Monitoring report form for CDM project activity
(Version 06.0)

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

MONITORING REPORT		
Title of the project activity	Ciudad Juarez Landfill Gas to Energy Project	
UNFCCC reference number of the project activity	1123	
Version number of the PDD applicable to this monitoring report	6.0	
Version number of this monitoring report	1.0	
Completion date of this monitoring report	14/01/2019	
Monitoring period number	4th MP (fourth monitoring period) 2nd CP (second crediting period)	
Duration of this monitoring period	From 01/06/2017 – 31/08/2018 (both days included).	
Monitoring report number for this monitoring report	1/1 (unique MR for this MP)	
Project participants	Biogas de Juarez S.A. de C.V. BELEKTRON d.o.o	
Host Party	Mexico	
Sectoral scopes	Scope number linked to applied methodology: 13 Sectoral scope: Waste handling and disposal Scope number conditioned to the power plant component : 1 Sectoral scope: Energy industries (renewable - / non-renewable)	
Applied methodologies and standardized baselines	ACM0001 Version 15: "Large-scale Consolidated Methodology: Flaring or use of landfill gas."	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0 tCO_{2e}	173,935 tCO_{2e}
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	206,713 tCO_{2e}	

SECTION A. Description of project activity

A.1. General description of project activity

The Ciudad Juarez Landfill Gas to Energy Project (the Project) developed by Biogas de Juarez, S.A. de C.V. (the Project Developer) is a landfill gas (LFG) collection and utilization project in the Ciudad Juarez landfill in the state of Chihuahua, Mexico (the Host Country). The project was registered as a CDM project activity on 30 November 2007. The second 7-year renewable crediting period started on 30/11/2014 and ends on 29/11/2021. The present Monitoring Report corresponds to the 4th verification of the second crediting period.

The Project's purpose is to reduce greenhouse gas (GHG) emissions by capturing and utilizing the methane (CH_4) in the LFG released by the Ciudad Juarez landfill, and avoiding future GHG emissions from the decomposition of municipal solid waste residues. The captured methane is combusted to generate electricity that is fed to the national power grid and used as an alternative source of cheap, indigenous, stable and renewable energy that will reduce dependence on grid power. Thus, in addition to directly eliminating a significant portion of the methane, which is a potent GHG with 25 times the global warming potential of CO_2, the Project also displace fossil fuel-based electricity generation that would have emitted additional CO_2. All landfill gas collected during periods when electricity is not produced is being flared, however, due to the marginal quantity of time-stamps, no emission reductions are claimed from flaring the gas in the current report.

For proper gas extraction, conduction and destruction, the following components have been installed:

- 17 horizontal and vertical extraction wells.
- Modulators of LFG collection wells field systems.
- High density polyethylene pipe (HDPE) to connect the extraction wells to the flare station and power plant.
- Condensate management system.
- 1 blower station.
- 1 enclosed flare.
- 1 control room.
- 4 generator engines 1.6 MW each, totalizing an installed capacity of 6.4 MW

The fourth monitoring period comprises from 01/06/2017 to 31/08/2018 (both days included). The total emission reductions obtained during this period are 173,935 tCO_2e.

A.2. Location of project activity

The Project is located at the Ciudad Juárez Landfill, in the municipality of Ciudad Juárez, state of Chihuahua, Mexico. It is located at kilometer 27.5 of Federal Highway number 45.

The project site is located within the coordinates of 31º 33' 35.62'' N - 106º 29' 40.94'' W; 31º 33' 36.80'' N - 106º 29' 18.90'' W; 31º 33' 15.44'' N - 106º 29' 21.62'' W; and 31º 33' 15.29'' N - 106º 29' 39.64'' W.

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Mexico (host Party)	Biogas de Juarez S.A. de C.V.	No
Switzerland	BELEKTRON d.o.o.	No

A.4. Reference to applied methodologies and standardized baselines

Two approved baseline methodologies are used:

- ACM0001: "Large-scale Consolidated Methodology Flaring or use of landfill gas", version 15.0[1]

The methodologies also refer to the following methodological tools, which have been applied:

- "Tool Project emissions from flaring", version 2.0.0[2]
- "Tool Emissions from solid waste disposal sites", version 6.0.1[3]
- "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0[4]
- "Tool to calculate the emission factor for an electricity system", version 4.0[5]
- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", version 1[6]
- "Tool Assessment of the validity of the original/current baseline and update of the baseline at renewal of the crediting period", version 03.0.1[7]

A.5. Crediting period type and duration

Second 7-year renewable crediting period started on 30/11/2014 and ends on 29/11/2021

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

In order to maximize LFG recovery rates, and thus GHG emission reductions, an active LFG collection system has been installed. The system consists of a series of horizontal extraction wells interconnected by header piping, including modulators systems. High density polyethylene pipelines (HDPE) to connect the extraction wells with the flare station and the power plant have been installed. The LFG is extracted from the landfill by a blower and then conducted to the power plant or the enclosed flare station. Additionally, infrastructure for electricity generation with a capacity of 6.4MW was designed. The main components of this system are:

[1] https://cdm.unfccc.int/methodologies/DB/QOU487ZYKBIAU17YHORZXENWDTEPAC

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

[3] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v4.pdf/history_view

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

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

[6] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf/history_view

[7] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v1.pdf/history_view

Table 1. Description of the installed technology

Landfill gas extraction and capture system					
Implemented technology	**Quantity**	**Manufacturer Brand/Model**	**Serial number**	**Installed capacity**	**Operating during this MP (YES/NO)**
Horizontal / vertical wells	17	Iohisa	N/A	N/A	YES
Separator	19	SmartSoil Canada	According to every separator nameplate	300 l	YES
Chiller	1	York	035-16283-000	32°C or less	YES
Blowers	2	Gardner Denver, 9CDL23	450740 361221	Max. 2,700 m^3/h	YES
Electricity generation system					
Implemented technology	**Quantity**	**Manufacturer Brand/Model**	**Serial number**	**Installed capacity**	**Operating during this MP (YES/NO)**
Generation engines	4	CAT 3520C	GZJ00278 GZJ00280 GZJ00281 GZJ00663	1.6 MW each 60Hz 1200 rpm 480 V	YES
Switch gear system	1	N/A	N/A	N/A	YES
Transformer	5	Continental	4005-22088 4005-22089 4005-22090 4005-22672 4005-22691	2000KVA 2000KVA 2000KVA 500KVA 2000KVA	YES
Landfill gas flaring system					
Implemented technology	**Quantity**	**Manufacturer Brand/Model**	**Serial number**	**Installed capacity**	**Operating during this MP (YES/NO)**
Enclosed flare	1	Mactronic Enerflex	0821	16" x 18" Flare Stack	NO

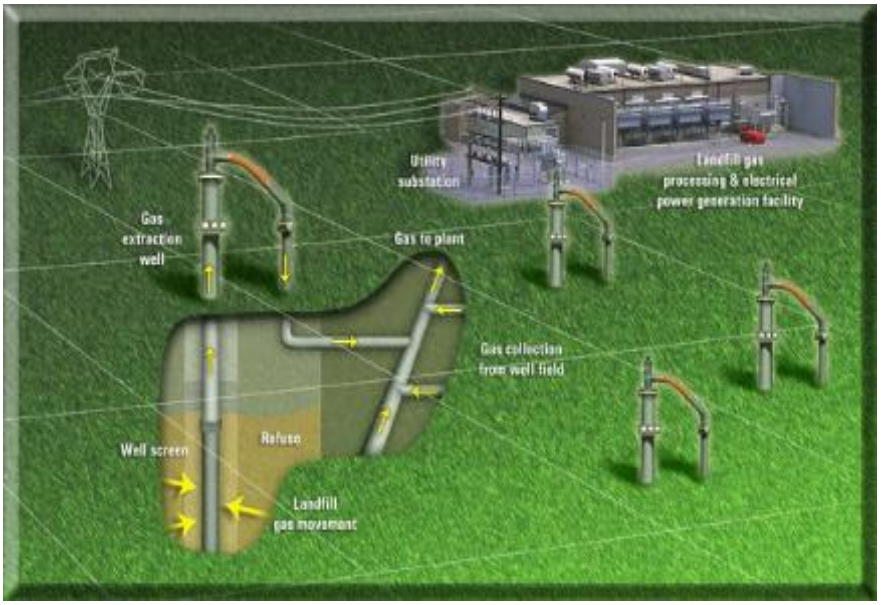


Figure 1: A typical LFG generation plant (*Source: Biogas de Juarez)*

Information on the implementation and actual operation of the project activity:

The Ciudad Juarez landfill started operating in 1994. The landfill is separated into three main areas consisting of three differentiated cells: A, B, C. The first step of the Project, captures and use the biogas produced in a fraction area of cell A, which was closed in April 2008. This partially closed area extends over an area of approximately 128,000 square meters (m^2), accumulated a total of 2.628 million tons of waste. On April 2013, this area was extended over an area of approximately 196,000 m^2 and contains 5.633 million tons of waste. Final closure of cell A took place in December 2014 and has accumulated a total of 8.261 million tons of waste to-date. The Project has an electricity component that was designed in two phases. In Phase I, the infrastructure for electricity generation with a capacity of 6.4MW was initially designed, and was planned to start operations in 2008. During the second phase, the installed capacity was expected to increase to a total of 20.8MW in 2011. However the project has experienced delays in the implementation of the electricity generation component due to delays in obtain relevant permits from local and national authorities and for the low biogas captured flow from the landfill which is below than the initial ex-ante estimation. Therefore, phase I only began partially operation on June 15th, 2011 with an installed capacity of 4.8MW (1.6MW X 3 units) after that on September 2013 an extra unit of 1.6MW was installed; therefore the installed capacity is 6.4MW. This is still the actual installed capacity.

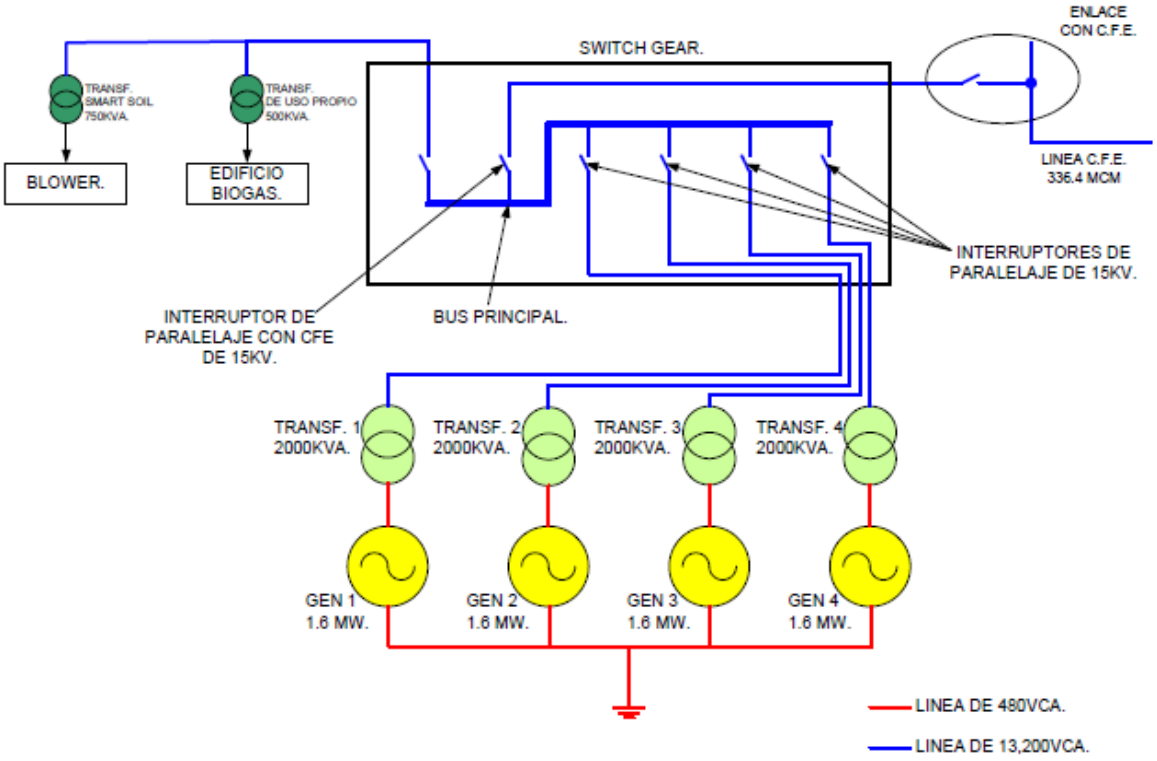
The actual captured biogas flow only justifies the implementation of the currently installed 17 horizontal / vertical wells (eight wells installed during phase I plus another 9 installed during phase II) and 1.6MW X 4 generation units. In the case the collected biogas flow rates increase, additional wells and power units will be added to reach the initial design as per PDD.

Interconnection to CFE

The Federal Electricity Commission (CFE) is a company created and owned by the Mexican government. It generates, distributes and markets electric power for almost 35.3 million customers. As a federal authority, the CFE is in charge of monitoring electricity from renewable and fossil sources that is being exported to the national grid. All projects related to electricity generation in Mexico must celebrate a contract (named interconnection contract) with CFE, which indicates the regulations and normative to be followed during the life of the project.

For Ciudad Juarez Landfill Gas to Energy Project the link with CFE is established through a synchronization system and an automatic switchgear controlled directly by a master system designed by IsoPower-LINK. The system is linked with the CFE at 13,800 Volts; therefore, a transformer is used as a link between the generation units and the synchronization system. The transformer has a power capacity of 2,000 KVA for the transformation of 13,800 Volts to 480 Volts. The following figure shows the line diagram of connection from the generator to the point of interconnection to CFE:

Diagram 1. Interconnection to CFE



Relevant dates for the project activity are provided below in Table 2:

Table 2. Relevant dates for project activity

Date	Event
12/03/2007	Construction starting date
23/11/2007	Project commissioning
11/06/2009	Legal permits for electricity generation “Permission to generate electricity for self-consumption”- Comisión Reguladora de Energía (CRE)
11/06/2009	Right of way contract – authorization to build interconnection line inside the municipal landfill – Juarez Municipality
26/05/2010	Construction of interconnection line concluded
15/06/2010	Interconnection contract with Comisión Federal de Electricidad (CFE)
25/06/2010	Right of way contract – authorization to operate interconnection line inside the municipal landfill – Juarez Municipality
29/07/2010	Modification of the Permission to generate electricity for self-consumption” – construction end dates extension – Comisión Reguladora de Energía (CRE)
22/03/2011	Installation of the bidirectional power meter device
01/04/2011- 14/06/2011	Electricity generation PERIOD OF TESTS
15/06/2011	Power plant OFFICIAL STARTING DATE (flare is turned off)

During this monitoring period there were events that affected the generation of emission reductions. The following table summarizes the main events and the total hours where no emission reductions have being claimed:

Table 3. Events during the Monitoring Period

	Number of time stamps recorded during the Monitoring Period (hours)
Event	**01/06/2017 – 31/08/2018**
Power shutdown by CFE	48
Maintenance / Reparation	314
Software / Program issues	195
Low LFG extraction volume	0
TOTAL	**557**

- **Power shutdown:** These events occur, for example, during unexpected blackouts on the federal grid, CFE; as per the security normative, power plant must be isolated through the automatic opening of the interconnection switches when power shutdowns occur.

- **Maintenance / Reparation:** In these cases, all power plant systems are turned off in order to provide service to operational equipment. The service is scheduled according to equipment specifications and requirements.

- **Software / Program issues:** unexpected failure in computing software leads to misreading of measurements; the emission reductions estimated during a software problem are disregarded from final claiming.

- **Low LFG extraction volume:** Partial or full closing of LFG extraction valves due to adverse meteorological conditions and/or detection of low levels of methane.

All of the above events are part of the normal operation of the project and may not impact the applicability of the applied methodologies, however, as mentioned before, no emission reductions are claimed during the total of mentioned hours in table 3.

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines

Not applicable. No temporary deviations were applied during this monitoring period.

B.2.2. Corrections

The following corrections have been made since the registration of the project activity:

(a) Corrections that have been approved by the Board as applicable from the period prior to this monitoring period.

A post registration change (PRC ref No. PRC-1123-001) was submitted and accepted by the Chair of the EB on September 06 2013[8], which included the following correction:

During the transcription of the PDD form version 03 to PDD form version 04.1, was found an inconsistency related to the annual average emissions reduction estimated over the crediting period (tonnes of CO_2e). In the registered PDD on November 30th, 2007, section A.4.4., table 1,

[8] http://cdm.unfccc.int/PRCContainer/DB/prcp686787438/view

stated the annual average emission reductions over the crediting period as 170,499 (tonnes of CO_2e) while on section B.6.4, the same data is reported as 166,912 tCO_2e.

According to the spreadsheet "appendix 4 baseline calculation phase II.xls" public available on http://cdm.unfccc.int/Projects/DB/TUEV-SUED1179241731.11/view, the correct value is 160,361 tCO_2e.

Furthermore, emissions reduction estimation over the second and third crediting period was corrected in section B.6.4 according to the values presented on the registered PDD page 2.

Contact information of project participant was updated as per the updated version of MoC format.

A post registration change (PRC ref No. PRC-1123-002) was submitted and approved by the Chair of the EB on February 12 2018[9], which included the following corrections:

- To include the recently added PP, BELEKTRON d.o.o. in all relevant sections.
- To delete all the references to the methodology ACM0002, since it is no longer used and applicable to the project activity. As per used ACM0001, version 15, for the second crediting period for the calculation of the emission factor of the grid the methodology ACM0002 has to be changed to the "Tool to calculate emission factor for an electricity system". All deleted references to ACM0002 came from the initially registered PDD for the first crediting period and could be just deleted since for the second crediting period the mentioned tool completely substitutes this methodology.
- The PP updated the value of GWP of methane, from 21 to 25. According to EB 69, annex 3, all emission reductions achieved in the second commitment period shall be calculated using the GWP as applied by decision 4/CMP. 7. The increase in the ex-ante ER calculation is due exclusively to this change, specifically in the parameters: "Baseline emissions of methane from the SWDS", table 9; and "Project emissions", table on section B.6.4. Both parameters were recalculated and consequently, ex-ante ER calculations changed all over the document.
- To include further information on how to determine the parameter $F_{CH4,EL,y}$ ex-post. The aim of this inclusion is to add clarity to calculations made in the Monitoring Reports.
- To include parameters ρ_{CH4} = D_{CH4}, TDL_k and TDL_j in section B.6.2. These parameters are used in the ex-post calculations and are important within the Monitoring Reports; however, they were accidentally not included in this section before.
- To delete the parameter EL_y, which came from the initially registered PDD for the first crediting period, and for this second crediting period is substituted by the parameters: $EG_{PJ,y}$ and $EG_{EC,y}$
- To include monitoring parameters **T**, and **P** in section B.7.1. These parameters are used in the ex-post calculations and are important within the Monitoring Reports; however, they were accidentally not included in this section before.
- In the previous version of the PDD, there were references to files and spreadsheets for the data management, however actually they are no longer in use. The real and actual collection, transfer and processing of data and information is now placed in the PDD. This change is to add accuracy to the actual monitoring process.
- Since the PDD template needs to be updated from version 05.0 to 10.1, the PP included new information requested by the latest PDD template.
- All over the document, changes in the wording and inclusion of further references in order to add clarity to some statements.
- Typo mistakes

(b) Corrections that have been approved by the Board as applicable from this monitoring period.

[9] http://cdm.unfccc.int/PRCContainer/DB/prcp608476019/view

Not applicable. Mentioned corrections submitted under PRC-1123-002 are applicable from past monitoring period (2nd MP, 2nd CP).

(c) Corrections that are being submitted with this monitoring report as part of the request for issuance (post-registration change – issuance track) as applicable from this monitoring period.

Not applicable, no corrections are to be submitted with this monitoring report.

B.2.3. Changes to the start date of the crediting period

Not applicable. There were no changes to the start date of the crediting period. As described in the project webpage: the second 7-year renewable crediting period comprises from 30/11/2014 to 29/11/2021.

B.2.4. Inclusion of monitoring plan

Not applicable. Any inclusion to the registered monitoring plan was conducted during this monitoring period.

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

The following corrections have been made since the registration of the project activity:

(a) Changes that have been approved by the Board as applicable from the period prior to this monitoring period.

A post registration change (PRC ref No. PRC-1123-001) was submitted and accepted by the Chair of the EB on September 06 2013[10], which included the following permanent changes from registered monitoring plan:

The Monitoring Plan was updated to include the following parameters:

- Operation hours of the energy plant

A post registration change (PRC ref No. PRC-1123-002) was submitted and approved by the Chair of the EB on February 12 2018[11], which included the following permanent deviation of the monitoring from the applied methodology:

The project applies the methodology ACM0001, version 15, which is tied to clarification AM_CLA_0252, in which it is requested to have one single flow meter for each one of the energy generators placed in the site. In the case of the project design there is only one flow meter for all the energy generators, i.e. one flow meter measures the total of biogas introduced into the four engines. Therefore, in order to alleviate the lack of flow meters, the PP proposes a permanent

[10] http://cdm.unfccc.int/PRCContainer/DB/prcp686787438/view

[11] http://cdm.unfccc.int/PRCContainer/DB/prcp608476019/view

deviation from the applied methodology, which consists on the deduction of the accuracy level (1%) of the installed monitoring equipment to the actual measured biogas flow.

(b) Changes that have been approved by the Board as applicable from this monitoring period.

Not applicable. Mentioned permanent deviation of the monitoring from the applied methodology submitted under PRC-1123-002 is applicable from the past monitoring period (2nd MP, 2nd CP).

(c) Changes that are being submitted with this monitoring report as part of the request for issuance (post-registration change - issuance track) as applicable from this monitoring period.

SUMMARY of proposed Post-Registration changes in version 6.0, of the PDD:

Parameters: LFG_{total}, LFG_{flared}, $LFG_{electricity}$ and $\rho_{CH4} = D_{CH4}$, have changed in order to comply with the following paragraph of Ruling Note: CDM-PA1123-RULE01:

"(a) The monitoring plan under valid version of the PDD applies standard conditions (STP expressed in Nm3, Normal Cubic Meter unit) for the parameters: LFGtotal, LFGflared, LFGelectricity and DCH4 = ρCH4. However, application of these parameters at standard conditions is not in accordance with the applied version of the methodology and the tool, which require the parameters to be determined at the operating conditions".

This way, the mentioned parameters are now determined in operating conditions as required by applicable methodology and tool.

B.2.6. Changes to project design

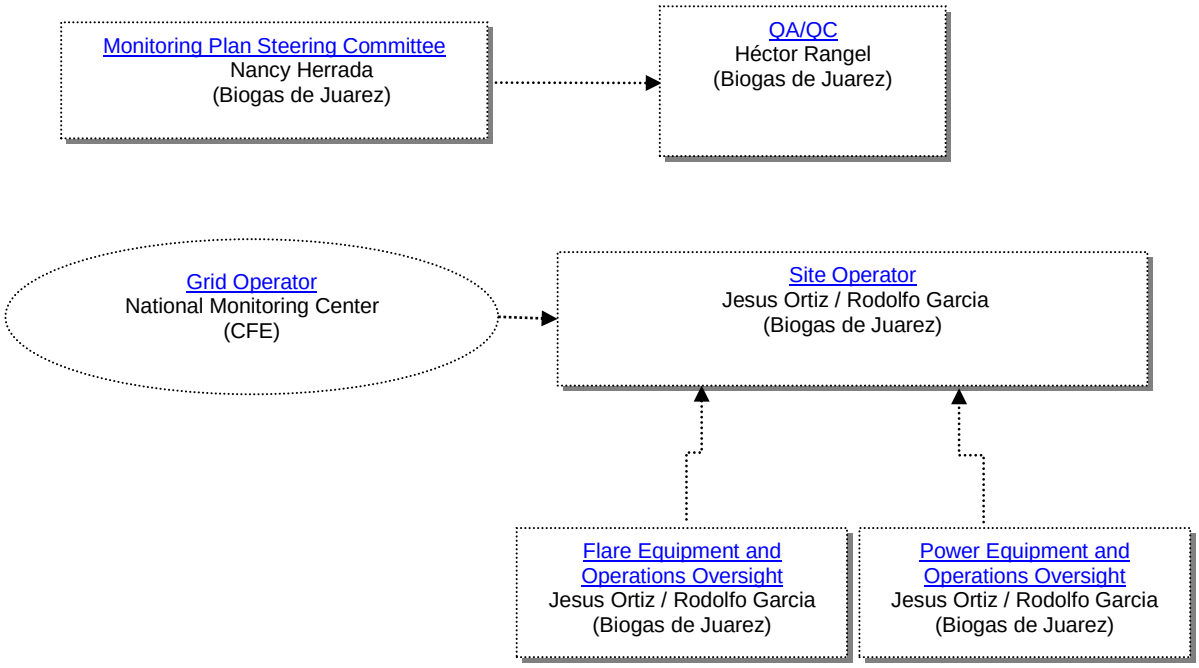
Not applicable. Any change to the registered PDD was conducted during this monitoring period.

SECTION C. Description of monitoring system

Organizational structure – roles and responsibilities:

The monitoring organizational structure presented in the following diagram summarizes the key roles in the performance of monitoring activities.

Diagram 2. Monitoring organizational structure



Monitoring Plan Steering Committee (MP Committee):

- Coordinates with the QA/QC Committee, reporting to the DOE at verification, including providing all necessary monitoring information to facilitate the verification work and cooperating with the DOE in a timely manner on all data requests and questions.
- Responds to requests by the CDM Executive Board and conducts preparatory work for the verification.
- Training of the monitoring staff and Site Operator on the requirements of the monitoring plan the PDD.
- Secures written proof of the Project's monthly energy consumption/production from the Grid Operator.
- Keeps data for at least two years following the end of the crediting period.
- Implements file management procedures to ensure integrity of data and calculations as per Monitoring Protocol.
- Receives reports on the training of monitoring staff and Site Operator.
- Submits all reports related to the monitoring process: 1) data to estimate ERs from the ERCP Manager and Site Operator; 2) report of the total ERs; 3) training of monitoring staff and Site Operator; and, 4) updates related to the monitoring process as instructed by the QA/QC Committee.
- Receives and keeps calibration and maintenance reports (hard and soft copies).
- Receives and keeps weekly operational reports (hard and soft copies)

QA/QC Committee:

- QA/QC information on a monthly basis from previous month.
- Oversees the work undertaken by the MP Committee.
- Tracks changes in national regulatory requirements relating to LFG projects.

Site Operator

- Secures measurements of data variables identified in the PDD and indicated in the Monitoring Checklists.
- Reports to the MP Committee on the daily operations at the site.

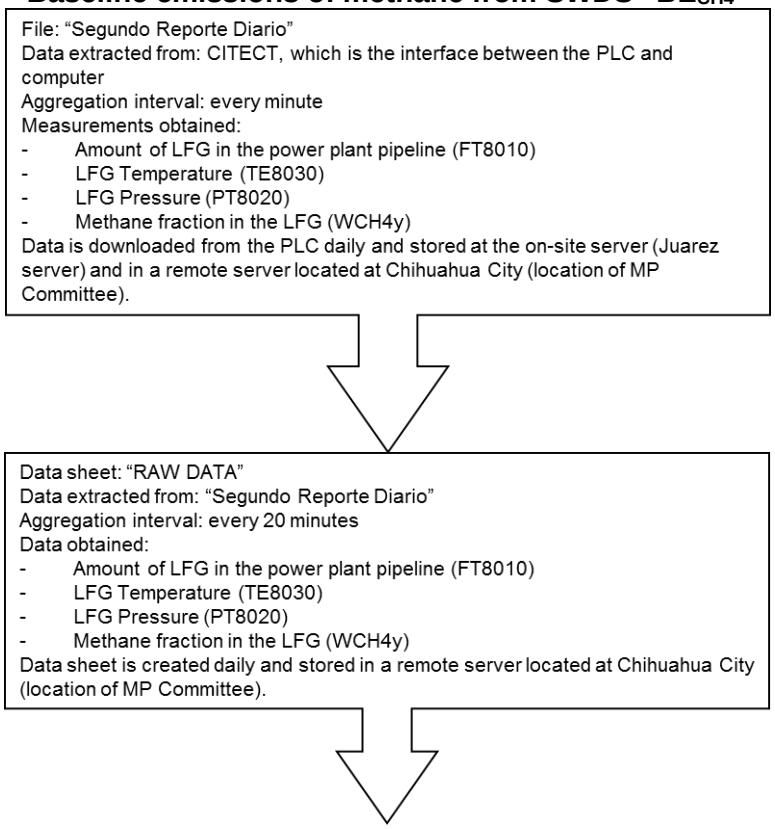
Flare/Power Equipment and Operations Oversight:

- Supervises equipment operation and maintenance program, ensuring that the equipment meets the monitoring requirements set forth in PDD, Monitoring Plan and manufacturer's specifications.
- Trains appropriate personnel on operational matters.

Data Management: Collection, transfer, processing and storage

The following diagrams show the information flow that conforms the ER calculation, file: "Total ER – XX Verification" (XX is for the MP number).

Diagram 3: Collection of parameters to calculate the Baseline emissions of methane from SWDS "BE_{CH4}"



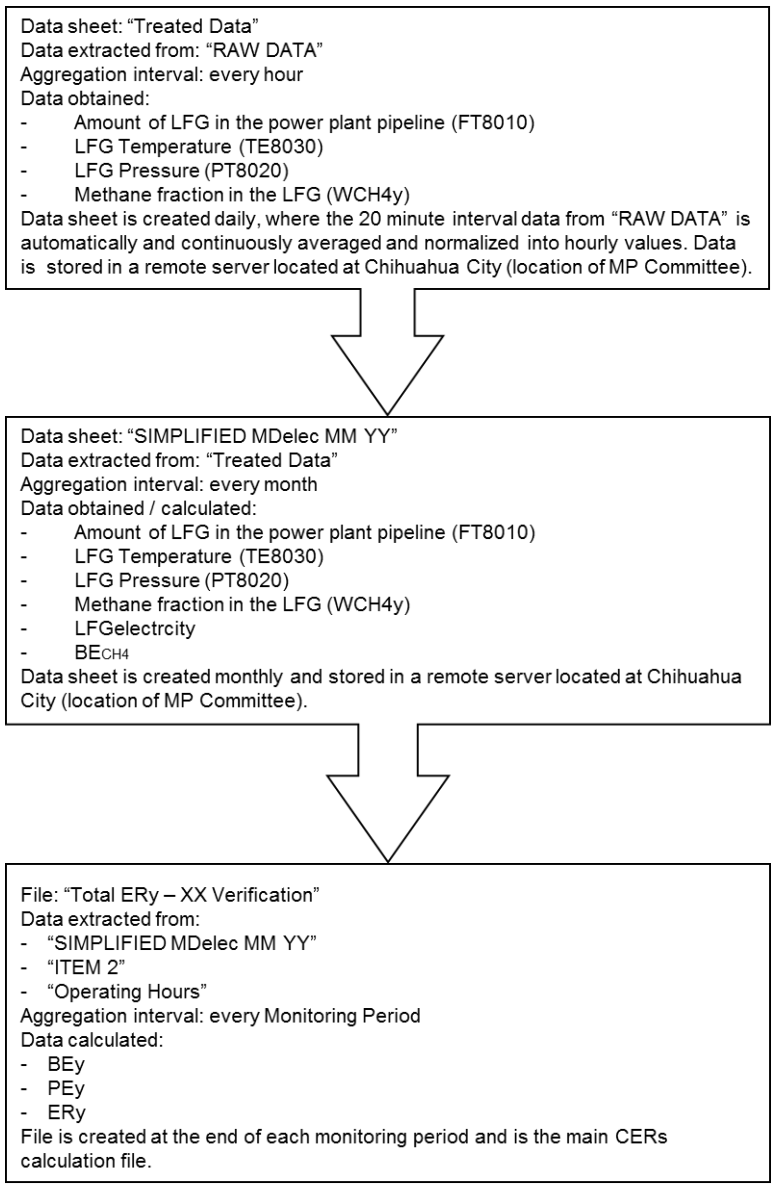


Diagram 4: Collection of parameters to calculate the Baseline emission associated with electricity generation "BE_{EC}" and Project emissions from consumption of electricity due to the project activity "PE_{EC}"

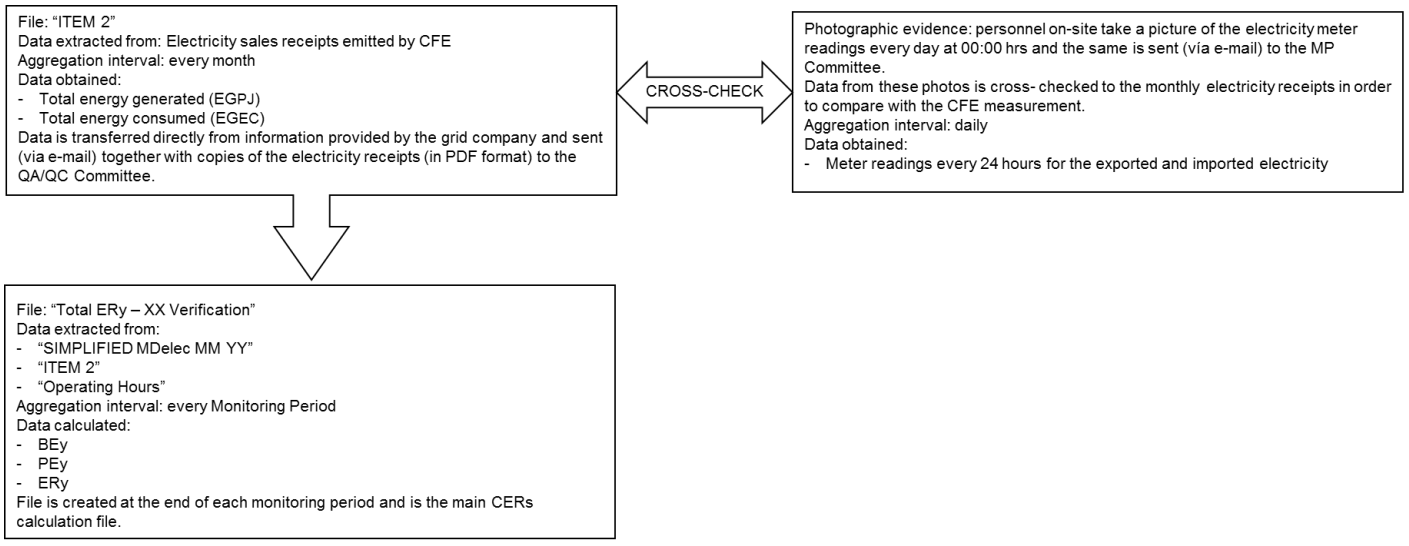
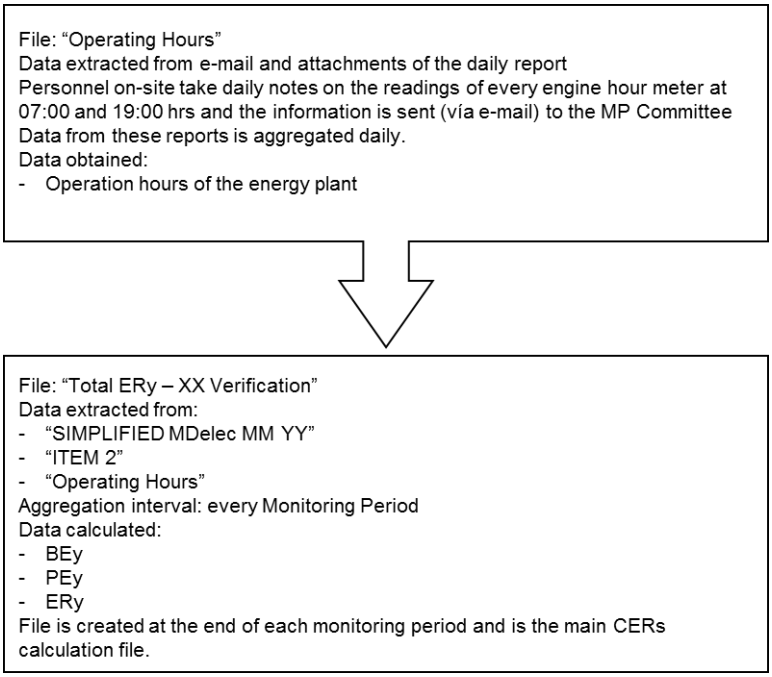


Diagram 5: Collection of parameter Operation hours of the energy plant "OP_j"



Regarding the parameter $\mathbf{MD_{reg}}$ or $\mathbf{F_{CH4,BL}}$, changes related to methane to be destroyed due to regulatory or other requirements are monitored by the MP Committee by means of communication with the relevant authority. Communication is received, confirmed and signed by the authority and the same is archived at Chihuahua City. For the current monitoring period the files called: "Constancia de monitoreo anual a los requerimientos relacionados con los proyectos Landfill Gas-to-Energy" are dated on 10 March 2017 and 12 March 2018, for each year. The information though recorded annually is used for changes to the parameter $MD_{reg,y}$ at renewal of the credit period.

Archiving:

- Measurements from on-site monitoring equipment and ER calculations are saved on external media (e.g., USB or Hard Disk) and filed along with all project-related information. These data are saved on external media every month.
- In addition, all monitoring-related data on long term back up are saved to external media (e.g., external hard drive disk) and stored in a secure location onsite and offsite.
- All documents shall be kept for at least 2 years beyond the end of the crediting period.

Treatment of missing or invalid data / Emergency procedures:

On the unplanned occasions where the data is missing or invalid no emission reduction is claimed. These incidents could be attributed to interruption of the data stream (computer, software issues) or equipment status (shutdowns, maintenance).

Presentation of monitoring results:
All the project data for this monitoring period is presented in Excel workbook: "Total ERy- 4th verification". In the following tables information contained in the file, by sheet, is explained.

Table 4. "Simplified MDelec Month"

Column	Description	Unit
FT8010	Amount of LFG fed to the power plant	m^3dry gas/h
FT8010 -1% adjusted	Adjusted amount of LFG fed to the power plant due to permanent deviation	m^3dry gas/h
TE8030 (°C)	Temperature of the LFG fed to the power plant readings from the temperature meter in °C	°C
TE8030 (°K)	Temperature of the LFG fed to the power plant converted to °K	°K
PT8020 (kPa)	Pressure of the LFG fed to the power plant readings from the absolute pressure meter	kPa
W_{CH4}	Methane fraction in the Landfill Gas	m^3CH_4/m^3dry gas
$LFG_{electricity}$	Amount of LFG combusted in power plant at operating conditions	m^3dry gas/h
ρ _CH4	Hourly methane density in the gaseous stream at operating conditions	tCH_4/m^3CH_4
$F_{CH4,EL,y}$	Amount of methane in the LFG which is used for electricity generation	tCH_4/h
GWP_{CH4}	Global Warming Potential	tCO_{2e}/tCH_4
OX_{top_layer}	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline	dimensionless
BE_{CH4}	Baseline emissions of methane from the SWDS	tCO_{2e}

Table 5. "ITEM 2"

Column	Description	Unit
EG_{PJ}	Amount of electricity generated using LFG	kWh
EF_{CM}	Combined Margin emission factor for Mexican grid	tCO_2/kWh
TDL_k	Average technical transmission and distribution losses for providing electricity to the grid	%
BE_{EC}	Baseline emissions associated with electricity generation	tCO_{2e}
EG_{EC}	Amount of electricity consumed by the project activity	kWh
TDL_j	Average technical transmission and distributions losses for the electricity consumption from the grid	%
PE_{EC}	Project emissions from consumption of electricity due to the project activity	tCO_{2e}

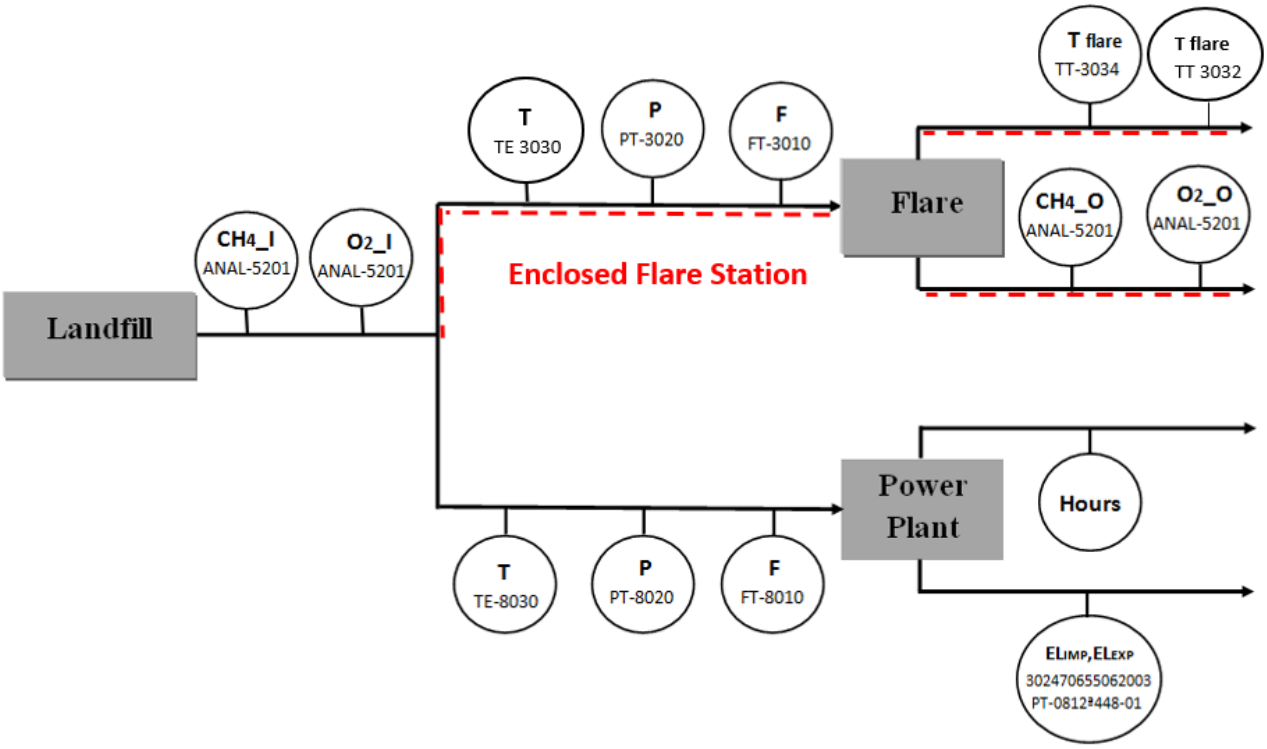
Table 6. "Total ERy"

Column	Description	Unit
BE_{CH4}	Baseline emissions of methane from the SWDS	tCO_{2e}
BE_{EC}	Baseline emissions associated with electricity generation	tCO_{2e}
BE_y	Total Baseline Emissions	tCO_{2e}
$PE_y = PE_{EC}$	Total Project Emissions = Project emissions from consumption of electricity due to the project activity	tCO_{2e}
ER_y	Total Emission Reductions	tCO_{2e}

Monitoring points and calibration

The following diagram presents a simplified scheme identifying relevant monitoring equipment and parameters used to calculate ER. Please notice that since the flare system is off, for the present monitoring period the relevant monitoring equipment was not used (red line), however the calibration of all the monitoring equipment was properly carried out.

Diagram 6. Monitoring points



The following table shows calibrations carried out valid during this monitoring period.

Table 7. Calibration of monitoring equipment

Instrument	Internal TAG	Serial number	Date	Validity	Date	Validity
Flow meter	FT-8010	10512227	17/02/17 20/08/17	6 months	26/02/18 18/08/18	6 months
Gas analyzer	ANAL-5201	N1-V3-0218	01/05/17 01/06/17 01/07/17 01/08/17 01/09/17 01/10/17 01/11/17 01/12/17	3 months	01/01/18 01/02/18 01/03/18 01/04/18 01/05/18 01/06/18 01/07/18 01/08/18	3 months
Temperature transmitter	TE-8030	D5002B 23365	17/02/17 20/08/17	6 months	26/02/18 18/08/18	6 months
Absolute Pressure Transmitter	PT-8020	14262838	17/02/17 20/08/17	6 months	26/02/18 18/08/18	6 months
Electricity meter	NA	PT-0812A448-01	27/03/17 09/11/17	1 year	06/04/18 --------	1 year
Flow meter	FT-3010	07210815	17/02/17 20/08/17	6 months	26/02/18 18/08/18	6 months
Temperature transmitter	TE-3030	950090 23365	17/02/17 20/08/17	6 months	26/02/18 18/08/18	6 months
Absolute Pressure Transmitter	PT-3020	07213133	17/02/17 20/08/17	6 months	26/02/18 18/08/18	6 months
Temperature transmitter	TT-3032	D50BC7231C1	17/02/17 20/08/17	6 months	26/02/18 18/08/18	6 months
Temperature transmitter	TT-3034	D50BC8231C1	17/02/17 20/08/17	6 months	26/02/18 18/08/18	6 months

During the present Monitoring Period the following instruments presented gaps on calibration from August 17-20, 2017 (both days included); and from February 20-26, 2018 (both days included):

- Flow meter FT-8010, penalty equals to the accuracy level -1%
- Temperature transmitter TE-8030, penalty equals to the accuracy level +0.2%
- Absolute pressure transmitter PT-8020, penalty equals to the accuracy level -0.1%

Penalties were applied to the readings of the instruments during the lack of calibration.

Also for equipment: FT-3010, TE-3030, PT-3020, TT-3032, TT-3034, there were gaps on calibration, however since no emissions from flaring are claimed there is any data to be deducted.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data / Parameter:	**GWP_{CH4}**
Unit:	tCO_2e/tCH_4
Description:	Global Warming Potential of methane
Source of data:	IPCC Fourth Assessment Report: Climate Change 2007 http://www.ipcc.ch/publications_and_data/ar4/wg1/en/erratataserrata-errata.html#table214
Value(s) applied):	25

Choice of data or measurement methods and procedures:	According to EB 69, annex 3, all emission reductions achieved in the second commitment period shall be calculated using the GWP as applied by decision 4/CMP. 7
Purpose of data:	Calculation of baseline emissions
Additional comments:	NA

Data / Parameter:	**$\rho_{CH4} = D_{CH4}$**
Unit:	tCH_4/m^3CH_4
Description:	Density of methane gas at standard temperature and pressure
Source of data:	http://www.engineeringtoolbox.com/gas-density-d_158.html
Value(s) applied):	0.0007168
Choice of data or measurement methods and procedures:	As per applied methodology
Purpose of data:	Calculation of baseline emissions
Additional comments:	**This parameter is included in this section, D.1, as it was used in ex-ante ER estimation, for ex-post calculations means this parameter will be determined at the operating conditions as per section E.1**

Data / Parameter:	**Operating Margin Emission Factor ($EF_{OM,y}$)**
Unit:	tCO_{2e}/MWh
Description:	CO_2 emissions intensity factor of the electricity displaced
Source of data:	Based on official statistics published by the Department of Energy
Value(s) applied):	0.6484
Choice of data or measurement methods and procedures	As per registered PDD
Purpose of data:	Calculation of baseline and project emissions
Additional comments:	Fixed value for the second crediting period

Data / Parameter:	**Build Margin Emission Factor ($EF_{BM,y}$)**
Unit:	tCO_{2e}/MWh
Description:	CO_2 emissions intensity factor of the electricity displaced
Source of data:	Based on official statistics published by the Department of Energy
Value(s) applied):	0.3157
Choice of data or measurement methods and procedures	As per registered PDD
Purpose of data:	Calculation of baseline and project emissions
Additional comments:	Fixed value for the second crediting period

Data / Parameter:	**Carbon Emission Intensity Factor ($CEF_{electricity,y}$)**
Unit:	tCO_{2e}/MWh
Description:	Combined Margin emission factor for Mexican grid
Source of data:	Based on official statistics published by the Department of Energy

Value(s) applied):	0.3989
Choice of data or measurement methods and procedures	As per registered PDD
Purpose of data:	Calculation of baseline emissions Calculation of project emissions
Additional comments:	Fixed value for the second crediting period

Data / Parameter:	**TDL_k**
Unit:	%
Description:	Average technical transmission and distribution losses for providing electricity to the grid
Source of data:	"Tool to calculate baseline, project and/or leakage emissions from electricity consumption", version 1
Value(s) applied):	3%
Choice of data or measurement methods and procedures:	Default value provided by the applied tool.
Purpose of data:	Calculation of baseline emissions
Additional comments:	NA

Data / Parameter:	**TDL_j**
Unit:	%
Description:	Average technical transmission and distribution losses for the electricity consumption from the grid
Source of data:	"Tool to calculate baseline, project and/or leakage emissions from electricity consumption", version 1
Value(s) applied):	20%
Choice of data or measurement methods and procedures:	Default value provided by the applied tool.
Purpose of data:	Calculation of project emissions
Additional comments:	NA

Data / Parameter:	**Regulatory requirements relating to landfill gas projects**
Unit:	Review
Description:	The regulatory requirements will be checked once a year and in case of changes, necessary adjustments will be made.
Source of data:	National environmental legislation – annual phone calls to environmental authorities. Communication is received, confirmed and signed by the authority and the same is archived at Chihuahua City.
Value(s) applied):	No changes in the regulatory requirements.
Choice of data or measurement methods and procedures	For the current monitoring period the file called: "Constancia de monitoreo anual a los requerimientos relacionados con los proyectos Landfill Gas-to-Energy" are dated on 10 March 2017 and 12 March 2018, for each year.
Purpose of data:	Calculation of Baseline emissions
Additional comments:	N/A

Data / Parameter:	OX_{top_layer}
Unit:	Dimensionless
Description:	Oxidation factor (reflecting the amount of methane from solid waste disposal site (SWDS) that is oxidized in the soil or other material covering the waste)
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied):	0.1
Choice of data or measurement methods and procedures	Managed solid waste disposal site not covered with oxidizing material, such as soil or compost.
Purpose of data:	Calculation of baseline emissions
Additional comments:	NA

Data / Parameter:	- **Fuel Quantity ($F_{i,y}$)** - **Emission Factor Coefficient ($COEF_i$)** - **Electricity Quantity (GEN_i,)** - **$\varphi_{default}$** - **$MCF_{default}$** - **Kj** - **F** - **η_{pj} = Efficiency of the LFG capture system that will be installed in the project activity** - **Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS ($DOCf_{,default}$)**
Unit:	Various
Description:	Various
Source of data:	Various
Value(s) applied):	Various
Choice of data or measurement methods and procedures	Various
Purpose of data:	Calculation of baseline and project emissions
Additional comments:	These parameters are part of the PDD, section B.6.2, and used tools; however they were not used and are not relevant for the ER calculation during the present monitoring period, thus they are included in the same table for simplicity.

D.2. Data and parameters monitored

Data / Parameter:	LFG_{total} = $LFG_{electricity}$
Unit:	**m^3dry gas/h**
Description:	Amount of LFG combusted in power plant at operating conditions
Measured/ Calculated / Default:	Measured
Source of data:	Flow meter, data extracted from PLC records
Value(s) of monitored parameter:	Values presented in a separate spreadsheet: "2019_01_14_Total ERy 4th verification"

Monitoring equipment:	<table><tr><td>**Type**</td><td>FOXBORO flow meter</td></tr><tr><td>**Accuracy Class**</td><td>Accuracy for gases and steam is ± 1% of reading for flow rates with Reynolds number of 20,000 or greater</td></tr><tr><td>**Serial No.**</td><td>Serial: 10512227 (installed 02/01/2017) Model: 83F-T08S1SSTJA</td></tr><tr><td>**Calibration Frequency**</td><td>Calibration is not required by the manufacturer; however, for QA/QC procedures, verification of the instrument is performed every 6 months.</td></tr><tr><td>**Date of last calibration**</td><td>Refer to table 7 above</td></tr><tr><td>**Validity**</td><td>During the monitoring period</td></tr></table>
Measuring/ Reading/ Recording frequency:	Data are continuously measured by a flow meter, aggregated every minute and averaged hourly for the calculation means.
Calculation method (if applicable):	As per applied **"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0),** value is presented at actual conditions (temperature and pressure)
QA/QC procedures:	Flow meter is subject to a regular maintenance and testing regime to ensure accuracy.
Purpose of data:	Calculation of baseline emissions
Additional comments:	Since during this monitoring period, the LFG was used to generate electricity, one flow meter can be used and therefore **$LFG_{total} = LFG_{electricity}$** Due to a permanent deviation (explained in section B.2.5) the raw data measured by this instrument applies a deduction according to the accuracy class above, i.e. 1%.

Data / Parameter:	**T**
Unit:	°C
Description:	Temperature of LFG
Measured/ Calculated / Default:	Measured
Source of data:	Temperature transmitter, data extracted from PLC records
Value(s) of monitored parameter:	Values presented in a separate spreadsheet: "2019_01_14_Total ERy 4th verification"
Monitoring equipment:	<table><tr><td>**Type**</td><td>Endress+Hauser Temperature transmitter</td></tr><tr><td>**Accuracy Class**</td><td>±0.2%</td></tr><tr><td>**Serial No.**</td><td>Serial: D5002B 23365 Model: T13-G3A12A3AACKA</td></tr><tr><td>**Calibration Frequency**</td><td>Manufacturer states 1 calibration per year; however, for QA/QC procedures, calibration is performed every 6 months.</td></tr><tr><td>**Date of last calibration**</td><td>Refer to Table 7 above</td></tr><tr><td>**Validity**</td><td>During the monitoring period</td></tr></table>
Measuring/ Reading/ Recording frequency:	Data are continuously measured by a temperature transmitter, aggregated every minute and averaged hourly for the calculation means.
Calculation method (if applicable):	Value is converted to °K for calculation means.

QA/QC procedures:	Temperature transmitter is subject to a regular maintenance and testing regime to ensure accuracy. Standard Operating Procedure for Calibration and Maintenance SOP-A-en-002.
Purpose of data:	Calculation of baseline emissions
Additional comments:	NA

Data / Parameter:	**P**
Unit:	Pa
Description:	Pressure of LFG
Measured/ Calculated / Default:	Measured
Source of data:	Absolute pressure transmitter, data extracted from PLC records
Value(s) of monitored parameter:	Values presented in a separate spreadsheet: "2019_01_14_Total ERy 4th verification"
Monitoring equipment:	**Type**: FOXBORO Absolute pressure transmitter **Accuracy Class**: ±0.1% **Serial No.**: Serial: 14262838 Model: IAP10-A22C1F **Calibration Frequency**: Calibration is not required by the manufacturer; however, for QA/QC procedures, verification of the instrument is performed every 6 months. **Date of last calibration**: Refer to table 7 above **Validity**: During the monitoring period
Measuring/ Reading/ Recording frequency:	Data are continuously measured by an absolute pressure transmitter, aggregated every minute and averaged hourly for the calculation means.
Calculation method (if applicable):	NA
QA/QC procedures:	Absolute pressure transmitter is subject to a regular maintenance and testing regime to ensure accuracy.
Purpose of data:	Calculation of baseline emissions
Additional comments:	NA

Data / Parameter:	**w_{CH4}**
Unit:	% (m^3CH_4/m^3LFG)
Description:	Methane fraction in the LFG
Measured/ Calculated / Default:	Measured
Source of data:	Gas analyser, data extracted from PLC records
Value(s) of monitored parameter:	Values presented in a separate spreadsheet: "2019_01_14_Total ERy 4th verification"

Monitoring equipment:	<table><tr><td>**Type**</td><td>Gas analyser</td></tr><tr><td>**Accuracy Class**</td><td><1% of full-scale value.</td></tr><tr><td>**Serial No.**</td><td>Serial: N1-V3-0218 Model: ULTRAMAT 23</td></tr><tr><td>**Calibration Frequency**</td><td>Quarterly basis as per manufacturer specifications, however, a stricter practice which is to perform a manual calibration at least once a month has been implemented. Automatic Zero on CH_4 and a span on O_2 are performed every day.</td></tr><tr><td>**Date of last calibration**</td><td>Refer to Table 7 above</td></tr><tr><td>**Validity**</td><td>During the monitoring period</td></tr></table>
Measuring/ Reading/ Recording frequency:	Data are continuously measured by a gas analyser, aggregated every minute and averaged hourly for the calculation means.
Calculation method (if applicable):	NA
QA/QC procedures:	The gas analyser is subject to a regular maintenance and testing regime to ensure accuracy.
Purpose of data:	Calculation of baseline emissions
Additional comments:	NA

Data / Parameter:	**MD_{reg} or $F_{CH4,BL,y}$**
Unit:	% or tones
Description:	Methane destroyed due to regulatory or other requirements
Measured/ Calculated / Default:	Regulatory requirements relating to landfill gas projects (NOM-083-SEMARNAT-2003) have been followed in order to comply with it.
Source of data:	National environmental legislation – annual phone calls to environmental authorities. Communication is received, confirmed and signed by the authority and the same is archived at Chihuahua City.
Value(s) of monitored parameter:	Remain the same (zero)
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	For the current monitoring period the file called: “Constancia de monitoreo anual a los requerimientos relacionados con los proyectos Landfill Gas-to-Energy” are dated on 10 March 2017 and 12 March 2018
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	The information though recorded annually, is used for the amount of methane destroyed in the baseline scenario $F_{CH4,BL,y}$ or directly MD_{reg} at renewal of the crediting period.
Additional comments:	NA

Data / Parameter:	**$EG_{PJ,y}$**
Unit:	MWh
Description:	Amount of electricity generated using LFG
Measured/ Calculated / Default:	Measured

Source of data:	Bidirectional power meter Monthly electricity sale receipts emitted by CFE
Value(s) of monitored parameter:	35,017.77 MWh Values per month are presented in a separated spreadsheet: 2019_01_14_Total ERy 4th verification
Monitoring equipment:	**Type**: Bidirectional electricity meter – Schneider Electric **Accuracy Class**: +0.2% **Serial No.**: Serial: PT-0812A448-01 Model: PowerLogic ION8600 **Calibration Frequency**: Annually **Date of last calibration**: Refer to table 7 above **Validity**: During the monitoring period
Measuring/ Reading/ Recording frequency:	Continuously measured, aggregated every month by the grid administrator (CFE). Photographic evidence on the meter readings every 24 hours is also archived.
Calculation method (if applicable):	N/A
QA/QC procedures:	The meter is calibrated annually by the grid administrator (CFE)
Purpose of data:	Calculation of baseline emissions
Additional comments:	Data from the photos is cross-checked to the monthly electricity sale receipts.

Data / Parameter:	**$EG_{EC,y}$**
Unit:	MWh
Description:	Amount of electricity consumed by the project activity
Measured/ Calculated / Default:	Measured
Source of data:	Bidirectional power meter Monthly electricity sale receipts emitted by CFE
Value(s) of monitored parameter:	8.408 MWh Values per month are presented in a separated spreadsheet: 2019_01_14_Total ERy 4th verification
Monitoring equipment:	**Type**: Bidirectional electricity meter – Schneider Electric **Accuracy Class**: +0.2% **Serial No.**: Serial: PT-0812A448-01 Model: PowerLogic ION8600 **Calibration Frequency**: Annually **Date of last calibration**: Refer to table 7 above **Validity**: During the monitoring period
Measuring/ Reading/ Recording frequency:	Continuously measured, aggregated every month by the grid administrator (CFE). Photographic evidence on the meter readings every 24 hours is also archived.
Calculation method (if applicable):	N/A
QA/QC procedures:	The meter is calibrated annually by the grid administrator (CFE)
Purpose of data:	Calculation of project emissions

Additional comments:	Data from the photos is cross-checked to the monthly electricity sale receipts.

Data / Parameter:	**$OP_{j,h}$**
Unit:	Hours
Description:	Operating hours of the energy plant
Measured/ Calculated / Default:	Measured
Source of data:	Hour meter located in every generation engine
Value(s) of monitored parameter:	29,026 hours Values in detail are presented in a separate spreadsheet: 2019_09_14_Total ERy 4th verification
Monitoring equipment:	Hour meter
Measuring/ Reading/ Recording frequency:	Continuously measured. Personnel on-site take daily notes on the readings of every engine hour meter at 7:00 and 19:00 hrs. Data is aggregated daily.
Calculation method (if applicable):	Operation hours registered for every engine are summed to obtain the total.
QA/QC procedures:	N/A
Purpose of data:	This parameter is monitored to ensure methane destruction is claimed for methane used in electricity plant when it is operational.
Additional comments:	N/A

Data / Parameter:	**Management of SWDS**
Unit:	
Description:	Management of SWDS
Measured/ Calculated / Default:	National environmental legislation – annual phone calls to environmental authorities. Communication is received, confirmed and signed by the authority and the same is archived at Chihuahua City.
Source of data:	Regulatory requirements relating to landfill gas projects (NOM-083-SEMARNAT-2003) have been followed in order to comply with it. Also, Biogas de Juarez has not changed the original design of the landfill nor the technical specifications of the site management.
Value(s) of monitored parameter:	N/A
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	For the current monitoring period the file called: “Constancia de monitoreo anual a los requerimientos relacionados con los proyectos Landfill Gas-to-Energy” are dated on 10 March 2017 and 12 March 2018
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	To ensure that any practice to increase methane generation have been occurring prior to the implementation of the project activity.
Additional comments:	NA

Data / Parameter:	**LFG_{flared}**
Unit:	**m^3**
Description:	Total amount of LFG flared

Measured/ Calculated / Default:	Measured
Source of data:	Flow meter
Value(s) of monitored parameter:	Zero, any LFG flared was taken into account during the present monitoring period.
Monitoring equipment:	

Type	FOXBORO flow meter
Accuracy Class	Accuracy for gases and steam is + 1% of reading for flow rates with Reynolds number of 20,000 or greater
Serial No.	Serial: 07210815 Model: 83F-T08S1SSTJA
Calibration Frequency	Calibration is not required by the manufacturer; however, for QA/QC procedures, verification of the instrument is performed every 6 months.
Date of last calibration	Refer to table 7 above
Validity	During the monitoring period

Measuring/ Reading/ Recording frequency:	Data are continuously measured by a flow meter.
Calculation method (if applicable):	Value presented at normal conditions (temperature and pressure)
QA/QC procedures:	Flow meter is subject to a regular maintenance and testing regime to ensure accuracy.
Purpose of data:	No purpose during this monitoring period.
Additional comments:	Although the parameter is part of the registered PDD and used methodologies and tools, the same was not used for calculations since the flare system is off.

Data / Parameter:	**FE**
Unit:	Number
Description:	Flare/combustion efficiency, determined by the operation hours (1) and the methane content in the exhaust gas (2)
Measured/ Calculated / Default:	Calculated
Source of data:	N/A
Value(s) of monitored parameter:	N/A, any LFG flared was taken into account during the present monitoring period.
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	Tool to determine project emissions from flaring gases containing methane.
QA/QC procedures:	N/A
Purpose of data:	No purpose during this monitoring period
Additional comments:	Although the parameter is part of the registered PDD and used methodologies and tools, the same was not used for calculations since the flare system is off.

Data / Parameter:	**$PE_{flare,y}$**
Unit:	tCO2e
Description:	Project emissions from flaring of the residual gas stream in year *y*
Measured/ Calculated / Default:	Calculated
Source of data:	N/A
Value(s) of monitored parameter:	N/A, any LFG flared was taken into account during the present monitoring period.
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	Tool to determine project emissions from flaring gases containing methane.
QA/QC procedures:	N/A
Purpose of data:	No purpose during this monitoring period
Additional comments:	Although the parameter is part of the registered PDD and used methodologies and tools, the same was not used for calculations since the flare system is off.

Data / Parameter:	**$V_{i,RG,\ m}$**
Unit:	%
Description:	Volumetric fraction of component *i* in the residual gas in the minute *m* where *i* = CH_4, N_2
Measured/ Calculated / Default:	Measured
Source of data:	Gas analyzer
Value(s) of monitored parameter:	Zero, any LFG flared was taken into account during the present monitoring period.
Monitoring equipment:	**Type**: Gas analyzer **Accuracy Class**: <1% of full-scale value. **Serial No.**: Serial: N1-V3-0218 Model: ULTRAMAT 23 **Calibration Frequency**: Quarterly basis as per manufacturer specifications, however, a stricter practice which is to perform a manual calibration at least once a month has been implemented. Automatic Zero on CH_4 and a span on O_2 are performed every day. **Date of last calibration**: Refer to Table 7 above **Validity**: During the monitoring period
Measuring/ Reading/ Recording frequency:	Data are continuously measured by a gas analyzer.
Calculation method (if applicable):	NA
QA/QC procedures:	The gas analyzer is subject to a regular maintenance and testing regime to ensure accuracy.

Purpose of data:	No purpose during this monitoring period
Additional comments:	Although the parameter is part of the registered PDD and used methodologies and tools, the same was not used for calculations since the flare system is off.

Data / Parameter:	$V_{RG,m}$
Unit:	**m^3/h**
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the minute *m*
Measured/ Calculated / Default:	Measured
Source of data:	Flow meter
Value(s) of monitored parameter:	Zero, any LFG flared was taken into account during the present monitoring period.
Monitoring equipment:	**Type**: FOXBORO flow meter **Accuracy Class**: Accuracy for gases and steam is + 1% of reading for flow rates with Reynolds number of 20,000 or greater **Serial No.**: Serial: 07210815 Model: 83F-T08S1SSTJA **Calibration Frequency**: Calibration is not required by the manufacturer; however, for QA/QC procedures, verification of the instrument is performed every 6 months. **Date of last calibration**: Refer to table 7 above **Validity**: During the monitoring period
Measuring/ Reading/ Recording frequency:	Data are continuously measured by a flow meter.
Calculation method (if applicable):	Value presented at normal conditions (temperature and pressure)
QA/QC procedures:	Flow meter is subject to a regular maintenance and testing regime to ensure accuracy.
Purpose of data:	No purpose during this monitoring period.
Additional comments:	Although the parameter is part of the registered PDD and used methodologies and tools, the same was not used for calculations since the flare system is off.

Data / Parameter:	**$V_{O2,EG,m}$**
Unit:	%
Description:	Volumetric fraction of O_2 in the exhaust gas on a dry basis at reference conditions in the minute *m*
Measured/ Calculated / Default:	Measured
Source of data:	Gas analyser
Value(s) of monitored parameter:	Zero, any LFG flared was taken into account during the present monitoring period.

Monitoring equipment:	<table><tr><td>**Type**</td><td>Gas analyzer</td></tr><tr><td>**Accuracy Class**</td><td><1% of full-scale value.</td></tr><tr><td>**Serial No.**</td><td>Serial: N1-V3-0218 Model: ULTRAMAT 23</td></tr><tr><td>**Calibration Frequency**</td><td>Quarterly basis as per manufacturer specifications, however, a stricter practice which is to perform a manual calibration at least once a month has been implemented. Automatic Zero on CH_4 and a span on O_2 are performed every day.</td></tr><tr><td>**Date of last calibration**</td><td>Refer to Table 7 above</td></tr><tr><td>**Validity**</td><td>During the monitoring period</td></tr></table>
Measuring/ Reading/ Recording frequency:	Data are continuously measured by a gas analyzer.
Calculation method (if applicable):	NA
QA/QC procedures:	The gas analyzer is subject to a regular maintenance and testing regime to ensure accuracy.
Purpose of data:	No purpose during this monitoring period
Additional comments:	Although the parameter is part of the registered PDD and used methodologies and tools, the same was not used for calculations since the flare system is off.

Data / Parameter:	**$fc_{CH4,EG,m}$**
Unit:	%
Description:	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the minute *m*
Measured/ Calculated / Default:	Measured
Source of data:	Gas analyzer
Value(s) of monitored parameter:	Zero, any LFG flared was taken into account during the present monitoring period.
Monitoring equipment:	<table><tr><td>**Type**</td><td>Gas analyzer</td></tr><tr><td>**Accuracy Class**</td><td><1% of full-scale value.</td></tr><tr><td>**Serial No.**</td><td>Serial: N1-V3-0218 Model: ULTRAMAT 23</td></tr><tr><td>**Calibration Frequency**</td><td>Quarterly basis as per manufacturer specifications, however, a stricter practice which is to perform a manual calibration at least once a month has been implemented. Automatic Zero on CH_4 and a span on O_2 are performed every day.</td></tr><tr><td>**Date of last calibration**</td><td>Refer to Table 7 above</td></tr><tr><td>**Validity**</td><td>During the monitoring period</td></tr></table>
Measuring/ Reading/ Recording frequency:	Data are continuously measured by a gas analyzer.
Calculation method (if applicable):	NA

QA/QC procedures:	The gas analyzer is subject to a regular maintenance and testing regime to ensure accuracy.
Purpose of data:	No purpose during this monitoring period
Additional comments:	Although the parameter is part of the registered PDD and used methodologies and tools, the same was not used for calculations since the flare system is off.

Data / Parameter:	$T_{EG,m}$
Unit:	°C
Description:	Temperature in the exhaust gas of the enclosed flare in minute *m*
Measured/ Calculated / Default:	Measured
Source of data:	2 Temperature transmitters
Value(s) of monitored parameter:	N/A, any LFG flared was taken into account during the present monitoring period.
Monitoring equipment:	

Type	Endress+Hauser Temperature transmitter
Accuracy Class	The maximum tolerance for an RTD class B system is + 0.3+0.005 C (absolute).
Serial No.	Serial: D50BC7231C1 Model: TMT122-D31BA
Calibration Frequency	Manufacturer states 1 calibration per year; however, for QA/QC procedures, calibration is performed every 6 months.
Date of last calibration	Refer to Table 7 above
Validity	During the monitoring period

Type	Endress+Hauser Temperature transmitter
Accuracy Class	The maximum tolerance for an RTD class B system is + 0.3+0.005 C (absolute).
Serial No.	Serial: D50BC8231C1 Model: TMT122-D31BA
Calibration Frequency	Manufacturer states 1 calibration per year; however, for QA/QC procedures, calibration is performed every 6 months.
Date of last calibration	Refer to Table 7 above
Validity	During the monitoring period

Measuring/ Reading/ Recording frequency:	Data are continuously measured by a temperature transmitter.
Calculation method (if applicable):	N/A
QA/QC procedures:	Temperature transmitter is subject to a regular maintenance and testing regime to ensure accuracy. Standard Operating Procedure for Calibration and Maintenance SOP-A-en-002.
Purpose of data:	No purpose during this monitoring period
Additional comments:	Although the parameter is part of the registered PDD and used methodologies and tools, the same was not used for calculations since the flare system is off.

D.3. Implementation of sampling plan

This section is not applicable

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

The baseline emissions were calculated according to the following formulas:

From the used methodology ACM0001, version 15.0

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y} \quad \text{(1BE)}$$

Where:

BE_y = Baseline emissions in year y (t CO_2e/yr)
$BE_{CH4,y}$ = Baseline emissions of methane from the SWDS in year y (t CO_2e/yr)
$BE_{EC,y}$ = Baseline emissions associated with electricity generation in year y (t CO_2/yr)
$BE_{HG,y}$ = Baseline emissions associated with heat generation in year y (t CO_2/yr)
$BE_{NG,y}$ = Baseline emissions associated with natural gas use in year y (t CO_2/yr)

The sample calculation for this formula, randomly chosen, is the accumulated of the month of July 2017, we chose the accumulated since the electricity generation data is based on the monthly invoices and the accumulated could easily provide traceability with the spreadsheet. For all the sample calculations showed in section E, please take into account that the figures show limited decimals, complete numbers can be examined in the spreadsheet attached.

BE_y	$BE_{CH4,y}$	$BE_{EC,y}$	$BE_{HG,y}$	$BE_{NG,y}$
13,866 tCO_{2e}	12,789 tCO_{2e}	1,077 tCO_{2e}	0 tCO_{2e}	0 tCO_{2e}

During the monitoring period the captured LFG was only destroyed through generation of electricity, thus $BE_{HG,y}$= 0 and $BE_{NG,y}$ = 0.

Therefore:

$$BE_y = BE_{CH4,y} + BE_{EC,y} \quad \text{(2BE)}$$

BE_y	$BE_{CH4,y}$	$BE_{EC,y}$
13,866 tCO_{2e}	12,789 tCO_{2e}	1,077 tCO_{2e}

From which:

$$BE_{CH4} = (1 - OX_{top\_layer}) * (F_{CH4,PJ,y} - F_{CH4,BL,y}) * GWP_{CH4} \quad (3BE)$$

Where:

$BE_{CH4,y}$ = Baseline emissions of methane from the SWDS in year y (t CO_2e/yr)

OX_{top_layer} = Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)[12]

$F_{CH4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the project activity in year y (t CH_4/yr)

$F_{CH4,BL,y}$ =Amount of methane in the LFG that would be flared in the baseline in year y (t CH_4/yr)

GWP_{CH4} = Global warming potential of CH4 (t CO_2e/t CH_4)

From the above formula, $F_{CH4,BL,y}$ = 0, as per registered PDD.

Sample calculation from the random date: 02 October 2017, 01:00 PM.

$BE_{CH4,y}$	OX_{top_layer}	$F_{CH4,PJ,y}$	$F_{CH4,BL,y}$	GWP_{CH4}
19* tCO_{2e}	0.1	0.85 tCH_4	0 tCH_4	25 tCO_{2e}/tCH_4

* Value is rounded; however, complete calculation and numbers are shown in the spreadsheet

Therefore:

$$BE_{CH4} = (1 - OX_{top\_layer}) * F_{CH4,PJ,y} * GWP_{CH4} \quad (4BE)$$

$BE_{CH4,y}$	OX_{top_layer}	$F_{CH4,PJ,y}$	GWP_{CH4}
19* tCO_{2e}	0.1	0.85 tCH_4	25 tCO_{2e}/tCH_4

* Value is rounded; however, complete calculation and numbers are shown in the spreadsheet

From which:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y} \quad (5BE)$$

Where:

$F_{CH4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the project activity in year y (t CH_4/yr)

$F_{CH4,flared,y}$ = Amount of methane in the LFG which is destroyed by flaring in year y (t CH_4/yr)

$F_{CH4,EL,y}$ = Amount of methane in the LFG which is used for electricity generation in year y (t CH_4/yr)

$F_{CH4,HG,y}$ = Amount of methane in the LFG which is used for heat generation in year y (t CH_4/yr)

$F_{CH4,NG,y}$ = Amount of methane in the LFG which is sent to the natural gas distribution network in year y (t CH_4/yr)

[12] *OXtop-layer* is the fraction of the methane in the LFG that would oxidize in the top layer of the SWDS in the absence of the project activity. Under the project activity, this effect is reduced as a part of the LFG is captured and does not pass through the top layer of the SWDS. This oxidation effect is also accounted for in the methodological tool "Emissions from solid waste disposal sites". In addition to this effect, the installation of a LFG capture system under the project activity may result in the suction of additional air into the SWDS. In some cases, such as with a high suction pressure, the air may decrease the amount of methane that is generated under the project activity. However, in most circumstances where the LFG is captured and used this effect was considered to be very small, as the operators of the SWDS have in most cases an incentive to main a high methane concentration in the LFG. For this reason, this effect is neglected as a conservative assumption.

Following with the above sample, the calculation of 02 October 2017 at 01:00 PM is showed:

$F_{CH4,PJ,y}$	$F_{CH4,flared,y}$	$F_{CH4,EL,y}$	$F_{CH4,HG,y}$	$F_{CH4,NG,y}$
0.85 tCH_4	0 tCH_4	0.85 tCH_4	0 tCH_4	0 tCH_4

The captured gas is only used for electricity generation, no flaring, or heating, or natural gas replacement took place, then:

$$F_{CH4,PJ,y} = F_{CH4,EL,y} \quad (6BE)$$

$F_{CH4,PJ,y}$	$F_{CH4,EL,y}$
0.85 tCH_4	0.85 tCH_4

As per used methodology ACM0001, version 15.0, parameter $F_{CH4,EL,y}$ is determined using the *"Tool to determine the mass flow of a greenhouse gas in gaseous stream", version 2.0.0.*

Option A in page 5 is being used, since it is demonstrated that the temperature in the gaseous stream is less than 60°C at the flow measurement point, as required in way (b) of the tool. Please refer to the complete hourly-recorded data in the file: "2019_01_14_Total ERy 4th verification"; column E shows readings from the temperature meter TE8030.

During the complete monitoring period, there are only eight readings in which the temperature meter was above 60°C.

For the mentioned readings there is any claim of emission reductions, i.e. for these 8 readings parameter BE_{CH4}=0.

The mass flow of greenhouse gas *i* ($F_{i,t}$), $F_{CH4,EL,y}$ in the project case, is determined as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t} \quad (5)$$

With

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \quad (6)$$

Where:

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

In terms of the project activity and the parameters described in section C and D above:

$$F_{CH4,EL,y} = (LFG_{electricity,y}) * (W_{CH4}) * (\rho_{CH4}) \quad (7BE)$$

Following with the above sample calculation, for 02 October 2017 at 01:00 PM:

$F_{CH4,EL,y}$	$LFG_{electricity,y}$	W_{CH4}	ρ_{CH4}
0.85* tCH_4	2,464.8115 m^3/h	0.4729	0.0007286 tCH_4/m^3CH_4

* Value is rounded; however, complete calculation and numbers are shown in the spreadsheet

$$\rho_{CH4} = \frac{P * MM_{CH4}}{(T + 273.15) * Ru} \quad (8BE)$$

From the above equations (7BE) and (8BE) parameters $LFG_{electricity}$, W_{CH4}, P, T are monitored according to sections C and D.2 above.

For the following parameters the values are stated in the mentioned tool:

$MM_{CH4} = 16.04$ kg/kmol
$R_u = 8{,}314$ Pa m^3/kmol °K

Then, the calculation for the chosen date, 02 October 2017 at 01:00 PM leads to:

ρ_{CH4}*	P	MM_{CH4}	T	Ru
0.0007286 tCH_4/m^3CH_4	116.45 kPa	16.04 kg/kmol	35.21 °C = 308.36 °K	8,314 Pa m^3/kmol°K

* Value is rounded; however, complete calculation and numbers are shown in the spreadsheet

Back to the formula (2BE), the baseline emissions associated with electricity generation in year y ($BE_{EC,y}$) are calculated using the *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption", version 1.* When applying the tool:

(a) The electricity sources *k* in the tool correspond to the sources of electricity generated identified in the selection of the most plausible baseline scenario; and
(b) $EC_{BL,k,y}$ in the tool is equivalent to the net amount of electricity generated using LFG in year y ($EG_{PJ,y}$)

Scenario A described in the Tool applies for the calculation in the following equation:

$$BE_{EC,y} = \sum_k EC_{BL,k} * EF_{EL,k,y} * (1 + TDL_{k,y}) \quad (9BE)$$

Where:

$BE_{EC,y}$ = Baseline emissions from electricity consumption in year y (tCO2/yr)
$EC_{BL,k}$ = Quantity of electricity that would be consumed by the baseline electricity consumption source k in year y (MWh/yr)
$EF_{EL,k,y}$ = Emission factor for electricity generation for source k in year y (tCO2/MWh)
$TDL_{k,y}$ = Average technical transmission and distribution losses for providing electricity to source k in year y

Sample calculation for this formula is the electricity generated during July 2017 in order to show consistency with formulas (1BE) and (2BE) above.

$BE_{EC,y}$	$EC_{BL,k}$	$EF_{EL,k,y}$	$TDL_{k,y}$
1,077.24 tCO_{2e}	2,621,880.54 kWh	0.0003989 tCO2/kWh	0.03 (3%)

For the means of the project activity and according to the used parameters and values, the above formula and calculation will lead to:

$$BE_{EC,y} = \sum_{k} EG_{PJ,y} * EF_{CM} * (1 + 0.03) \quad \text{(10BE)}$$

$BE_{EC,y}$	$EG_{PJ,y}$	EF_{CM}	$TDL_{k,y}$
1,077.24 tCO_{2e}	2,621,880.54 kWh	0.0003989 tCO2/kWh	0.03 (3%)

E.2. Calculation of project emissions or actual net removals

According to methodology ACM0001, version 15.0, project emissions are calculated as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} \quad \text{(1PE)}$$

Where:

PE_y = Project emissions in year y (t CO_2/yr)

$PE_{EC,y}$ = Emissions from consumption of electricity due to the project activity in year y (t CO_2/yr)consumption source *k* in year *y* (MWh/yr)

$PE_{FC,y}$ = Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year y (t CO_2/yr)

For the sample calculation the random month of January 2018 is chosen:

PE_y	$PE_{EC,y}$	$PE_{FC,y}$
1 tCO_2	1 tCO_2	0 tCO_2

During the monitoring period there was any use of fossil fuels on Ciudad Juarez landfill due to the implementation of the project activity ($PE_{FC,y}$=0); hence, the project emissions are equivalent to emissions from electricity consumption and will be calculated as follows:

$$PE_y = PE_{EC,y} \quad \text{(2PE)}$$

PE_y	$PE_{EC,y}$
1 tCO_2	1 tCO_2

The project emissions from consumption of electricity by the project activity ($PE_{EC,y}$) shall be calculated using the *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption", version 1:*

$$PE_{EC,y} = \sum_{k} EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y}) \quad \text{(3PE)}$$

Where:

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

$EC_{PJ,j,y}$ = Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)

$EF_{EL,j,y}$ = Emission factor for electricity generation for source *j* in year *y* (tCO2/MWh)

$TDL_{j,y}$ = Average technical transmission and distribution losses for providing electricity to source *j* in year *y* (%)

Sample calculation for this formula is the electricity consumed during January 2018 in order to show consistency with formulas (1PE) and (2PE) above. Please notice that although the result is less than 1 tCO2e, the value was rounded up for conservativeness principle (the same applies for all the $PE_{EC,y}$ monthly values).

$PE_{EC,y}$	$EC_{PJ,j,y}$	$EF_{EL,k,y}$	$TDL_{j,y}$
0.115* tCO_{2e}	239.46 kWh	0.0003989 tCO2/kWh	0.20 (20%)

* Value is rounded; however, complete calculation and numbers are shown in the spreadsheet

For the means of the project activity and according to the used parameters and values, the above formula and values will lead to:

$$PE_{EC,y} = \sum_{k} EG_{EC,y} * EF_{CM} * (1 + 0.20) \quad \text{(4PE)}$$

$PE_{EC,y}$	EG_{EC}	EF_{CM}	$TDL_{j,y}$
0.115* tCO_{2e}	239.46 kWh	0.0003989 tCO2/kWh	0.20 (20%)

* Value is rounded; however, complete calculation and numbers are shown in the spreadsheet

Summary:

According to the general formula: $ER_y=BE_y-PE_y-LE_y$; (ER)

and to the formulas:

$$BE_y = BE_{CH4,y} + BE_{EC,y} \quad \text{(2BE)}$$

$$PE_y = PE_{EC,y} \quad \text{(2PE)}$$

$LE_y = 0$ (1LE)

Table 8. ER values per month

					PEy	
		BECH4 (tCO2e)	BEEC (tCO2e)	BEy (tCO2e)	PEEC (tCO2e)	ERy (tCO2e)
2017	June	11,451	962	12,413	1	12,412
	July	12,789	1,077	13,866	1	13,865
	August	12,409	1,051	13,459	1	13,458
	September	11,981	1,026	13,006	1	13,005
	October	13,247	1,161	14,407	1	14,406
	November	12,049	1,093	13,142	1	13,141
	December	8,479	1,132	9,611	1	9,610
2018	January	10,685	943	11,627	1	11,626
	February	9,864	866	10,730	1	10,729
	March	11,332	981	12,313	1	12,312
	April	9,524	843	10,367	1	10,366
	May	10,109	870	10,979	1	10,978
	June	8,059	721	8,780	1	8,779
	July	8,378	770	9,147	1	9,146
	August	9,211	893	10,103	1	10,102
				173,950	**15**	**173,935**

Columns BE_{CH4} and BE_{EC} are calculated with the raw data from the PLC and invoices. In order to be conservative, columns BE_y and PE_y are rounded down and rounded up, respectively.

The rest of the values mentioned in the above formulae are completely shown in the excel file: "2019_01_14_Total ERy 4th verification"

E.3. Calculation of leakage emissions

No leakage effects need to be accounted under the approved consolidated methodology ACM0001, version 15.

$LE_y=0$ (1LE)

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals (t CO_2e)	Project GHG emissions or actual net GHG removals (t CO_2e)	Leakage GHG emissions (t CO_2e)	GHG emission reductions or net anthropogenic GHG removals (t CO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	173,950	15	0	0	173,935	173,935

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (t CO_2e)	Amount estimated ex ante (t CO_2e)
173,935	206,713

E.6. Remarks on increase in achieved emission reductions

The actual values achieved during this monitoring period do not overpass the estimation in the registered PDD.

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Document information

Version	*Date*	*Description*
06.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

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