national regulations.“
- b) „In case of not available/accurate EC<sub>imp</sub> data, the most conservative assumption may be used as per installed capacity\*100% of operational hours“

As per actual practice and MR:

- a) Equipment calibration frequency is established at least every 3 years as per project proponent internal quality procedure, however there exist some delays on calibration (please notice all the gaps on delay carried a penalty accordingly). The reason for the delay is that the company in charge of making the calibrations is the National Grid, CFE, even though the calibrations have been requested it is up to CFE to carry it out or not, that is out of control of the project proponent.  
In the case of San Nicolas the last calibration was made on 23/03/2012, valid until 22/03/2015. The rest of the MP readings were penalized as per proposed PRC.  
In the case of Cumbres a new meter was installed on October 2014 from which there is no evidence of calibration, then a penalty was also applied as per proposed PRC.
- b) Data is currently measured and available; however, it may not be accurate due to the lack of calibration, explained above. The stated approach to use the installed capacity \* 100% of operational hours is not plausible since that would represent that all the equipment is consuming energy at full capacity 8,760 hours a year, overestimating real project emissions from electricity consumption. Instead, pursuing accuracy, the actual measured data is being penalized to provide the most exact electricity consumption.

Proposed PRC as per VVS §369:

- a) As per paragraph 361 (c) of the CDM validation and verification standard for project activities, the equipment used for monitoring is in accordance with section 9.2.6 and is controlled and calibrated in accordance with:
  - the registered monitoring plan,
  - the applied methodologies,
  - the applied standardized baselines,
  - the other applied methodological regulatory documents,
  - Board guidance,
  - local/national standards, or as per
  - the manufacturer’s specification

In the case of the project activity, the registered monitoring plan is being modified as per PRC, there is not relevant methodologies, standardized baselines, other applied methodological regulatory documents nor board guidance for electricity meter calibration. Furthermore, there is not any local/national standards applicable to calibration of electricity meters in Mexico, thus, the manufacturer’s specifications have been followed in terms of calibration requirements.

- b) Since no National Regulations are to be followed because law is not specific on the calibration frequency and the calibration of the equipment is not under the PP control because it is carried out by the National Grid Company, CFE, it is proposed, as internal quality procedure by the project proponent, to have a 3 year calibration frequency, and

whenever it cannot be accomplished, a penalty equals to the maximum permissible error from manufacturer's specification will be deducted from actual readings.

- c) Since there is no plausibility on following the established approach (installed capacity\*100% of operational hours) and it is not real and excessive in project emissions penalization, the PP proposes to establish that in case of lack of calibration, that would lead to inaccurate ECIMP data, a penalty equals to the maximum permissible error from manufacturer's specification will be deducted from actual readings. It is important to note that, as per meter manufacturer, the measurement equipment used to monitor imported electricity (Landis Gyr + E650 S4e) is robust (designed for +20 years of lifetime) and high technology equipment, it was calibrated in the factory and should not have to be recalibrated at any point, unless the readings are wrong for some reason, so it does not require calibration.

2. For parameter  $EG_{EXP}$ , as per originally registered PDD QA/QC procedures:

“Equipment will be calibrated according to national regulations.”

As per actual practice and MR:

- a) Equipment calibration frequency is established at least every 3 years, however there exist some delays on calibration (please notice all the gaps on delay carried a penalty accordingly). The reason for the delay is that the company in charge of making the calibrations is the National Grid, CFE, even though the calibrations have been requested it is up to CFE to carry it out or not.  
In the case of San Nicolas the last calibration was made on 04/01/2011, valid until 03/01/2014. From January 2014 until the end of the MP readings were penalized as per proposed PRC.
- b) Data is currently measured and available; however, it may not be accurate due to the lack of calibration, explained above. Thus, pursuing accuracy, the actual measured data is being penalized to provide the most exact electricity generation.

Proposed PRC as per VVS §369:

- a) As per paragraph 361 (c) of the CDM validation and verification standard for project activities, the equipment used for monitoring is in accordance with section 9.2.6 and is controlled and calibrated in accordance with:
- the registered monitoring plan,
  - the applied methodologies,
  - the applied standardized baselines,
  - the other applied methodological regulatory documents,
  - Board guidance,
  - local/national standards, or as per
  - the manufacturer's specification

In the case of the project activity, the registered monitoring plan is being modified as per PRC, there is not relevant methodologies, standardized baselines, other applied methodological regulatory documents nor board guidance for electricity meter calibration. Furthermore, there is not any local/national standards applicable to calibration of electricity meters in Mexico, thus, the manufacturer's specifications have been followed in terms of calibration requirements.

- b) Since no National Regulations are to be followed because law is not specific on the calibration frequency and the calibration of the equipment is not under the PP control because it is carried out by the National Grid Company, CFE, it is proposed, as internal quality procedure by the project proponent, to have a 3 year calibration frequency, and whenever it cannot be accomplished, a penalty equals to the maximum permissible error from manufacturer's specification will be deducted from actual readings.

- c) Thus, the PP proposes to establish that in case of lack of calibration, that would lead to inaccurate  $EG_{EXP}$  data, a penalty equals to the maximum permissible error from manufacturer's specification will be deducted from actual readings. It is important to note that, as per meter manufacturer, the measurement equipment used to monitor exported electricity (ION8650 series) is digital, calibrated in factory and provides high technology so it does not require calibration, only verification of its accuracy in case of measurement failure is detected. Additionally, there is not official recommendation from the manufacturer for its accuracy verification frequency.

Please note that the parameter EGy changed accordingly.

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## Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
12.0	8 October 2021	Revision to: <ul style="list-style-type: none"> <li>• Improve consistency with version 03.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN).</li> </ul>
11.0	31 May 2019	Revision to: <ul style="list-style-type: none"> <li>• Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN);</li> </ul> <p>Make editorial improvements.</p>
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: <ul style="list-style-type: none"> <li>• Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms;</li> <li>• Make editorial improvement.</li> </ul>
09.0	24 May 2017	Revision to: <ul style="list-style-type: none"> <li>• Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0);</li> <li>• Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM);</li> <li>• Make editorial improvement.</li> </ul>
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: <ul style="list-style-type: none"> <li>• Include provisions related to statement on erroneous inclusion of a CPA;</li> <li>• Include provisions related to delayed submission of a monitoring plan;</li> <li>• Provisions related to local stakeholder consultation;</li> <li>• Provisions related to the Host Party;</li> <li>• Make editorial improvement.</li> </ul>
05.0	25 June 2014	Revision to: <ul style="list-style-type: none"> <li>• Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0));</li> <li>• Include provisions related to standardized baselines;</li> <li>• Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1;</li> <li>• Change the reference number from F-CDM-PDD to CDM-PDD-FORM;</li> <li>• Make editorial improvement.</li> </ul>

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

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