Monitoring report form for CDM project activity
(Version 09.0)

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

MONITORING REPORT			
Title of the project activity	CTR Rosario Landfill Gas Project		
UNFCCC reference number of the project activity	8242		
Version number of the PDD applicable to this monitoring report	08		
Version number of this monitoring report	5		
Completion date of this monitoring report	22/11/2021		
Monitoring period number	2nd monitoring period		
Duration of this monitoring period	From 01/09/2019 to 02/03/2020[1]		
Monitoring report number for this monitoring period	Not applicable		
Project participants	Vital Engenharia Ambiental S.A.		
Host Party	Brazil		
Applied methodologies and standardized baselines	ACM0001: Flaring or use of landfill gas, version 19.0;		
Sectoral scopes	Sectoral Scope: 1 (Energy industries) Sectoral Scope: 13 (waste handling and disposal)		
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 until 31 December 2020	Amount achieved from 1 January 2021
	-	13,290	-
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	49,146[2]		

[1] Both days included

[2] Calculated using the PDD estimation for 2019 (94,495) times the number of days monitored in the year (122) divided by the total number of days in the year (365), plus PDD estimation for 2020 (103,671) times the number of days monitored in the year (62) divided by the total number of days in the year (366).

SECTION A. Description of project activity

A.1. General description of project activity

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CTR Rosario Landfill Gas Project is a landfill gas collection, use and flare project in Brazil. The project's core idea is to avoid emissions of methane gas to the atmosphere from the landfill called "C*entral de Tratamento de Resíduos Rosario*" (hereinafter referred to as *CTR Rosario*) located in the municipality of Rosario in the state of Maranhão, Brazil. The project activity comprises the installation of a new active LFG extraction, flaring and electricity generation systems. The main equipment currently installed in this project activity are:

- 2 blowers;
- 1 flare;
- 2 Electricity Group Generators
- Several collection wells, manifolds and transmission pipelines;

See section B.1. for further details on the technology employed.

Vital Engenharia Ambiental S.A. is the company responsible for the implementation and operation of the landfill (disposing around 1,200 tons of solid waste per day) and Enc Energy is responsible for electricity generation and commercialization. The project consists of:

- LFG capture and flaring, reducing uncontrolled release to atmosphere;
- Generating electricity from LFG. Part of the electricity will be used for self-consumption and the other part will be exported to the grid.

During the period between the start of the 1st Crediting Period until open flare commissioning date, the plant has not operational, once the Project Participant could not find the sufficient commercial conditions to implement the plant.

The commissioning of the open flare is 23/07/2019.

The commissioning date of each Group generators are:

- Group generator 1: 26/08/2019
- Group generator 2: 17/01/2020

The start of the commercial operation of each Group generator are:

- Group generator 1: 26/08/2019
- Group generator 2: 31/03/2020

The landfill gas was collected only through a passive system, with no systematic and monitored flare. Therefore, an extra-incentive was needed to make additional investments and enhance its landfill gas collection rate and install appropriate facilities to properly flare the methane produced at the site and generate electricity.

The total emission reductions achieved in this period is **13,290 tCO2e.**

A.2. Location of project activity

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Host Party:

- Brazil

Region/State/Province:

- Maranhão

City/Town/Community:
- Rosario

Physical/Geographical location:
CTR Rosario is located at Fazenda Arapixi - zona industrial, Buenos aires, Rosario (city), Maranhão (State), Brazil.

Geo-coordinates: Latitude: 02° 54' 53.64" S and Longitude: 44° 16' 26.50" W
Decimal coordinates: Latitude: -2.914900° Longitude: -44.274028°

Figure 1 - Geographical position of Rosario city, inside of Maranhão State in Brazil

Source: IBGE Cidades (http://www.ibge.gov.br/cidadesat/topwindow.htm?1)

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Vital Engenharia Ambiental S.A. (private entity)	No

This monitoring report was developed and reviewed by:

Consultancy	Project Proponent (Project Participant)
BENG	Vital Engenharia Ambiental S.A.
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A.4. References to applied methodologies and standardized baselines

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The applied methodology is ACM0001 - Flaring or use of landfill gas, version 19.0.
Tools to which the methodology refers are the following:

- Large-scale Consolidated Methodology ACM0001: "Flaring or use of landfill gas" (Version 19.0)[3];
- TOOL02 Methodological tool: "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 07.0)[4];
- TOOL03 Methodological tool: "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 03.0)[5].
- TOOL04 Methodological tool: "Emissions from solid waste disposal sites" (Version 08.0)[6];
- TOOL05 Methodological tool: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (Version 03.0)[7];
- TOOL06 Methodological tool: "Project emissions from flaring" (Version 03.0)[8];
- TOOL07 Methodological tool: "Tool to calculate the emission factor for an electricity system" (Version 07.0)[9];
- TOOL08 Methodological tool: "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0)[10];
- TOOL09 Methodological tool: "Determining the baseline efficiency of thermal or electric energy generation systems" (Version 02.0)[11];
- TOOL10 Methodological Tool: "Tool to determine the remaining lifetime of equipment" (Version 01)[12];
- TOOL12 Methodological tool: "Project and leakage emissions from transportation of freight" (Version 01.1.0)[13];
- TOOL32 Methodological tool: "Positive lists of technologies" (Version 02.0)[14].

A.5. Crediting period type and duration

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The renewable crediting period is from 01/01/2014 to 31/12/2020 (1st Crediting Period).

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

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Rosário Landfill Gas Project started its operations on 26/08/2019, as per commissioning date of first group generator which also corresponds to the start of its commercial operation.

During this monitoring period, the project has operated with one flare, two blowers and two group generators destroying the LFG collected in only one landfill site.

[3] https://cdm.unfccc.int/methodologies/DB/JPYB4DYQUXQPZLBDVPHA87479EMY9M
[4] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v7.0.pdf
[5] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf
[6] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v8.0.pdf
[7] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf
[8] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v3.0.pdf
[9] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf
[10] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf
[11] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v2.0.pdf
[12] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-10-v1.pdf
[13] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.1.0.pdf
[14] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-32-v2.0.pdf

Flare	Manufacturer	ENC Energy
	Type	Open
	Commissioning date	23/07/2019
	Model	EM500
	Serial number	180023
	Year of manufacturing	2018
	Nominal gas flow	500 Nm³/h
	Minimum efficiency	50%
Blower 1	Year	2018
	Manufacturer	Continental Industries
	Model	051A.06
	Serial number	18510006
	Maximum capacity	3750 RPM
Blower 2	Year	2018
	Manufacturer	Continental Industries
	Model	051A.06
	Serial number	18510005
	Maximum capacity	3750 RPM

Table 1 –Technical details of equipment installed at Project Activity

The system has installed group generators, to supply electricity for the project internal consumption and electricity export to the grid. The specification of these equipment is presented in the table below:

Group Generator 1 Manufacturer: GE Jenbacher Group Generator 2 Manufacturer: GE Jenbacher
Group Generator 1 Model: JGC 320 GS-L.L. Group Generator 2 Model: JGS 320 GS-L.L.
Serial Number Group Generator 1: 1362594 Serial Number Group Generator 2: 1362606
Group Generator 1 installed capacity: 1.000 kW Group Generator 2 installed capacity: 1.000 kW
Year GG1: 2018 Year GG2: 2018

Table 2 – Group Generators specifications

Most of this monitoring period the system has been in normal operation. There were a few days with significant down period and those were listed in a separate spreadsheet and have no impact on the methodology applicability.

B.2. Post-registration changes

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

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DEVIATION 1:

In the registered monitoring plan described in the PDD, direct monitoring is conducted on the LFG captured, destroyed by flare and used for power generation. The plant monitoring meters are connected through a Programmable Logic Control (PLC) and the monitored parameters are continuously sampled and stored in the plant data logger. Then the information registered is automatically aggregated every minute in a monitored data report.

- From the entire monitoring period, the supervisory system was not operational due to supervisory system software errors causing the lack of registration of the main data. The parameters which were not monitored correctly were:
  - $O_{pj,h}$ - Operation of the equipment that consumes the LFG;
  - $V_{t,db}$ - Volumetric flow of the gaseous stream in time interval t on a dry basis;
  - $V_{t,wb}$ - Volumetric flow of the gaseous stream in time interval t on a wet basis;
  - $v_{i,t,db}$ - Volumetric fraction of greenhouse gas i in a time interval t on a dry basis;
  - $v_{i,t,wb}$ - Volumetric fraction of greenhouse gas i in a time interval t on a wet basis;
  - T_t - Temperature of the gaseous stream in time interval t;
  - P_t - Pressure of the gaseous stream in time interval t;
  - Status of biogas destruction device - Operational status of biogas destruction devices;
  - $Flame_m$ - Flame detection of flare in the minute m;

The landfill gas suction and electricity generation systems operated normally, what can be clearly demonstrated by the exported electricity meter data, which has registered all the electricity exported to the grid. For this reason, a temporary deviation from the monitoring plan is being requested for these periods while the plant operated normally but no data was registered by the supervisory system, and emission reductions will be claimed according to a conservative estimative based on the electricity exported using landfill gas.

The estimative of methane volume into power plant will be based on the electricity exported to the grid instead of electricity generated by the power plant, which is greater as it includes the electricity for self-consumption by the plant equipment. The methane fed to the engines will be calculated as follows:

$$F_{CH4,EL} = \frac{EC_{BL} \times (Conversion\ rate\ MWh\ to\ TJ)}{(NCV_{CH4}) \times El.eff}$$

Where:

$F_{CH4,EL}$	=	Amount of methane in the LFG which is used for electricity generation (tCH4)
EC_{BL}	=	Net amount of electricity generated using LFG and exported to the grid during the monitoring period applying deviation (MWh)[15]
Conversion rate MWh to TJ	=	Unit conversion rate from MWh to TJ (0.0036 TJ/MWh)[16]
NCV_{CH4}	=	Net calorific value of methane at reference conditions (0.0504 TJ/tCH4) according to ex-ante PDD.
El.eff	=	Efficiency of engine, assuming a 100% plant load factor as a conservative approach[17] (39.10%)

Then, the emission reductions will be normally calculated according to the methodologies and tools defined in the registered PDD and in the Section E of this monitoring report.

B.2.2. Corrections

>>
Not applicable

[15] According to electricity reports provided by the local Electricity Trader Company and Electricity Chamber Company.

[16] According to MIT Units & Conversions Fact Sheet. Source: https://cngcenter.com/wp-content/uploads/2013/09/UnitsAndConversions.pdf, accessed on 07/10/2019.

[17] As a conservative approach, a 100% load factor and 39.10% efficiency of engine (%) according to group generator data sheet was used in order to lower the calculated volume of CH_4 fed into the group generators.

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

>>
Not applicable

B.2.4. Inclusion of monitoring plan

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Not applicable.

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

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Not applicable.

B.2.6. Changes to project design

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Changes to Project Design, PDD version 8, that have been approved on 29/06/2020, post-registration changes reference number PRC-8242-001.

1) By voluntary update of the applied methodology version, ACM0001 v19.0. All applicable tools, emission reductions calculations and parameters inclusion related to the applied methodology have been updated accordingly.
2) Change in the electricity generation plant installed capacity estimation from 5.7 MW to 3 MW. The investments into the electricity generators were not under the PP's control. Emission reductions calculations were updated according to the new installed capacity.
3) Change in the electricity generation plant installed capacity currently installed from 4.3 MW to 2 MW. The investments into the electricity generators were not under the PP's control.
4) Change in flare design from enclosed flare to open flare.
5) Change in the value of technical transmission and distribution losses ($TDL_{k,y}$) from 16% to 20%, as being the default value from TOOL05.

B.2.7. Changes specific to afforestation or reforestation project activity

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Not applicable.

SECTION C. Description of monitoring system

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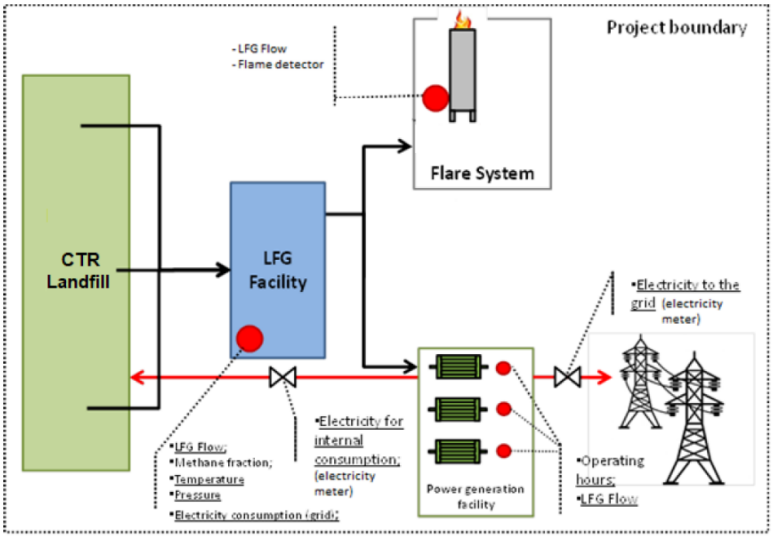
The monitoring equipment and their location are presented in below.



Considering the monitoring parameters presented in the registered PDD, it is important to highlight the current monitoring system situation for the present monitoring period:

(1) Since the flow meters already measures the volumetric flow rate of the residual gas at normal conditions, the parameters Temperature of the landfill gas (T) and Pressure of the landfill gas (P) have not been measured for normalizing purposes.

Monitoring instruments used under this monitoring period (deviation applied for the full monitored period) were running properly and calibrated during this monitoring period, as below:

Electricity Meter Group generator 1
Manufacturer: Landis Gyr
Model: E750 8701-A
Identification number: 3304-0070821-1
Range: 2.5 to 10 A
Accuracy class: C
Date of Calibration: 14/06/2018
Calibration Validity: 13/06/2023
Calibration Frequency: 5 years

Electricity Meter Group generator 2
Manufacturer: Landis Gyr
Model: E750 8701-A
Identification number: 3306-000226-1
Range: 2.5 to 10 A
Accuracy class: C
Date of Calibration: 19/07/2019
Calibration Validity: 18/07/2024
Calibration Frequency: 5 years

Also, aiming to demonstrate the normal operation conditions of the project plant, it is shown below the monitoring instruments not used under this monitoring period, due to deviation applied for the full monitored period are also shown below with calibration when available:

Open Flare flow meter
Manufacturer: Endress Hauser
Model: Prosonic Flow B 200
Serial number: N4120602000
Range: 1 to 30 m/s
Accuracy: 3%
Date of calibration: 24/04/2018
Calibration frequency: 2 years
Validity: 23/04/2020

Group Generators flow meter
Manufacturer: Endress Hauser
Model: Prosonic Flow B 200
Serial number: N4066002000
Range: 1 to 30 m/s
Accuracy: 3%
Date of calibration: 12/04/2018
Calibration frequency: 2 years
Validity: 11/04/2020

Residual gas analyser
Manufacturer: MRU
Model: SWG 100BIO-Ex
Serial number: 080902
Range: 0 - 100%
Accuracy: 3%
Date of calibration: 23/05/2018
Calibration frequency: 1 year
Validity: 22/05/2019

LFG Temperature
Manufacturer: Endress Hauser
Model: TR10

Sensor Type: Pt100
Serial number: R1043823180
Range: -50 up to 400ºC
Accuracy: ± (0.3 + 0.005 x Measured)
Date of calibration: 22/01/2020
Calibration frequency: 2 years
Validity: 21/01/2022

LFG Pressure
Manufacturer: Endress Hauser
Model: Cerabar PMP21
Serial number: N405A80116A
Range: 0 - 400 bar
Accuracy: 0.3%
Date of calibration: 26/04/2018
Calibration frequency: 2 years
Validity: 25/04/2020

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

In accordance to the registered PDD, the parameter Manufacturer's flare specifications for temperature, flow rate and maintenance schedule (SPECflare) was not used. In addition, specifically related to this monitoring period, the following ex ante parameters, also listed in the registered PDD, were not used for the calculation of emission reductions and thus not presented in the tables below:

- Waste composition
- Efficiency of the LFG capture system that will be installed in the project activity (ηPJ)
- Default value for model correction factor to account for model uncertainties (φdefault)
- Oxidation factor (reflecting the amount of methane from the considered SWDS that is oxidized in the soil (or other material covering the waste)) (OX)
- Fraction of methane in the SWDS gas (volume fraction) (F)
- Default value for the fraction of degradable organic carbon in MSW that decomposes in the SWDS (DOCf,default)
- Methane correction factor (MCFdefault)
- Fraction of degradable organic carbon in the waste type j (weight fraction) (DOCj)
- Decay rate for the waste type j (kj)
- Universal ideal gas constant (Ru)
- Molecular mass of greenhouse gas I (MMi)
- Molecular mass of gas k (MMk)
- Molecular mass of water (MMH2O)

Data/Parameter	OX_{top_layer}
Data unit	Dimensionless
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Consistent with how oxidation is accounted for in the methodological tool "Emissions from solid waste disposal sites"
Value(s) applied	0.1
Choice of data or measurement methods and procedures	Default value used, according to ACM0001
Purpose of data	Calculation of baseline emission
Additional comment	Applicable to Step A

Data/Parameter	GWP_{CH4}
Data unit	t CO_2e/t CH_4
Description	Global warming potential of CH_4
Source of data	IPCC
Value(s) applied	25 Updated for the 2nd commitment period according to COP/MOP decisions[18]
Choice of data or measurement methods and procedures	Default value used, according to IPCC Fourth Assessment Report: Climate Change 2007, item 2.10.2: Direct Global Warming Potentials, Table 2.14
Purpose of data	Calculation of baseline emission
Additional comment	In opposite of the PDD registered on 31/07/2013 using GWP of 21, it has been updated to 25.

D.2. Data and parameters monitored

In accordance with the registered PDD, the parameters below are not used:

- Quantity of LPG combusted in pilot flames of flares during year y (FCi,j,y)
- Weighted average CO2 emission factor of LPG in year y (EFCO2,LPG,y)
- Weighted average net calorific value of fossil fuel i in year y (NCVfuel,y)
- Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period t (FCH4,EG,t)
- Maintenance events completed in year y (Maintenancey)
- Temperature in the exhaust gas of the flare in minute m (TEG,m)

In addition to the parameters listed above, specifically to this monitored period, the following parameters that were listed in the registered PDD were not used to determine the emissions reductions by the project activity during the monitored period due to temporary deviation from the registered monitoring plan:

- $P_{H20,t,Sat}$: Saturation pressure of H_2O at temperature Tt in time interval t
- $EC_{PJ2,y} = EG_{EC2,y}$: Quantity of electricity consumed from diesel generator by the project activity during the year y

[18] IPCC Fourth Assessment Report: Climate Change 2007, item 2.10.2: Direct Global Warming Potentials, Table 2.14, available at: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html , accessed on 11/01/2018 and in accordance with EB69, Annex 3 and decision 4/CMP.7, available at: http://cdm.unfccc.int/Reference/Standards/meth/reg_stan02.pdf , accessed on 11/01/2018.

Baseline, project and/or leakage emission from electricity consumption and monitoring of electricity generation

Data/parameter:	$EF_{grid,CM,y}$
Unit	tCO_2 /MWh
Description	CO_2 emission factor of the Brazilian grid electricity during the year y
Measured/calculated/default	Calculated as the weighted average of the dispatch data analysis OM (Operating Margin) and the BM (Build margin).
Source of data	Brazilian DNA
Value(s) of monitored parameter	0.3100 (2019) 0.2759 (2020)
Monitoring equipment	Not applicable
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	Value applicable is calculated by considering the applicable guidance of the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures	Apply procedures in the "Tool to calculate the emission factor for an electricity system"
Purpose of data/parameter	Calculation of baseline/project emissions or actual net GHG removals by sinks;
Additional comments	All data and parameters to determine the grid electricity emission factor, as required by the "Tool to calculate the emission factor for an electricity system", were included in the monitoring plan.

Data/parameter:	$EF_{grid,OM,y}$
Unit	tCO_2 /MWh
Description	Operating margin emission factor of the Brazilian grid
Measured/calculated/default	Calculated (based on official monthly values as calculated and published by the DNA of Brazil).
Source of data	Brazilian DNA
Value(s) of monitored parameter	0.5181 (2019) 0.4539 (2020)
Monitoring equipment	Not applicable
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	Value applicable is calculated by considering the applicable guidance of the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures	Apply procedures in the "Tool to calculate the emission factor for an electricity system"
Purpose of data/parameter	Calculation of baseline/project emissions or actual net GHG removals by sinks;
Additional comments	All data and parameters to determine the grid electricity emission factor, as required by the "Tool to calculate the emission factor for an electricity system", were included in the monitoring plan.

Data/parameter:	$EF_{grid,BM,y}$
Unit	tCO_2 /MWh
Description	Build margin emission factor of the Brazilian grid

Measured/calculated/default	Calculated (based on official monthly values as calculated and published by the DNA of Brazil).
Source of data	Brazilian DNA
Value(s) of monitored parameter	0.1020 (2019) 0.0979 (2020)
Monitoring equipment	Not applicable
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	Value applicable is calculated by considering the applicable guidance of the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures	Apply procedures in the "Tool to calculate the emission factor for an electricity system". Most recently available data was used.
Purpose of data/parameter	Calculation of baseline/project emissions or actual net GHG removals by sinks;
Additional comments	All data and parameters to determine the grid electricity emission factor, as required by the "Tool to calculate the emission factor for an electricity system", were included in the monitoring plan.

Data/parameter:	TDL_y
Unit	-
Description	Average technical transmission and distribution losses in the grid in year *y* for the voltage level at which electricity is obtained from the grid at the project site.
Measured/calculated/default	Based on official documentation
Source of data	National Electricity Energy Balance 2020 (base year 2019)
Value(s) of monitored parameter	26.3% (2019) 26.3% (2020)
Monitoring equipment	Not applicable
Measuring/reading/recording frequency:	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years
Calculation method (if applicable):	Not applicable
QA/QC procedures	-
Purpose of data/parameter	Calculation of baseline/project emissions or actual net GHG removals by sinks;
Additional comments	-

Data/parameter:	$EC_{PJ1,y} = EG_{EC1,y}$
Unit	MWh/y
Description	Quantity of electricity consumed from the grid by the project activity during the year y;
Measured/calculated/default	Continuously measured by electricity meter.
Source of data	Measurement from Project participants.
Value(s) of monitored parameter	The CERs calculation spreadsheet includes all records of measurement data of this parameter during the considered monitoring period.

Monitoring equipment	*Group generator 1 (operational since 14/08/2019)* Monitored Period: From 01/09/2019 to 02/03/2020 Manufacturer: Landis Gyr Model: E750 8701-A Identification number: 3304-0070821-1 Range: 2.5 to 10 A Accuracy class: C Date of Calibration: 14/06/2018 Calibration Validity: 13/06/2023 Calibration Frequency: 5 years *Group generator 2 (operational since 14/02/2020)* Monitored Period: From 01/09/2019 to 02/03/2020 Manufacturer: Landis Gyr Model: E750 8701-A Identification number: 3306-000226-1 Range: 2.5 to 10 A Accuracy class: C Date of Calibration: 19/07/2019 Calibration Validity: 18/07/2024 Calibration Frequency: 5 years
Measuring/reading/recording frequency:	Continuously
Calculation method (if applicable):	Not applicable
QA/QC procedures	As per the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation". Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. According to electricity local distribution company invoices Calibration frequency is in accordance with Electric System National Operator (ONS).
Purpose of data/parameter	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comments	The data will be archived throughout the crediting period and two years thereafter.

ACM0001: Flaring or use of landfill gas

Data/parameter:	Management of SWDS
Unit	-
Description	Management of SWDS
Measured/calculated/default	As per the adopted monitoring procedure for the project activity, the management of the landfill is yearly compared against the previously conceived original construction and operational design of the landfill in order to confirm that the overall management and operation of the landfill (including relevant aspects related to landfilling practice) were not modified with the unique aim to increase generation of methane on site. By performing the checking annually, it is monitored whether any practice aiming to increase methane generation in the landfill has occurred. As required by ACM0001, any change in the management of the landfill after the implementation of the project activity should be justified by referring to applicable technical or regulatory specifications.

Source of data	Project Participant The current configuration and operational conditions of the landfill were compared against the previously conceived design and operational conditions of the landfill prior to the implementation of the project activity. According to the declaration issued by the Project Participant on 14/04/2021 there has never been organic waste recycling inside the landfill.
Value(s) of monitored parameter	Not applicable
Monitoring equipment	-
Measuring/reading/recording frequency:	Annually
Calculation method (if applicable):	Not applicable
QA/QC procedures	-
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	-

Data/parameter:	$EG_{PJ,y} = EC_{BL,k,y}$
Unit	MWh
Description	Amount of electricity generated using LFG by the project activity in year y
Measured/calculated/default	Measured by Project Participant
Source of data	Electricity meter
Value(s) of monitored parameter	The CERs calculation spreadsheet includes all records of measurement data of this parameter during the considered monitoring period.
Monitoring equipment	*Group generator 1 (operational since 14/08/2019)* Monitored Period: From 01/09/2019 to 02/03/2020 Manufacturer: Landis Gyr Model: E750 8701-A Identification number: 3304-0070821-1 Range: 2.5 to 10 A Accuracy class: C Date of Calibration: 14/06/2018 Calibration Validity: 13/06/2023 Calibration Frequency: 5 years *Group generator 2 (operational since 14/02/2020)* Monitored Period: From 01/09/2019 to 02/03/2020 Manufacturer: Landis Gyr Model: E750 8701-A Identification number: 3306-000226-1 Range: 2.5 to 10 A Accuracy class: C Date of Calibration: 19/07/2019 Calibration Validity: 18/07/2024 Calibration Frequency: 5 years
Measuring/reading/recording frequency:	Continuous

Calculation method (if applicable):	Not applicable
QA/QC procedures	This parameter is required for calculating baseline emissions associated with electricity generation ($BE_{EC,y}$) using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation". Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. According to electricity data reports monitored by PP and cross-checked against local distribution company invoices. Calibration frequency is in accordance with Electric System National Operator (ONS).
Purpose of data/parameter	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comments	The data will be archived throughout the crediting period and two years thereafter.

Data/parameter:	$O_{pj,h}$
Unit	-
Description	Operation of the equipment that consumes the LFG
Measured/calculated/default	For each equipment unit j using the LFG monitor that the plant is operating in hour h by the monitoring any one or more of the following three parameters: (a) Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer's specifications of the burning equipment. Document and justify the location and minimum threshold in the PDD; (b) Flame. Flame detection system is used to ensure that the equipment is in operation; (c) Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnances. This option is not applicable to brick kilns. $O_{pj,h}$=0 when: (a) One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); (b) Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); (c) No products are generated in the hour h. Otherwise, $O_{pj,h}$=1
Source of data	Measurements by Project participant using a device integrated with the operational software at the landfill gas plant.
Value(s) of monitored parameter	Not used during the monitored period due to the deviation.
Monitoring equipment	Flame detection system
Measuring/reading/recording frequency:	Once per minute
Calculation method (if applicable):	Not applicable

QA/QC procedures	The calibration of this equipment is not applicable since it is a device integrated with the operational software at the landfill gas plant.
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	-

Tool to determine the mass flow of a greenhouse gas in a gaseous stream

Data/parameter:	$V_{t,db}$
Unit	m^3 /h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Measured/calculated/default	Measured
Source of data	Measurements by Project participants using a flow meter
Value(s) of monitored parameter	Not used during the monitored period due to the deviation.
Monitoring equipment	*Open Flare flow meter* Manufacturer: Endress Hauser Model: Prosonic Flow B 200 Serial number: N4120602000 Range: 1 to 30 m/s Accuracy: 3% Date of calibration: 24/04/2018 Calibration frequency: 2 years Validity: 23/04/2020 *Group Generators flow meter* Manufacturer: Endress Hauser Model: Prosonic Flow B 200 Serial number: N4066002000 Range: 1 to 30 m/s Accuracy: 3% Date of calibration: 12/04/2018 Calibration frequency: 2 years Validity: 11/04/2020
Measuring/reading/recording frequency:	Continuous recorded and hourly aggregated
Calculation method (if applicable):	Not applicable
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. The calibration frequency of this monitoring equipment should be in accordance with manufacturer's specifications.
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	The design of the installed LFG flow meter for measuring the LFG flow to the flare ensures that measurement data is automatically converted and recorded in normal cubic meters per hour (Nm3 /h). Due to that, as further explained in Section D.1, measurements of LFG pressure and LFG temperature are not required for determining $V_{t,db}$ Monitored in case of Option A from tool

Data/parameter:	$V_{t,wb}$
Unit	m^3 /h

Description	Volumetric flow of the gaseous stream in time interval t on a wet basis
Measured/calculated/default	Measured
Source of data	Measurements by Project participants using a flow meter
Value(s) of monitored parameter	Not used during the monitored period due to the deviation.
Monitoring equipment	*Open Flare flow meter* Manufacturer: Endress Hauser Model: Prosonic Flow B 200 Serial number: N4120602000 Range: 1 to 30 m/s Accuracy: 3% Date of calibration: 24/04/2018 Calibration frequency: 2 years Validity: 23/04/2020 *Group Generators flow meter* Manufacturer: Endress Hauser Model: Prosonic Flow B 200 Serial number: N4066002000 Range: 1 to 30 m/s Accuracy: 3% Date of calibration: 12/04/2018 Calibration frequency: 2 years Validity: 11/04/2020
Measuring/reading/recording frequency:	Continuous recorded and hourly aggregated
Calculation method (if applicable):	Not applicable
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. The calibration frequency of this monitoring equipment should be in accordance with manufacturer's specifications.
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	The design of the installed LFG flow meter for measuring the LFG flow to the flare ensures that measurement data is automatically converted and recorded in normal cubic meters per hour (Nm3 /h). Due to that, as further explained in Section D.1, measurements of LFG pressure and LFG temperature are not required for determining $V_{t,db}$ Monitored in case of Option A from tool

Data/parameter:	$V_{i,t,db}$
Unit	m^3 gas i/m^3 dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Measured/calculated/default	Continuously measured by continuous CH_4 content gas analyzer.
Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (CH_4 content gas analyzer)
Value(s) of monitored parameter	Not used during the monitored period due to the deviation.

Monitoring equipment	*Residual gas analyser* Manufacturer: MRU Model: SWG 100BIO-Ex Serial number: 080902 Range: 0 - 100% Accuracy: 3% Date of calibration: 23/05/2018 Calibration frequency: 1 year Validity: 22/05/2019
Measuring/reading/recording frequency:	Continuous recorded and hourly aggregated
Calculation method (if applicable):	Not applicable
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	-

Data/parameter:	$v_{i,t,wb}$
Unit	m^3 gas i/m^3 dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a wet basis
Measured/calculated/default	Continuously measured by continuous CH_4 content gas analyzer.
Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (CH_4 content gas analyzer)
Value(s) of monitored parameter	Not used during the monitored period due to the deviation.
Monitoring equipment	*Residual gas analyser* Manufacturer: MRU Model: SWG 100BIO-Ex Serial number: 080902 Range: 0 - 100% Accuracy: 3% Date of calibration: 23/05/2018 Calibration frequency: 1 year Validity: 22/05/2019
Measuring/reading/recording frequency:	Continuous recorded and hourly aggregated
Calculation method (if applicable):	Not applicable
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	-

Data/parameter:	T_t
Unit	K
Description	Temperature of the gaseous stream in time interval t
Measured/calculated/default	Measured by Project Participant using temperature sensor
Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (temperature sensor)
Value(s) of monitored parameter	Not used during the monitored period due to the deviation.
Monitoring equipment	*LFG Temperature* Manufacturer: Endress Hauser Model: TR10 Sensor Type: Pt100 Serial number: R1043823180 Range: -50 up to 400ºC Accuracy: ± (0.3 + 0.005 x Measured) Date of calibration: 22/01/2020 Calibration frequency: 2 years Validity: 21/01/2022
Measuring/reading/recording frequency:	Continuous
Calculation method (if applicable):	Not applicable
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. The calibration frequency of this monitoring equipment should be according to the manufacturer's specifications
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, this parameter must be monitored continuously to assure the applicability condition is met.

Data/parameter:	P_t
Unit	Pa
Description	Pressure of the gaseous stream in time interval t
Measured/calculated/default	Measurements by Project participant using a pressure meter
Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (pressure meter)
Value(s) of monitored parameter	Not used during the monitored period due to the deviation.

Monitoring equipment	*LFG Pressure* Manufacturer: Endress Hauser Model: Cerabar PMP21 Serial number: N405A80116A Range: 0 - 400 bar Accuracy: 0.3% Date of calibration: 26/04/2018 Calibration frequency: 2 years Validity: 25/04/2020
Measuring/reading/recording frequency:	Continuous
Calculation method (if applicable):	Not applicable
QA/QC procedures	Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly. In case the pressure meter is not a capacitive or resistive pressure transducer, the calibration frequency of this monitoring equipment should be according to the manufacturer's specifications.
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency)

Data/parameter:	Status of biogas destruction device
Unit	-
Description	Operational status of biogas destruction devices
Measured/calculated/default	Measured by Project Participant
Source of data	Flame detector
Value(s) of monitored parameter	-
Monitoring equipment	UV flame detector
Measuring/reading/recording frequency:	Continuous
Calculation method (if applicable):	Not applicable
QA/QC procedures	-
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	For Flame detector devices refer to the methodological tool "Project emissions from flaring"

Methodological tool "Project emissions from flaring"

Data/parameter:	$Flame_m$
Unit	Flame on or Flame off
Description	Flame detection of flare in the minute m

Measured/calculated/default	Measurements by project participants using a continuous Ultra Violet flame detector
Source of data	Whenever flame is detected in the flare, flame status "on" or "1" value is attributed. Whenever no flame is detected in the flare, flame status "off" or "0" is attributed.
Value(s) of monitored parameter	Not used during the monitored period due to the deviation.
Monitoring equipment	UV flame detectors
Measuring/reading/recording frequency:	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off
Calculation method (if applicable):	Not applicable
QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations
Purpose of data/parameter	Calculation of baseline and project emissions when the flame is on[19].
Additional comments	-

D.3. Implementation of sampling plan

>>
Not applicable

SECTION E. Calculation of emission reductions or net anthropogenic removals

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

>>
Baseline emission calculation

The table below shows the consolidated collected and calculated data for the current monitoring period

	Deviation applied	BE,y	BEEC,y	BECH4,y	FCH4PJ,y	FCH4BL,y	FCH4flared,y	FCH4EL,y	% CH4	FCH4 sentflare,y	ECBL	Total methane for Group generators	Total methane to Flare	FCH4RG,t	PEflare,y
	(Yes/No)	tCO2	tCO2	tCO2	tCH4	tCH4	tCH4	tCH4	%	tCH4	MWh	Nm³CH4	Nm³CH4	kg	tCO2
09/2019	YES	1,443	158	1,285	73	15	0.0	73	N/A	0.0	402	102,555	0	0	0
10/2019	YES	2,793	305	2,488	142	28	0.0	142	N/A	0.0	779	198,572	0	0	0
11/2019	YES	2,313	253	2,060	118	24	0.0	118	N/A	0.0	645	164,422	0	0	0
12/2019	YES	2,410	263	2,147	123	25	0.0	123	N/A	0.0	672	171,347	0	0	0
01/2020	YES	2,371	233	2,138	122	24	0.0	122	N/A	0.0	670	170,644	0	0	0
02/2020	YES	1,894	186	1,708	98	20	0.0	98	N/A	0.0	535	136,286	0	0	0
Until 02/03/2020	YES	70	7	63	4	1	0.0	4	N/A	0.0	20	5,040	0	0	0

The baseline emission was calculated according to the following formula:

$$BE_y = BE_{CH4,y} + BE_{EC,y}$$

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)

Therefore, $BE_y = BE_{CH4,y} + BE_{EC,y}$

Step (A): Baseline emissions of methane from the SWDS ($BE_{CH4,y}$)

[19] When the flame is off, neither baseline nor project emissions occurs since the LFG is not combusted and instead released to the atmosphere.

$$BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y} \right) \times GWP_{CH4}$$

Where:

$BE_{CH4,y}$	=	Baseline emissions of LFG from the SWDS in year *y* (t CO_2e/yr)
OX_{top_layer}	=	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)
$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year *y* (t CH_4/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

Step A.1: *Ex-post* determination of $F_{CH4,PJ,y}$

During the crediting period, the **$F_{CH4,PJ,y}$** will be determined as follows:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$$

The following requirements apply:

(a) CH_4 is the greenhouse gas for which the mass flow should be determined;

(b) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations (3) or (17) in the tool);

(c) The mass flow should be calculated on an hourly basis for each hour *h* in year *y*;

(d) The mass flow calculated for hour *h* is 0 if the equipment is not working in hour *h* ($Op_{j,h}$=not working), the hourly values are then summed to a yearly unit basis.

The amount of methane destroyed by flaring ($F_{CH4,flared,y}$) will be determined as follows:

$$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}}$$

Where:

$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year y (t CH_4/yr)
$F_{CH4,sent\_flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year y (t CH_4/yr)
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year y (t CO_2e/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

$F_{CH4,sent\_flare,y}$ will be determined directly using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", applying the requirements described below. The tool shall be applied to the gaseous stream flowing in the LFG delivery pipeline to each flare.

According to "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" the following option will be considered for the present project activity:

- Option A (Volume flow in dry basis and volumetric fraction in dry basis) when the temperature of the gaseous stream is less than 60°C (333.15 K) at the flow measurement point.

- Option B (Volume flow in wet basis and volumetric fraction in dry basis) when the temperature of the gaseous stream is higher than 60ºC (333.15 K) at the flow measurement point.

Option A

Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. The demonstration will be made as following:

- Demonstrate that the temperature of the gaseous stream (T_t) is less than 60ºC (333.15 K) at the flow measurement point.

The mass flow of greenhouse gas i ($F_{i,t}$) is determined as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t}$$

With

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t}$$

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 (8,314 Pa.m³/kmol.K)
T_t = Temperature of the gaseous stream in time interval *t* (K)

If it cannot be demonstrated that the gaseous stream is dry, then the flow measurement should be assumed to be on a wet basis and the option B should be applied instead.

Option B

The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using equations used to Option A. The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis as follows:

$$V_{t,tb} = V_{t,wb}/(1 + v_{H2O,t,db})$$

Where:
$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m³ dry gas/h)
$V_{t,wb}$ = Volumetric flow of the gaseous stream in time interval *t* on a wet basis (m³ wet gas/h)
$v_{H2O,t,db}$ = Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m³ H_2O/m³ dry gas)

The volumetric fraction of H_2O in time interval *t* on a dry basis ($v_{H2O,t,db}$) is estimated according to following equation.

$$v_{H2O,t,db} = \frac{m_{H2O,t,db} * MM_{t,db}}{MM_{H2O}}$$

Where:

$v_{H2O,t,db}$ = Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m^3 H_2O/m^3 dry gas)

$m_{H2O,t,db}$ = Absolute humidity in the gaseous stream in time interval *t* on a dry basis (kg H_2O/kg dry gas)

$MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)

MM_{H2O} = Molecular mass of H_2O (kg H_2O/kmol H_2O)

The absolute humidity of the gaseous stream ($m_{H2O,t,db}$) will be determined using Option 2 (simplified calculation without measurement of the moisture content):

Option 2: Simplified calculation without measurement of the moisture content

This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation[20].

Concerning the project activity, the conservative situation will be to assume that the gaseous stream is saturated, then $m_{H2O,t,db}$ is assumed to equal the saturation absolute humidity ($m_{H2O,t,db,sat}$) and calculated using the following equation.

$$m_{H2O,t,db,Sat} = \frac{p_{H2O,t,Sat} * MM_{H2O}}{(P_t - p_{H2O,t,Sat}) * MM_{t,db}}$$

Where:

$m_{H2O,t,db,sat}$ = Saturation absolute humidity in time interval *t* on a dry basis (kg H_2O/kg dry gas)

$p_{H20,t,Sat}$ = Saturation pressure of H_2O at temperature Tt in time interval t (Pa)

T_t = Temperature of the gaseous stream in time interval *t* (K)

P_t = Absolute pressure of the gaseous stream in time interval *t* (Pa)

MM_{H2O} = Molecular mass of H_2O (kg H_2O/kmol H_2O)

$MM_{t,db}$ = Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas)

Parameter $MM_{t,db}$ is estimated using the following equation.

$$MM_{t,db} = \sum_k (v_{k,t,db} * MM_k)$$

Where:

$MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)

$v_{k,t,db}$ = Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis (m^3 gas k/m^3 dry gas)

MM_k = Molecular mass of gas *k* (kg/kmol)

k = All gases, except H_2O, contained in the gaseous stream (e.g. N_2 and CH_4,). See available simplification below

[20] An assumption that the gaseous stream is saturated is conservative for the situation that the mass flow of greenhouse gas *i* is underestimated (applicable for calculating baseline emissions). Conversely, an assumption that the gas stream is dry is conservative for the situation that the greenhouse gas *i* is overestimated (applicable for calculating project emissions).

The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (*k*) in the gaseous stream. However as a simplification, in the case of the project activity, the volumetric fraction of the methane that is a greenhouse gas and considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. The simplification is not acceptable if it is differently specified in the underlying methodology.

None of the available options to determine the mass flow of a GHG in a gaseous stream as described above was adopted due to the temporary deviations from the registered monitoring plan applied during the monitored period.

$PE_{flare,y}$ shall be determined using the methodological tool "Project emissions from flaring". If LFG is flared through one open flare, then $PE_{flare,y}$ is the sum of the emissions for each flare determined separately.

To determine the project emissions from flaring gases was used the tool "Project emissions from flaring". The project emissions calculation procedure is given in the following steps:

STEP 1: Determination of the methane mass flow of the residual gas;
STEP 2: Determination of the flare efficiency;
STEP 3: Calculation of project emissions from flaring.

Step 1: Determination of the methane mass flow in the residual gas

The "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" shall be used to determine the following parameter:

Parameter	SI Unit	Description
$F_{CH4,m}$	kg	Mass flow of methane in the residual gaseous stream in the minute m

The following requirements apply:

- The gaseous stream tool shall be applied to the residual gas;
- The flow of the gaseous stream shall be measured continuously;
- CH4 is the greenhouse gas i for which the mass flow should be determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool); and
- The time interval t for which mass flow should be calculated is every minute m

$F_{CH4,m}$, which is measured as the mass flow during minute m, shall then be used to determine the mass of methane in kilograms fed to the flare in minute m ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis.

None of the available options to determine the mass flow of a GHG in a gaseous stream as described above was adopted due to the temporary deviations from the registered monitoring plan applied during the monitored period.

Step 2: Determination of flare efficiency

Open flare

In the case of open flares, the flare efficiency in the minute *m* ($\eta_{flare,m}$) is 50% when the flame is detected in the minute *m* ($Flame_m$), otherwise $\eta_{flare,m}$ is 0%.

Step 3: Calculation of project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions for each minute *m* in year *y,* based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

$$PE_{flare\,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times (1 - \eta_{flare\,m}) \times 10^{-3}$$

Where:

$PE_{flare,y}$	=	Project emissions from flaring of the residual gas in year *y* (tCO_2e)
GWP_{CH4}	=	Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)
$F_{CH4,RG,m}$	=	Mass flow of methane in the residual gas in the minute *m* (kg)
$\eta_{flare,m}$	=	Flare efficiency in minute m

Table 3 – Parameters[21] used in the Tool "Project emissions from flaring"

Parameter	Description	Value	Unit
P_{ref}	Atmospheric pressure at reference conditions	101,325	Pa
R_u	Universal ideal gas constant	0.008314472	$Pa.m^3/kmol.K$
T_{ref}	Temperature at reference conditions	273.15	K
GWP_{CH4}	Global warming potential of methane valid for the commitment period	25[22]	tCO_2/tCH_4
$\rho_{CH4,n}$	Density of methane at reference conditions	0.716	kg/m^3

Step A.2: Determination of $F_{CH4,BL,y}$

In the baseline there are no regulatory or contractual requirements, or to address safety and odour concerns to capture and destroy LFG. Thus, the case of the project activity for determining methane captured and destroyed in the baseline is **Case 3** because there is existing LFG capture system (passive system), however there is no requirement to destroy methane. In this case:

$$F_{CH4,BL,y} = F_{CH4,BL,sys,y} = F_{CH4,sent\_flare,y}$$

Where:

$F_{CH4,BL,sys,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system (t CH_4/yr)
$F_{CH4,sent\_flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year y (t CH_4/yr)

The amount of methane captured with the existing system will be monitored along with the amount captured under the project activity and there is no historic data on the amount of methane that was captured in the year prior to the implementation of the project activity. Thus, the situation to determine $F_{CH4,BL,y}$ is:

If there is no monitored or historic data on the amount of methane that was captured in the year prior to the implementation of the project situation, then:

$F_{CH4,BL,sys,y} = 20\% \times F_{CH4,PJ,y}$; or

$F_{CH4,BL,y} = 20\% \times F_{CH4,PJ,y}$

Baseline emissions associated with electricity generation ($BE_{EC,y}$)

[21] As the Option B.1 of the tool "*Project emissions from flaring*" has been adopted to calculate the flare efficiency, the molecular mass parameters are not mentioned.

[22] Value for the 2nd commitment period updated according to COP/MOP decisions

$$BE_{EC,y} = \sum_{k} EC_{BL,k,y} \times EF_{EL,k,y} \times (1 + TDL_{k,y})$$

Where:

$BE_{EC,y}$	=	Baseline emissions from electricity generation in year *y* (tCO2/yr)
$EC_{BL,k,y} = EG_{PJ,y}$	=	Net amount of electricity generated using LFG in year y (MWh/yr)
$EF_{EL,k,y}$[23]	=	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*.

The baseline emissions associated with electricity generation in year y ($BE_{EC,y}$) shall be calculated using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

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

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The table below shows the consolidated collected and calculated data for the current monitoring period.

	Deviation applied	PE,y	PEEC1	PEEC2	ECPJ1	ECPJ2
	(Yes/No)	tCO2	tCO2	tCO2	MWh	MWh
09/2019	YES	1.30	1.30	0.00	3.32	0.00
10/2019	YES	0.19	0.19	0.00	0.48	0.00
11/2019	YES	0.10	0.10	0.00	0.27	0.00
12/2019	YES	0.19	0.19	0.00	0.48	0.00
01/2020	YES	0.21	0.21	0.00	0.60	0.00
02/2020	YES	1.29	1.29	0.00	3.69	0.00
Until 02/03/2020	YES	0.00	0.00	0.00	*	0.00

Project emissions:

$$PE_y = PE_{EC,y} + PE_{FC,y}$$

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

There is no consumption of fossil fuels due to the project activity for purpose other than electricity generation, in year y (tCO2/yr), therefore PEFC,y = 0

Calculation of $PE_{EC,y}$ – project emission from consumption of electricity

According to "*Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"*, the project emission from consumption of electricity will be from two sources:

[23] According to the "*Tool to calculate project or leakage CO2 emissions from fossil fuel combustion*", $EF_{EL,k,y} = EF_{grid,CM,y}$

- $PE_{EC1,y}$ - Grid (Brazilian interconnected electric system);
- $PE_{EC2,y}$ - Diesel generator(s) (off-grid captive power plant)

Thus,

$$PE_{EC,y} = PE_{EC1,y} + PE_{EC2,y}$$

$PE_{EC1,y}$ - Project emission from electricity consumption from the grid

As electricity will be consumed from the grid, the option A1 of the scenario A was chosen, as follows:

> *Option A1: Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest approved version of the "Tool to calculate the emission factor for an electricity system" ($EF_{EL,j/k/l,y} = EF_{grid,CM,y}$).*

Thus, the project emission is calculated as following:

$$PE_{EC\ 1,y} = EC_{PJ\ 1,y} \times EF_{grid\ ,CM\ ,y} \times (1 + TDL_{\ y})$$

Where:

$EC_{PJ1,y}$	= quantity of electricity consumed from the grid by the project activity during the year y (MWh);
$EF_{grid,CM,y}$	= the emission factor for the grid in year y (tCO_2/MWh);
TDL_y	= average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

$PE_{EC2,y}$ - Project emission from electricity consumption from an off-grid captive power plant (diesel generator(s))

As electricity will be consumed from diesel generators (off-grid captive power plant), a conservative approach was adopted and the option B2 of the scenario B was chosen because: "The electricity consumption source is a project or leakage electricity consumption source". Therefore, the value used will be 1.3 tCO2/MWh for project emission from diesel generator(s).

$$PE_{EC\ 2,y} = EC_{PJ\ 2,y} \times EF_{diesel\ \_\ generator\ \ ,y} \times (1 + TDL_{\ y})$$

Where:

$EC_{PJ2,y}$	= quantity of electricity consumed from diesel generator by the project activity during the year y (MWh);
$EF_{diesel\_generator,y}$	= the emission factor for the diesel generator in year y (tCO_2/MWh);
TDL_y	= average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

During the monitored period there were no diesel generator installed at the plant. Hence, there are no project emissions associated with the consumption of electricity from diesel generator (PE_{EC2} = 0 tCO_2e).

E.3. Calculation of leakage emissions

>>
Not applicable

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 until 31/12/2020	From 01/01/2021	Total amount
Total	13,294	4	-	-	13,290	-	13,290

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 for this monitoring period in the PDD (t CO_2e)
13,290	49,146

E.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the PDD"

>>
Calculated using the PDD estimation for 2019 (94,495) times the number of days monitored in the year (122) divided by the total number of days in the year (365), plus PDD estimation for 2020 (103,671) times the number of days monitored in the year (62) divided by the total number of days in the year (366).

E.6. Remarks on increase in achieved emission reductions

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The difference between the CERs calculated value for this monitoring period and estimated value in registered PDD is -73%.

E.7. Remarks on scale of small-scale project activity

>>
Not applicable.

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Document information

Version	*Date*	*Description*
09.0	8 October 2021	Revision to: • Ensure consistency with version 03.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN).
08.0	6 April 2021	Revision to: • Reflect the "Clarification: Regulatory requirements under temporary measures for post-2020 cases" (CDM-EB109-A01-CLAR).
07.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period; • Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods; • Make editorial improvements.
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.

Version	*Date*	*Description*
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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