Project design document form
(Version 12.0)

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

BASIC INFORMATION	
Title of the project activity	El Molle – Landfill gas (LFG) capture project
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	15
Completion date of the PDD	08/12/2021
Project participants	Gestión Integral de Residuos SpA (Chile) First Climate (Switzerland) AG
Host Party	Chile
Applied methodologies and standardized baselines	ACM0001: Flaring or use of landfill gas, version 19.0;
Sectoral scopes	Sectoral Scope: 1 (Energy) Sectoral Scope: 13 (waste handling and disposal)
Estimated amount of annual average GHG emission reductions	149,468 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>
El Molle landfill is an existing and operational landfill site. It is located 7 km far from Valparaiso city. The landfill site is suitable for municipal solid waste management and it is the most important landfill in the region. The landfill site belongs to the Valparaiso Municipality and was given under a 23 years public concession to Gestión Integral de Residuos SpA (GIRSpA). The landfill has been in operation since 1985 but GIRSpA has been landfilling only since the year of the contract, 2001. They will continue landfilling until 2021, year of the end of the contract.

Therefore, it will remain 3 years, since 2021, the year of this project start, to 2024, the year of the actual concession contract end.

The Project Activity aiming 3rd crediting period renewal is the same as in the 2nd crediting period, since:

- It is the same Project Participant GIRSpA;
- It is located in the same physical/geographical location;

Additionally, the flare used to burn LFG during the 1st crediting period has been decommissioned in 2012 and the electricity generation plant has entered in operation in 2015.

The purpose of the El Molle landfill project is the installation of a highly efficient landfill gas collection system and an electricity generation plant through LFG. This involves investments in a gas collection system, airtight covering of the landfill, flaring equipment and a LFG electricity generation plant with 4.5 MW (3 x 1.5 MW) installed capacity.

For this crediting period, estimates of GHG emission reductions are:

- Annual average GHG emission reduction: 149,468 tCO_2e
- Total estimated GHG emission reductions: 1,046,273 tCO_2e

The main social and environmental impacts of this project is a positive effect on health and amenity in the local area. The release of LFG can have a negative impact on the health of the local environment and the local population and lead to risks of explosions in the local surroundings. The project have a small, but positive impact on employment in the local area as a number of staff need to be recruited to manage the landfill gas operations.

The project is helping the Host Country fulfill its goal of promoting sustainable development.
Specifically, the project:

- Increases employment opportunities in the area where the project is located;
- Uses clean and efficient technologies;
- Acts as a clean technology demonstration project;
- Optimizes the use of natural resources, avoids uncontrolled waste management.

A.2. Location of project activity

>>
<u>Host Party:</u>

- Chile

<u>Region/State/Province:</u>

- Region V: So called Región de Valparaíso.

City/Town/Community:

- Between the “Puchuncaví” community to the north and the “Rocas de Santo Domingo”, community to the South.

Physical/Geographical location:

- El Molle landfill is located in Sector Camino La Pólvora, 7 km NE of Valparaiso city.

Geographically, the site is referred to the following coordinates:

Coordinates	
UTM (x,y)	**Geographic (long, lat)**
Limited to the North by	
(19S 254,251.85W, 6,336,801.82S)	(W 71.63, S 33.07)
(19S 254,591.09W, 6,336,429.51S)	(W 71.62, S 33.08)
Limited to the South by	
(19S 253,489.66W, 6,334,875.88S)	(W 71.64, S 33.09)
(19S 253,489.66W, 6,334,880.56S)	(W 71.64, S 33.09)

In the following figure, the physical location of El Molle landfill site is shown:

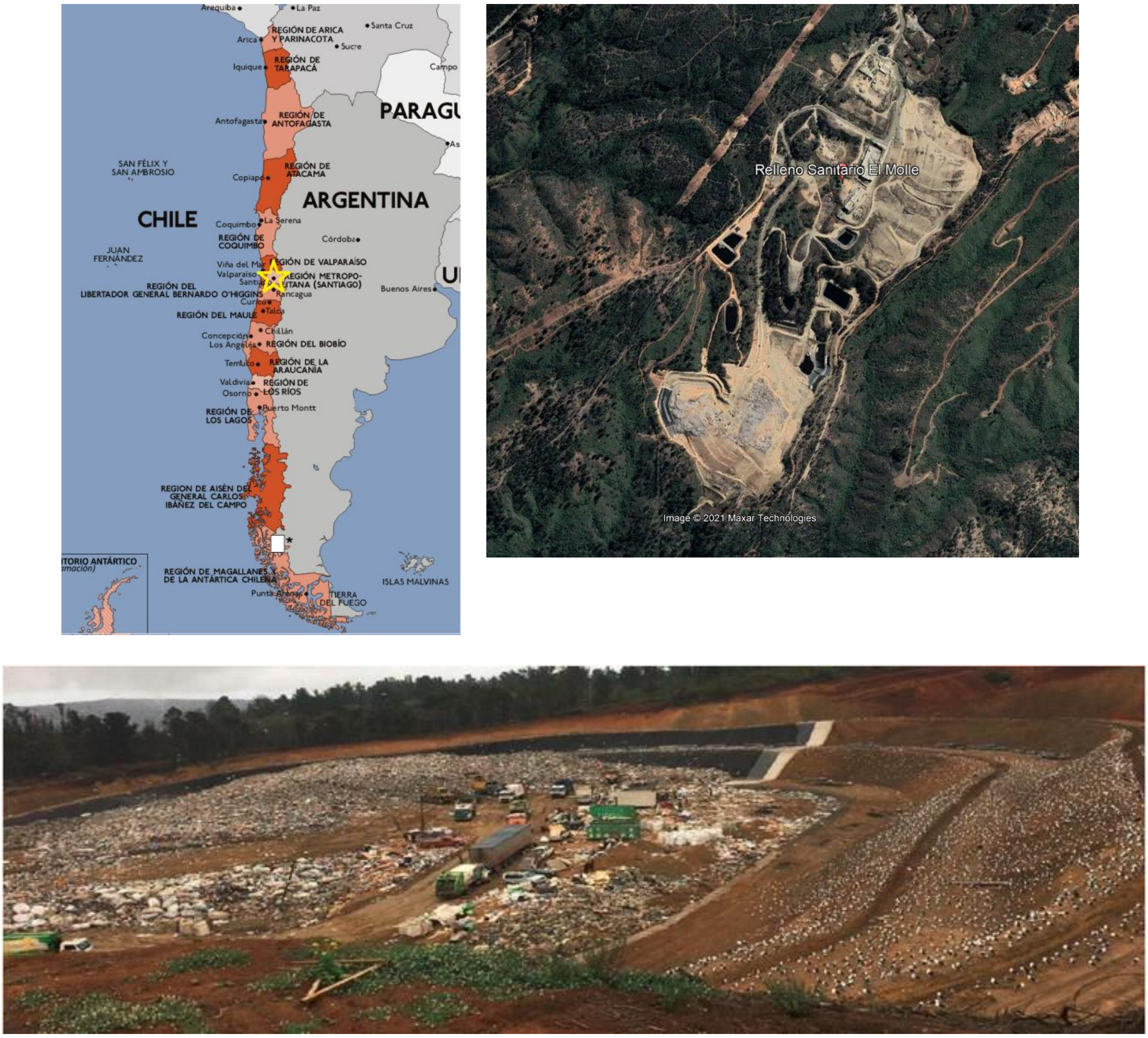

Figure 1 - El Molle Landfill site

El Molle landfill receives 1,440 tones of MSW per day average. To this date, it accumulate 6,337,000 tones of MSW and it expect to receive up to 11,606,000 tones until 2028.

The landfill is divided in five cells. Three out of the five cells (Old Cell and Cell I and Cell II) were totally filled and capped by GIRSpA S.A in 2013. Then, GIRSpA S.A started to fill Cell III using the best available techniques of landfilling at the host country by successions of layers of waste covered with layers of filling material (a mix of sand, silt, clay and organic earth).

A.3. Technologies/measures

>>
The implementation and operation of the El Molle Landfill Gas Capture Project consists in:

LFG Capture and Collection Systems

The landfill gas capture and collection infrastructure of the landfill was designed with horizontal trenches and with the recovery of the vertical wells/drains. The horizontal trenches and vertical

wells/drains will be connected to the collection system known as well as transmission pipeline that will accomplish the transport of gas to the flaring station responsible for its treatment and destruction.

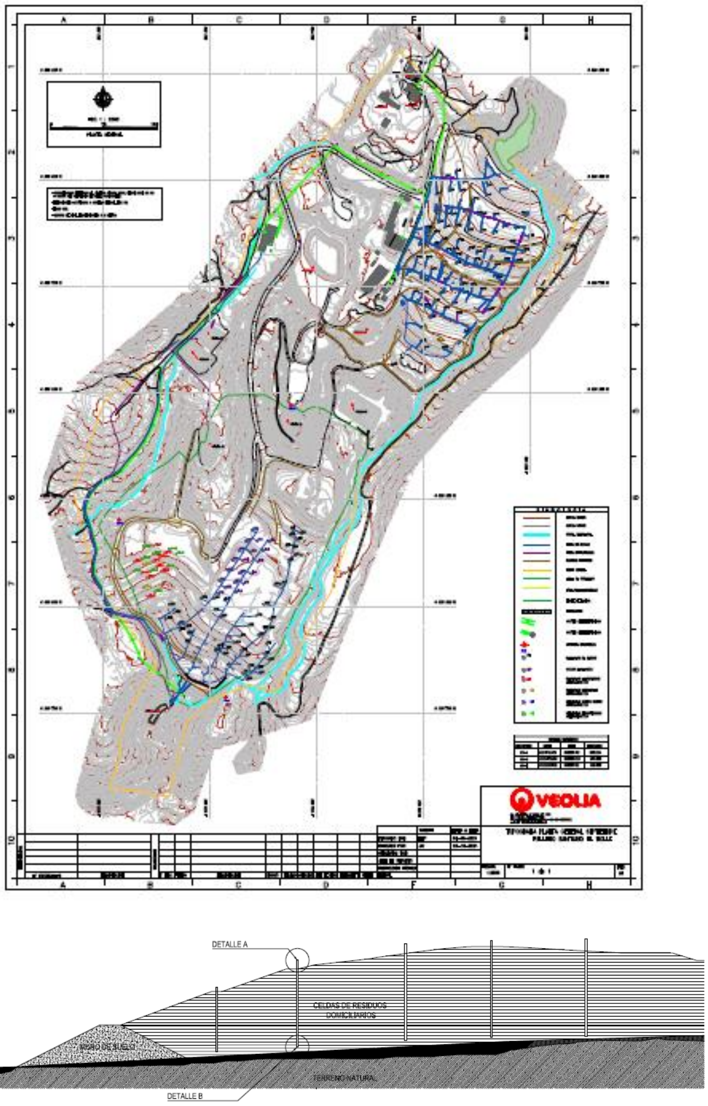

Figure 1 - General view of the LFG Capture and Collection Systems.

(Source: Stericycle El Molle Landfill)

- Capture System (Horizontal Trenches)

The capture system consists on a grid of horizontal trenches made of High Density Polyethylene (HDPE), due to the flexibility and the corrosion resistance. Each trench has an average length of 100 meters and is installed with approximately 15 meters away from each other. The capture system will be installed throughout the lifetime of the landfill.

The figures below show an example of the installation of a horizontal trench.

Figure 2 - Typical installation of a trench – LFG capturing System.

(Source: Stericycle El Molle Landfill)

All horizontal trenches (capture system) are connected to a collection system known as well as transmission pipeline that transports the landfill gas to the flaring station.

Each individual trench can regulate the concentrations of O_2 in the LFG collected. In case the concentrations are above a certain value, it means that maybe some air is infiltrating in the landfill and the valve corresponding to the trench is then closed. The periodic operation of the horizontal trenches will promote a systematic control and monitoring of the characteristics of the LFG extracted.

- Vertical Wells/Drains

In order to drain the leachate of the landfill, vertical wells/drains will be progressively installed. In order to recover the LFG which will be released through the wells/drains, the project aim to cap the vertical wells/drains and connect them to the collection system. The average distance will be about 30 – 35 meters from each other. The top of the drains will be equipped with LFG wellheads. This equipment connects the drain to the pipeline.

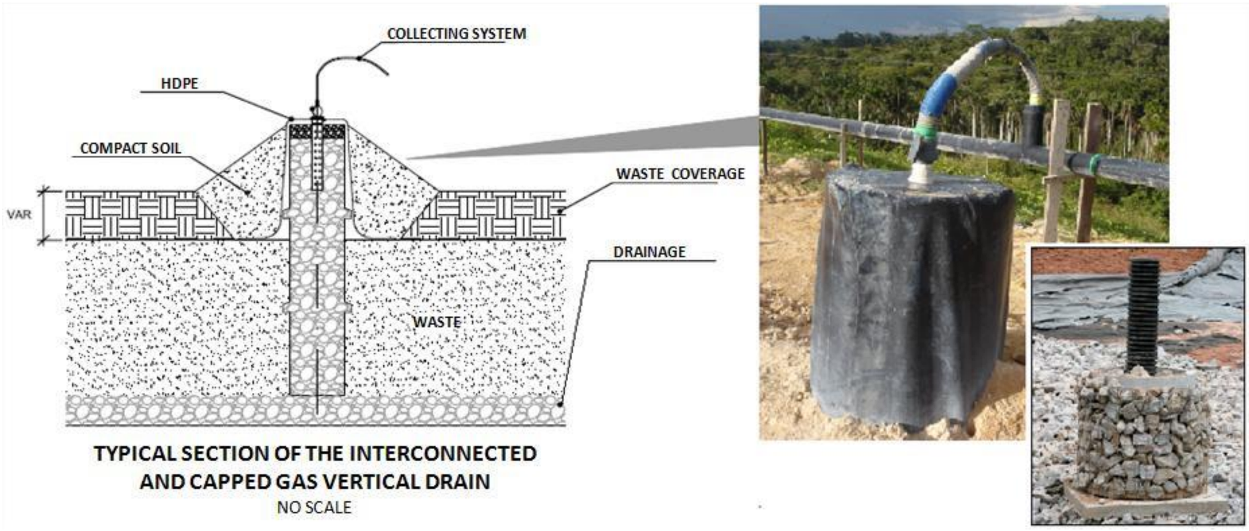

Figure 3 - Typical connection for recovery of the vertical wells/drains.

(Source: Conestoga-Rovers & Associates – CRA – Manaus Landfill)

- Collection System (Transmission Pipeline)

The collection system, known as well as transmission pipeline, transports the collected LFG to the flaring station.

The collection system is usually built using High Density Polyethylene (HDPE), due to the flexibility and the corrosion resistance. The sizing of the piping will be designed considering the maximum production of landfill gas. Intense welding activity is expected to connect each horizontal trench to the transmission pipeline.

Figure 4 - Example of transmission pipelines

(Source: Stericycle El Molle Landfill)

Flaring Station

The collection of LFG within the landfill will be made by applying a pressure differential in each horizontal trench and or vertical well/drain. The depressurization system shall be composed of a group of centrifugal multi-stage blowers, connected in parallel with the main transmission pipeline. The depressurization of the system will depend on the pressure of operation of flares. In addition, the Flaring Station usually has:

- Flares;
- Blowers;
- Safety valve on/off;
- Remover of condensate;
- Gas Analyzer;
- Meter for pressure;
- Meter for flow;
- Meter for temperature.

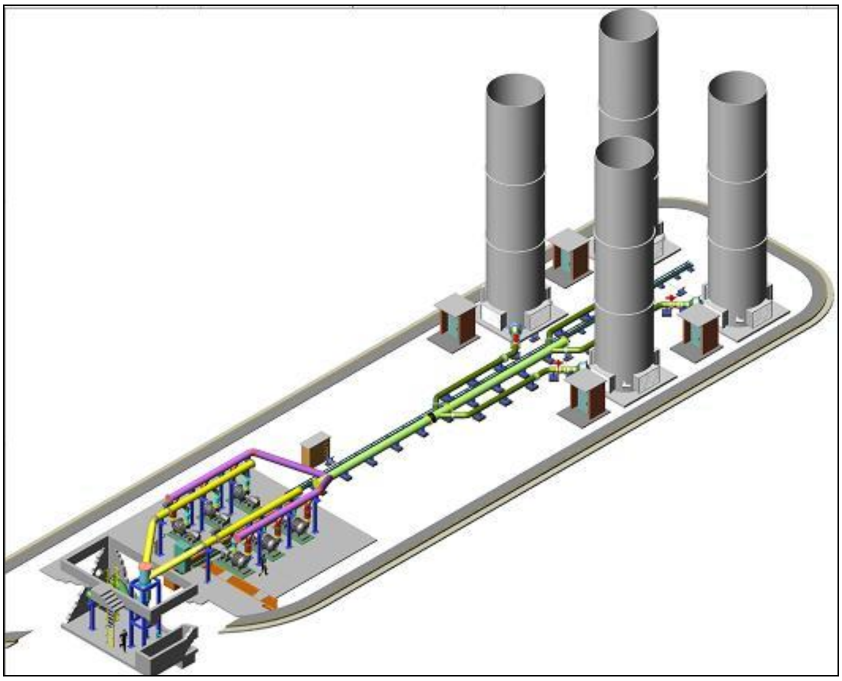

Figure 5 – Example of a Flaring station for a Landfill Gas Project.

(Source: Conestoga-Rovers & Associados Engenharia S/A)

- The Blower System

The blower system is responsible to give negative pressure to the landfill, suctioning the gas to the pipeline. The dimensioning of the blower will depend on the final use of the gas (flare, boiler, electricity).

In order to preserve the operation of the blowers, a dewatering system is installed to remove any condensate present in the LFG. This equipment is a single knock-out dewatering component.

Figure 6 – Blower system at El Molle plant

(Source: El Molle Landfill)

- The Flare System

The destruction of the methane content in the LFG collected will be made via an enclosed flare, in order to assure higher methane destruction (above 99%)[1].

The flare efficiency will be monitored according to Option B.1: Biannual measurement of the flare efficiency

The flaring station will have, even a system of destruction of methane through flares. This system will be composed initially by 1 enclosure flare and will have additional units installed, according to the LFG generation.

Basically, the flare is constructed using refractory material, a gas inlet, dampers to control the air inlet, an ignition spark, flame viewer and points to sample collection, as presented in the pictures below:

The flare is constructed in a vertical cylindrical combustion chamber, where the landfill gas is flared at a constant temperature (around 1,000º C), controlled by the admission of air, and with a retention time > 0.7 seconds.

Figure 7 - Detail of Enclosed Flare

(Source: Conestoga Rovers & Associates – CRA – Aurá Landfill - Belém / PA / Brazil)

Power generation

The power generation system will be comprised of around 4.5 MW. The electricity generated by the Project will be used for self-consumption at the Landfill and eventually exported to the electricity grid. The configuration of the equipment will be chosen in accordance with the availability

[1] The destruction of the methane content in the LFG is above 99%, according to manufacturer specifications. The document was given to DOE in validation visit.

of the generation equipment on the market at the time of actual implementation of the second phase.

The electricity meter works in a bi-directional metering, providing the net electricity exported to the grid.

The location of the exported electricity meter is at Chilquinta substation, 2 km distance from El Molle power generation plant.

This kind of technology is still not widely applied in Chile. Very few landfills have already installed equipment for the collection and flare of LFG.

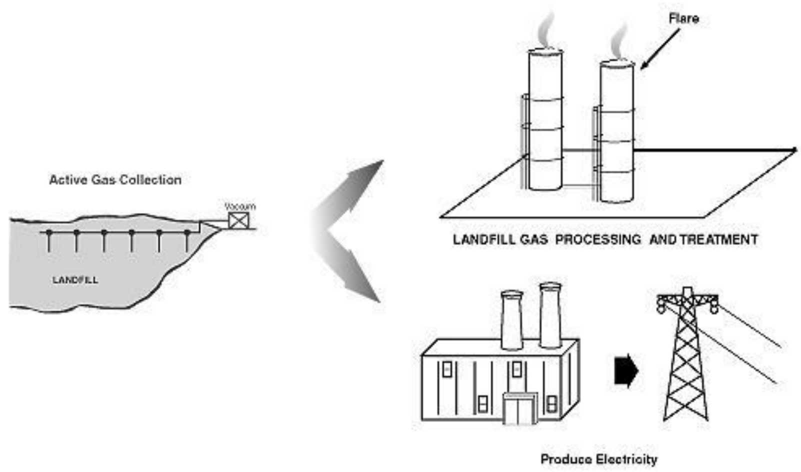

Figure 8 – Power generation diagram

The forecast installed capacity and electricity generated by the project activity are present below:

Year	Net capacity (MWe)[1]	Net electricity generated in the plant (MWh)
2020	4.5	36,266
2021	4.5	36,266
2022	4.5	36,266
2023	4.5	36,266
2024	4.5	36,266
2025	4.5	36,266
2026	4.5	36,266
2027	4.5	36,266

[1] Definition of Net capacity: is the maximum capacity at the plant minus the amount of electricity that is consumed by the plant;
[2] The electricity plant load factor is 92%, according to project participant internal studies.
Note: As highlighted in Section A.1, the final equipment that will be chosen (as well as the final installed capacity) may vary depending on the availability of the generation equipment on the market at the time of actual implementation of the second phase.

The lifetime of the equipment is 20 years and it was based on market standard specifications[2]. Technologies/measures and know how for the item listed above does not have to be transferred to the host Party.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Chile (host)	Gestión Integral de Residuos S.p.A. (Private Entity)	No
Switzerland	First Climate (Switzerland) AG (Private Entity)	No

A.5. Public funding of project activity

>>

There is no Annex I public funding involved in the Project Activity

A.6. History of project activity

>>

The proposed CDM project activity is not a project activity that has been deregistered, nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA);

A.7. Debundling

>>

Not applicable.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

>>

- 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];

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[2] The document was made available to DOE in validation visit.

[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

- TOOL08 Methodological tool: “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0)[9];
- TOOL09 Methodological tool: “Determining the baseline efficiency of thermal or electric energy generation systems” (Version 03.0)[10];
- TOOL10 Methodological Tool: “Tool to determine the remaining lifetime of equipment” (Version 01)[11];
- TOOL12 Methodological tool: “Project and leakage emissions from transportation of freight” (Version 01.1.0)[12];
- TOOL07 Methodological tool: “Tool to calculate the emission factor for an electricity system” (Version 07.0)[13];
- TOOL11 Methodological Tool: “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” (Version 03.0.1)[14];
- TOOL32 Methodological tool: “Positive lists of technologies” (Version 03.0)[15]

B.2. Applicability of methodologies and standardized baselines

>>

The methodology ACM0001 is applicable for project activities that comprise one of the following scenarios:

- The captured gas is flared; and/or
- The captured gas is used to produce energy and/or use to supply consumers (e.g. electricity/thermal energy);

<u>The methodology ACM0001: “Flaring or use of landfill gas” is applicable to project activities which:</u>

“...

(a) *Install a new LFG capture system in an existing or new (Greenfield) SWDS where no LFG capture system was or would have been installed prior to the implementation of the project activity; or*

(b) *Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that:*

(i) *The captured LFG was vented or flared and not used prior to the implementation of the project activity; and*

(ii) *In the case of an existing active LFG capture system for which the amount of LFG cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project system: historical data on the amount of LFG capture and flared is available;*

(c) *Flare the LFG and/or use the captured LFG in any (combination) of the following ways:*

(i) *Generating electricity;*

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[9] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf

[10] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v3.0.pdf

[11] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-10-v1.pdf

[12] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.1.0.pdf

[13] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

[14] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf

[15] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-32-v3.0.pdf

(ii) *Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace;[16] and/or*

(iii) *Supplying the LFG to consumers through a natural gas distribution network;*

(iv) *Supplying compressed/liquefied LFG to consumers using trucks;[17]*

(v) *Supplying the LFG to consumers through a dedicated pipeline;*

(d) *Do not reduce the amount of organic waste that would be recycled in the absence of the project activity.*

Justification: - Part 1
The methodology **is applicable** because it will be made an investment into an existing LFG capture system to increase the recovery rate (collection efficiency) and change the use of the captured LFG (also electricity generation). The captured LFG was only vented and partially flared in open flares and not used prior to the implementation of the project activity.

In the project activity, the LFG will be flared and will generate electricity.

Moreover, the amount of organic waste will be the same in the project activity as well as in the absence of the project activity. A declaration letter issued by the PP has been made available to the DOE.

"...
The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is:

(a) *Atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons; and*

(b) *In the case that the LFG is used in the project activity for generating electricity and/or generating heat in a boiler, air heater, glass melting furnace or kiln:*

(i) *For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or*

(ii) *For heat generation: that heat would be generated using fossil fuels in equipment located within the project boundary;*

[16] For claiming emission reductions for other heat generation equipment (including other products in kilns), project participants may submit a revision to this methodology.

[17] In case other means of transportation are used a revision to this methodology may be requested.

(c) *In the case of LFG supplied to the end-user(s) through natural gas distribution network, trucks or the dedicated pipeline, the baseline scenario is assumed to be displacement of natural gas.*

(d) *In the case of LFG from a Greenfield SWDS, the identified baseline scenario is atmospheric release of the LFG or capture of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.*

This methodology is not applicable:

In combination with other approved methodologies. For instance, ACM0001 cannot be used to claim emission reductions for the displacement of fossil fuels in a kiln or glass melting furnace, where the purpose of the CDM project activity is to implement energy efficiency measures at a kiln or glass melting furnace;

If the management of the SWDS in the project activity is deliberately changed during the crediting in order to increase methane generation compared to the situation prior to the implementation of the project activity.

...”

Justification: - Part 2
According to Section B.4 and B.5, the methodology is applicable because:

- The most plausible baseline scenario is release the LFG to atmosphere from the SWDS, and;
- The electricity would be generated in the grid.

Moreover, there is neither a combination with other approved methodologies nor change in management of the landfill due to the project activity (e.g. addition of liquids, pre-treating waste or changing the shape of the landfill to increase the Methane Correction Factor).

The “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” is **applicable** due to the consumption of fossil fuel by the project activity (with fossil fuel being used for purposes other than for electricity generation). In the particular case of the project activity, Liquefied Petroleum Gas (LPG) has been used to ignite the installed flare (after events of planned or unplanned interruptions of operation of the flare). The applicability condition of the methodological tool is thus met.

The tool “Emissions from solid waste disposal sites” is **applicable** to the project activity because the CDM project activity mitigates methane emissions from a specific existing SWDS (Application A).

The tool to calculate “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” is **applicable** to the project activity following one out of the three scenarios below applied to the sources of electricity consumption:

- Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer;
- Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or
- Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the

electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid.

As for the monitoring of the amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated:

a) Scenario I: Electricity is supplied to the grid;
b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or
c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.

Justification:
The tool is applicable according to Scenario A and Scenario B stated above since the project activity includes electricity consumption from the grid when electricity generated by the LFG power plant is not operational and electricity consumption from the diesel generators when electricity from the grid is not available.

Also, Scenario I is applicable since the project activity includes electricity generation to the grid.

The tool "Project emissions from flaring" is **applicable** to the project activity since the project activity uses enclosed flares and project participant documents the same in the PDD including the type of flare used in the project activity. Tool is applicable to the flaring of flammable greenhouse gases where:

- Methane is the component with the highest concentration in the flammable residual gas; and
- The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).
- The flares used in the project site operate according to the specifications provided by the manufacturer.

Justification:
Since methane is the component with the highest concentration in the flammable residual gas from waste anaerobic degradation generating LFG and flares used in the project site operate according to the specifications provided by the manufacturer, the tool is available.

The "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" is **applicable** to the project activity because the applicable methodology (ACM0001) demands measuring flow and composition of residual and exhaust gases for the determination of baseline and project emissions.

The "Tool to determining the baseline efficiency of thermal or electric energy generation systems " is **not applicable** to the project activity since that there is no thermal or electric energy generation in the baseline scenario and the project activity does not involve the improvement of the energy efficiency through retrofits or replacement of the existing system by a new system.

The "Tool to determine the remaining lifetime of equipment" is **not applicable** since the project activity do not involve the replacement of existing equipment with new equipment or retrofit of existing equipment as part of energy efficiency improvement activities.

LFG use equipment was not in operation prior to the implementation of the project activity.

The "Project and leakage emissions from transportation of freight" is **not applicable** since the project activity do not involve the transportation of freight.

The "Tool to calculate the emission factor for an electricity system" is **applicable** since the project activity demands electricity that is provided by the grid. This tool is also referred to in the "Tool to calculate project and/or leakage emissions from electricity consumption and monitoring of electricity generation" for the purpose of calculating project and leakage emissions in case where a project activity consumes electricity from the grid or results in increase of consumption of electricity from the grid outside the project boundary.

The "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" is **applicable** to the project activity since it is required to assess the continued validity of the baseline at the renewal of a crediting period.

The methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" is **not applicable** since demonstration of additionality is not applicable/required for the registered CDM project activity. Simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 has been used.

The "Positive lists of technologies" is **applicable** to the project activity since the LFG is exclusively used to generate electricity.

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

>>

	Source	GHG	Included ?	Justification / Explanation
Baseline	Emissions from decomposition of waste at the landfill site.	CH_4	Yes	The major source of emissions in the baseline
		N_2O	No	N_2O emissions are small compared to CH_4 emissions from SWDS. This is conservative
		CO_2	No	CO_2 emissions from decomposition of organic waste are not accounted since the CO_2 is also released under the project activity
	Emissions from electricity consumption	CO_2	Yes	Electricity may be consumed from the grid or generated onsite/offsite in the baseline scenario
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
	Emissions from the use of natural gas	CO_2	No	Excluded for simplification. This is conservative
		CH_4	No	Emission source when supplying LFG through a dedicated pipeline
		N_2O	No	Excluded for simplification. This is conservative
Project Activity	Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO_2	Yes	May be an important emission source.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from electricity consumption due to the	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission

	project activity			source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from flaring	CO_2	No	Emissions are considered negligible
		CH_4	Yes	May be an important emission source
		N_2O	No	Emissions are considered negligible
	Emissions from distribution of LFG using trucks and dedicated pipelines	CO_2	No	May be an important emission source
		CH_4	No	May be an important emission source
		N_2O	No	Emissions are considered negligible

Note: On-site fossil fuel consumption due to the project activity other than for electricity generation will be due to LPG consumption.

The project boundary of the project activity shall include the site where the LFG is captured and, as applicable:

(a) Sites where the LFG is flared or used (e.g. flare, power plant, boiler, air heater, glass melting furnace, kiln, natural gas distribution network, dedicated pipeline or biogas processing facility); (applicable)

(b) Captive power plant(s) (including emergency diesel generators) or power generation sources connected to the grid, which are supplying electricity to the project activity; (applicable)

(c) Captive power plant(s) (including emergency diesel generators) or power generation sources connected to the grid, which are supplying electricity in the baseline that is displaced by electricity generated by captured LFG in the project activity; (applicable)

(d) Heat generation equipment or sources which are supplying heat in the baseline that is displaced by heat generated by captured LFG in the project activity; and (not applicable)

(e) The transportation of the compressed/liquefied LFG from the biogas processing facility to consumers. (not applicable)

The flow diagram is presented below:

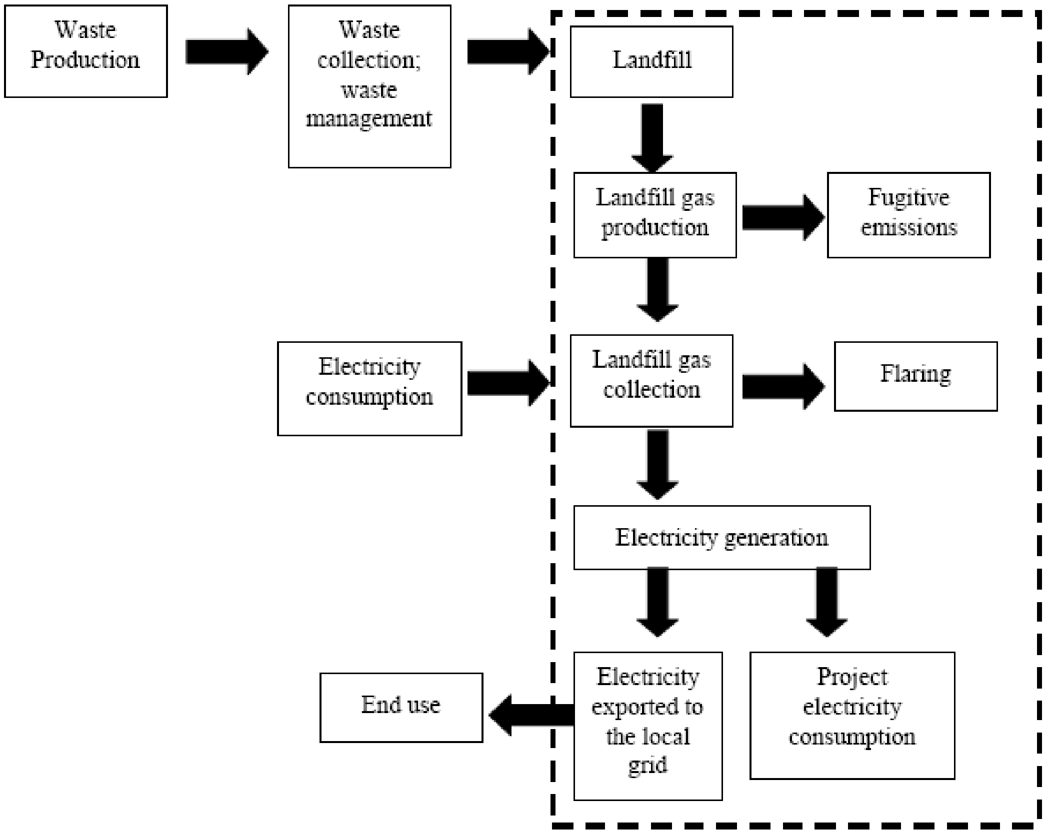

Figure 9 – Flow diagram project boundary

B.4. Establishment and description of baseline scenario

>>

The baseline scenario for LFG is assumed to be the atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.

Since LFG is also used in the project activity for generating electricity, the baseline scenario is assumed to be that the electricity would be generated in the grid or in captive fossil fuel fired power plants.

The methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period", has been used to assess the continued validity of the baseline considering the renewal of the crediting period.

It is important to clarify that the baseline scenario for LFG defined for the 3rd crediting period is maintained valid.

The stepwise procedure of the "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period are as follows:

Step 1: Assess the validity of the current baseline for the next crediting period

In order to assess the continued validity of the baseline, changes in the relevant national and/or sectorial regulations between two crediting periods has to be examined at the renewal of the crediting period. If at the start of the project activity, the project activity was not mandated by regulations, but at the time of renewal of the crediting period regulations are in place that enforce

the practice or norms or technologies that are used by the project activity, the new regulation (formulated after the registration of the project activity) has to be examined to determine if it applies to existing project or not.

The baseline scenario does not have to be updated for the third crediting period as no new regulations requiring capture and combustion or use of LFG are in place. Chilean government has count on Decree 189[18], dated from 2008 (unique version) which approves regulation on basic sanitary and safety conditions in sanitary landfills. In this decree does not require capture and combustion or use of LFG in Chilean sanitary landfills.

By analysing the LFG electricity generation plant operational license N° 126, issued in 07/04/2015 (no expiration date) and it is possible to notice that LFG use is permitted by legislation.

The "Procedures for the renewal of the crediting period of a registered CDM project activity" approved by the CDM Executive Board require assessing the impact of new relevant national and/or sectorial policies and circumstances on the baseline.

The validity of the current baseline is assessed using the following Sub-steps:

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectorial policies

At the start of the project activity at El Molle landfill in 2006, the Chilean legislation did not require landfills to capture and/or flare and/or use the LFG. After the registration of the project activity in 19/02/2006, the project participant in order to assess if the current baseline complies with all relevant mandatory national and/or sectorial policies which have come into effect after the submission of the project activity for validation has verified that the current baseline complies with all applicable laws and regulations.

Realistic and credible alternatives to the project activity that can be part of the baseline scenario are defined through the following sub-steps:

Step 1.2: Assess the impact of circumstances

There is no impact of circumstances existing at the time of requesting renewal of the crediting period on the current baseline emissions.

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

This sub-step is not applicable since the baseline scenario of the project activity is the business as usual (BAU) scenario (passive venting system).

Step 1.4: Assessment of the validity of the data and parameters

Considering the applied methodology at the project activity registration ACM0001, due to methodology version updates, related applicable tools and some ex-ante parameters published by IPCC have been updated accordingly.
According to the "Tool to assess the validity of the original/current baseline and to update the baseline at the renewal of a crediting period", where any data and parameter used and not monitored during the crediting period are not valid anymore they should be updated following the Step 2 as follows:

[18] https://www.bcn.cl/leychile/navegar?idNorma=268137

Step 2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

The baseline emissions for the third crediting period have been updated, without reassessing the baseline scenario, based on the latest approved version of the methodology ACM0001. This update was applied in the context of the sectorial policies and circumstances that are applicable at the time of requesting for renewal of the crediting period, which has not changed as to affect the project.

Step 2.2: Update the data and parameters

All fixed parameters were updated in accordance with the updated methodology ACM0001, applicable tools and supporting documentation.

The baseline scenario for LFG is assumed to be the atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.

Since LFG is also used in the project activity for generating electricity, the baseline scenario is assumed to be that the electricity would be generated in the grid or in captive fossil fuel fired power plants.

B.5. Demonstration of additionality

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It is crucial to consider that the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 remains being considered for the crediting period for the project activity. According to TOOL32 Methodological tool: “Positive lists of technologies”, the additionality of the project activities and PoAs is demonstrated as follows:

“The project activities and PoAs at new or existing landfills (greenfield or brownfield) are deemed automatically additional, if it is demonstrated that prior to the implementation of the project activities and PoAs the landfill gas (LFG) was only vented and/or flared (in the case of brownfield projects) or would have been only vented and/or flared (in the case of greenfield projects) but not utilized for energy generation, and that under the project activities and PoAs any of the following conditions are met:

(a) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW;
(b) The LFG is used to generate heat for internal or external consumption;
(c) The LFG is flared.

Taking into account simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001, the project activity is thus automatically/directly assumed as additional since types a) and c) mentioned above applies for this project activity.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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The baseline emission was calculated according to the following formula:

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

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)
$BE_{HG,y}$	=	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)

As the project flares LFG and generate electricity, the $BE_{HG,y} = 0$ and $BE_{NG,y} = 0$.

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

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

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

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 $\mathbf{F_{CH4,PJ,y}}$ will be determined as follows:

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

Where:

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

As the project flares LFG, generate electricity, the $F_{CH4,HG,y} = 0$ and $F_{CH4,NG,y.} = 0$. Thus, the equation is:

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

$F_{CH4,EL,y}$ and $F_{CH4,HG,y}$ are determined using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” and monitoring the working hours of the power plant(s), boiler(s), air heater(s), glass melting furnace(s) and kiln(s), so that no emission reduction are claimed for methane destruction during non-working hours. This is taken into account by monitoring the hours that the equipment utilizing the LFG is operating in year *y* ($Op_{j,h,y}$).

The following requirements apply:

(a) As per the gaseous stream tool, if the LFG is used for multiple purposes (e.g. flaring or energy generation), and all methane destruction devices are verified to be operational (e.g. by means of flame detectors records, energy generated), a single flow meter may be used to record the flow into multiple destruction devices. The destruction efficiency of the least efficient among the destruction devices shall be used as the destruction efficiency for all destruction devices monitored by this flow meter. If there are any periods for which one or more destruction devices are not operational, paragraph 5 (a) and (b) of the Appendix of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” tool shall be followed;

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

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

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

(e) 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 options 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

  And

- 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 (m^3 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 (m^3 gas *i*/m^3 dry gas)
$\rho_{i,t}$ = Density of greenhouse gas i in the gaseous stream in time interval *t* (kg gas *i*/m^3 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.m^3/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:

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

Where:
$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m^3 dry gas/h)
$V_{t,wb}$ = Volumetric flow of the gaseous stream in time interval *t* on a wet basis (m^3 wet gas/h)
$v_{H2O,t,db}$ = 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)

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 (mH_2O,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[19].

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)

[19] 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).

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

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.

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

Enclosed flare(s) have been installed in the project activity to increase the destruction efficiency. Those flares reach 99% (minimum)[20] of methane destruction efficiency.

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.

The option chosen for the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" by the project participant is option A. However, during the project operational monitoring, If not demonstrated that the temperature of the gaseous stream (T_t) is less than 60ºC (dry basis), then the flow measurement should be assumed to be on a wet basis and the option B should be applied instead.

Step 2: Determination of flare efficiency

[20] The document about the specification of the flare efficiencies has been provided to DOE.

Enclosed flare

In the case of enclosed flares, project participants may choose between the following two options to determine the flare efficiency for minute *m* ($n_{flare,m}$).

Option A: Apply a default value for flare efficiency

Option B: Measure the flare efficiency.

The project participant has chosen Option B.

In the present project activity the flare efficiency for minute m (ηflare,m) will be determined by Option B.1 of the methodological tool "Project emissions from flaring", where the flare efficiency is measured in a biannual basis or, if the biannual measurements are not available, Option A of the methodological tool "Project emissions from flaring" will be used. Both options are described below:

For enclosed flares that are defined as low height flares, which is the case of the project activity, the flare efficiency in the minute m ($n_{flare,m}$) shall be adjusted, as a conservative approach, by subtracting 0.1 from the efficiency as determined in Option A. For example, the default value applied should be 80%, rather than 90%, and if for example the measured value was 99%, then the value to be used shall correspond to 89%.

Option A: Default value

The flare efficiency for the minute m ($n_{flare,m}$) is 90% when the following two conditions are met to demonstrate that the flare is operating:

(1) The temperature of the flare ($T_{EG.m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute m; and

(2) The flame is detected in minute m ($Flame_m$).

Otherwise $n_{flare,m}$ is 0%.

Option B: Measured flare efficiency

The flare efficiency in the minute *m* is a measured value ($n_{flare,m} = n_{flare,calc,m}$) when the following conditions are met to demonstrate that the flare is operating:

(1) The temperature of the flare ($T_{EG.m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute *m*;

(2) The flame is detected in minute *m* ($Flame_m$); and

Otherwise $n_{flare,m}$ is 0%.

In applying Option B, the project participants chose to determine $n_{flare,calc,m}$ using Option B.1 where the measurement is conducted by an accredited entity on a biannual basis.

Option B.1: Biannual measurement of the flare efficiency

The calculated flare efficiency $\eta_{flare,calc,m}$ is determined as the average of two measurements of the flare efficiency made in year *y* ($\eta_{flare,calc,y}$), as follows:

$$\eta_{flare,calc,y} = 1 - \frac{1}{2}\sum_{t=1}^{2}\left(\frac{F_{CH4,EG,t}}{F_{CH4,RG,t}}\right)$$

Where:

$\eta_{flare,calc,y}$	=	Flare efficiency in the year y
$F_{CH4,EG,t}$	=	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period t (kg)
$F_{CH4,RG,t}$	=	Mass flow of methane in the residual gas on a dry basis at reference conditions in the time period t (kg)
t	=	The two time periods in year y during which the flare efficiency is measured, each a minimum of one hour and separated by at least six months

$F_{CH4,EG,t}$ is measured according to an appropriate national or international standard. $F_{CH4,RG,t}$ is calculated according to Step 1, and consists of the sum of methane flow in the minutes *m* that make up the time period *t*.

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:

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

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 1 – 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.1.1: *Ex-ante* estimation of $F_{CH4,PJ,y}$

An *ex ante* estimate of $F_{CH4,PJ,y}$ is required to estimate baseline emission of methane from the SWDS in order to estimate the emission reductions of the proposed project activity in the CDM-PDD. It is determined as follows:

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} / GWP_{CH4}$$

Where:

[21] As the Option B.1 of the tool "*Project emissions from flaring (Version 02.0.0)*" has been adopted to calculate the flare efficiency, the molecular mass parameters are not mentioned.

[22] Default value from IPCC. Shall be updated according to any future COP/MOP decisions.

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (tCH_4/yr)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (tCO_2e/yr)
η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH4}	=	Global warming potential of CH_4 (tCO_2e/tCH_4)

$BE_{CH4,SWDS,y}$ is determined using the methodological tool "Emissions from solid waste disposal sites". The calculation of $BE_{CH4,SWDS,y}$ according the tool is:

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

Where:

$BE_{CH4,SWDS,y}$	=	Baseline, project or leakage methane emissions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y (t CO_2e / yr)
X	=	Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to year y (x = y).
Y	=	Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)
$DOC_{f,y}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)
$W_{j,x}$	=	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t)
φ_y	=	Model correction factor to account for model uncertainties for year y
f_y	=	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
GWP_{CH4}	=	Global Warming Potential of methane
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction)
MCF_y		Methane correction factor for year *y*
DOC_j	=	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
k_j	=	Decay rate for the waste type *j* (1 / yr)
J	=	Type of residual waste or types of waste in the MSW

According to ACM0001 methodology, the parameter f_y in the methodological tool "Emissions from solid waste disposal sites" shall be assigned a value of 0 (zero) because the amount of LFG that would have been captured and destroyed is already accounted for in equation 2 of this methodology. Also, according to ACM0001 methodology, the parameter *X* begins with the year that the SWDS started receiving wastes. For this reason, the parameter f_y and *X* will not be monitored.

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

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

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

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

Where:

$BE_{EC,y}$	=	Baseline emissions from electricity generation in year *y* (tCO_2/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* (tCO_2/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 "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

Emission Factor calculation

The project emissions derived from fossil fuels used for electricity consumption from grid connected power plants are estimated and guided using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" . The combined margin emission factor was calculated by the "Tool to calculate the emission factor for an electricity system", as follows:

Step 1. Identify the relevant electric power system

For the purpose of determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or

[23] According to the "*Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion*", $EF_{EL,k,y} = EF_{grid,CM,y}$

the consumers where electricity is being saved) and that can be dispatched without signification transmission constraints.

The Chilean grid is SEN (*Sistema Eléctrico Nacional* – National Electric System). SEN resulted from the integration of the two existent subsystems that were interconnected in 2017.

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)

Option I is chosen to calculate the operating margin and build margin emission factor because there is no off-grid power plant to be included in the project electricity system.

Step 3. Select a method to determined the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

a) Simple OM, or
b) Simple adjusted OM, or
c) Dispatch data analysis OM, or
d) Average OM.

The method used to calculate $EF_{grid,OM,y}$ is going to be the Simple OM (Option a), once the average share of low cost must run sources in the 5 most recent years is less than 50% of total electricity generation in Chile (Table 2).

Table 2 – Share o LCMR electricity generation in Chile, 2016 – 2020.

Year	Share LCMR (%)
2016	36.7
2017	42.7
2018	45.5
2019	44.0
2020	46.2
Average	*43.0*

Source: Comisión Nacional de Energía[24], 2021.

The data vintage chosen for the calculation of the OM emission factor is the ex-ante option. In order to calculate the emission factor, a weighted average for the generation values over a 3 year period were used based on the most recent data available (2018, 2019 and 2020) at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emission factor during the crediting period.

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

The Simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (t CO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units. It was calculated choosing Option A, based on the electricity generation and a CO_2 emission factor of each power unit, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

[24] Availale at : https://www.cne.cl/en/normativas/electrica/consulta-publica/electricidad/, accessed on 01/12/2021.

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO2 emission factor in year *y* (t CO2/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by powerunit *m* in year *y* (MWh)
$EF_{EL,m,y}$	=	CO2 emission factor of power unit *m* in year *y* (t CO2/MWh)
m	=	All power units serving the grid in year *y* except low-cost/must-run powerunits
y	=	The relevant year as per the data vintage chosen in Step 3

The determination of the emission factor of each power unit *m* (***FE**$_{EL,m,y}$*) applies **Option A1** of the tool considering data on fuel consumption and electricity generation is available, as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (t CO_2/MWh)
$FC_{i,m,y}$	=	Amount of fuel type *i* consumed by power unit *m* in year *y* (Mass orvolume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fuel type *i* in year *y* (GJ/mass orvolume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fuel type *i* in year *y* (t CO_2/GJ)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by powerunit *m* in year *y* (MWh)
m	=	All power units serving the grid in year *y* except low-cost/must-run poweru nits
i	=	All fuel types combusted in power unit *m* in year *y*
y	=	The relevant year as per the data vintage chosen in Step 3

The below table presents the results obtained while calculating the operating margin emission factor as explained above.

Table 3 – Chilean operating Margin CO_2 emission factor, 2018 – 2020.

Year	**Operating margin CO_2 emission factor in year *y***	**Electricity generation**	**GHG Emissions**
	$EF_{grid,OM,y}$	***∑EGm,y***	***∑FCi,m,y * NCVi,y * EFCO2,I,y***
	tCO_2/MWh	MWh/y	tCO2/y
2020	0.7030	40,643,413	28,572,816
2019	0.7013	42,089,147	29,515,181
2018	0.7265	41,018,128	29,.797,810
Total	-	123,750,688	87,885,807
(3-year weighted average) *$EF_{grid,OM}$*		**0.7102**	

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

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: For the first crediting period, calculate the build margin emission factor *ex-ante* based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor should be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin factor shall be calculated ex-ante, as described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

The *Option 1* was chosen for the proposed project. This PDD consists refers to the third crediting period of the proposed CDM Project Activity. Hence, the build margin emission factor calculated for the second crediting period is used.

$EF_{grid,BM,2016} =$ 0.2549 tCO_2/MWh

Step 6. Calculate the combined margin emissions factor

The option a) weighted average CM was used to calculate the combined margin (CM).

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

The default weights are as follows: w_{OM} = 0.25 and w_{BM} = 0.75, fixed for the third crediting period. That gives:

$$EF_{grid,CM} = 0.7102 \times 0.25 + 0.2549 \times 0.75 = 0.3687 \text{ tCO2/MWh}$$

The build margin CO_2 emission factor will be ex-ante.

Therefore, the combined margin CO_2 emission factor will be ex-ante.

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)

The parameter $PE_{DT,y}$ and $PE_{SP,y}$ are not used in the calculation of project emissions since there is no distribution of compressed/liquefied LFG using trucks in the project activity.

Since there is no supply of LFG to consumers through a dedicated pipeline, $PE_{SP,y}$ = 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, but not including captive power plants:

- $PE_{EC1,y}$ - Grid (Chilean 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:

$$PE_{EC1,y} = EC_{PJ1,y} \times EF_{grid,CM,y} \times (1 + TDL_y)$$

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).

$$PE_{EC2,y} = EC_{PJ2,y} \times EF_{diesel\_generator,y} \times \left(1 + TDL_y\right)$$

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.

Calculation of $PE_{FC,y}$ – project CO2 emissions from fossil fuel combustion in process j during the year y (tCO2/yr)

The consumption of heat will be provided by the burning of liquefied petroleum gas (LPG) from pilot flames of the flares.

According to "*Tool to calculate project of leakage CO2 emissions from fossil fuel combustion*", the equation is:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y}$$

Where:

- $PE_{FC,j,y}$ is the CO_2 emissions from LPG combustion in flares during the year y (tCO_2/yr);
- $FC_{i,j,y}$ is the quantity of LFG combusted in pilot flames of flares during year y (mass /yr); and
- $COEF_{i,y}$ is the CO_2 emission coefficient of LPG in year y (tCO_2/mass).

In Chile, there is data about chemical composition in LPG purchasing invoices. Therefore, option B was chosen for calculation of $COEF_{i,y}$.

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

Where:

- $NCV_{i,y}$ is the weighted average net caloric value of fuel type i in year y (GJ/mass); and
- $EF_{CO2,I,y}$ is the weighted average emission factor of fuel type i in year y (tCO_2/GJ).

Leakage:

In accordance with the ACM0001, no leakage effects need to be accounted.

Emission Reduction

Emission reductions are calculated as follows:

$$ER_y = BE_y – PE_y,$$

Where:

ER_y = Emission reductions in year y (tCO_2e/yr);
BE_y = Baseline emissions in year y (tCO_2e/yr);
PE_y = Project emissions in year y (tCO_2e/yr);

B.6.2. Data and parameters fixed ex ante

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[25].
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	-

Data/Parameter	R_u
Data unit	Pa.m^3/kmol.K
Description	Universal ideal gas constant
Source of data	Methodological tool “Project emissions from flaring”
Value(s) applied	0.008314472
Choice of data or measurement methods and procedures	Default value used, according to Methodological tool “Project emissions from flaring”, table 1: Constants used in equations
Purpose of data	Calculation of baseline emission
Additional comment	-

Data/Parameter	Waste composition
Data unit	%

[25] 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.

Description	Waste composition
Source of data	Third party study
Value(s) applied	**Composition of waste** A) Wood and wood products — 0.00% B) Pulp, paper and cardboard (other than sludge) — 8.00% C) Food, food waste, beverages and tobacco (other than sludge) — 72.00% D) Textiles — 0.00% E) Garden, yard and park waste — 0.00% F) Glass, plastic, metal, other inert waste — 20.00% **TOTAL** — **100%**
Choice of data or measurement methods and procedures	Third party study
Purpose of data	Calculation of baseline emission
Additional comment	Used for projection of methane avoidance

Data/Parameter	$SPEC_{flare}$
Data unit	Temperature - °C Flow rate - Nm³/h Maintenance schedule - number of days
Description	Manufacturer's flare specifications for temperature, flow rate and maintenance schedule
Source of data	Flare Manufacturer
Value(s) applied	The Flare equipment has not been implemented so far. Thus, information about Temperature (°C), Flow rate (Nm³/h) and Maintenance schedule (number of days) are not available yet. Flare model — To be defined Minimum flare temperature — 500 ºC * Maximum flare temperature — 1200 ºC * Minimum and maximum inlet flow rate — Minimum flow: 500 Nm³/h * --- Maximum flow: 10,000 Nm³/h * Maximum duration in days between maintenance events — N/A[26] * Estimated values. Once the flare is implemented, the data presented above will be in accordance with the manufacturer specifications.

[26] The maximum duration in days between maintenance events by the equipment manufacturer is not available. Thus, the number of maintenance events completed in a determined year has been chosen considering preventive maintenance program which defines the frequency for checking flare equipment situation continuously every day.

Choice of data or measurement methods and procedures	Calculation of project emissions
Purpose of data	-
Additional comment	

Data/Parameter	P_{ref}
Data unit	Pa
Description	Atmospheric pressure at reference conditions
Source of data	Tool “Project emissions from flaring”
Value(s) applied	101,325
Choice of data or measurement methods and procedures	Default value extracted from Tool “Project emissions from flaring”
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	T_{ref}
Data unit	K
Description	Temperature at reference conditions
Source of data	Tool “Project emissions from flaring”
Value(s) applied	273.15
Choice of data or measurement methods and procedures	Default value extracted from Tool “Project emissions from flaring”
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	η_{PJ}
Data unit	Dimensionless
Description	Efficiency of the LFG capture system that is be installed in the project activity
Source of data	“LFG Collection and Valorization at El Molle Landfill Site, Valparaíso, Chile” prepared by Biothermica Technologies Inc. Canada. July 2004
Value(s) applied	75%
Choice of data or measurement methods and procedures	“LFG Collection and Valorization at El Molle Landfill Site, Valparaíso, Chile” prepared by Biothermica Technologies Inc. Canada. July 2004
Purpose of data	Calculation of baseline emission
Additional comment	-

Data/Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	CO_2 emission factor of the Chilean grid electricity during the year y
Source of data	Calculations based on parameters described above.

Value(s) applied	0.3687
Choice of data or measurement methods and procedures	The emission factor is calculated ex-ante, as the weighted average of the Simple OM (Operating Margin) and the BM (Build margin), as described in B.6.3.
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	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. For more details, see Annex 3.

Data/Parameter	$\varphi_{default}$
Data unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	Tool "Emissions from solid waste disposal sites"
Value(s) applied	0.75
Choice of data or measurement methods and procedures	According to "Emissions from solid waste disposal sites", the *Application A* was used because the landfill is an existing solid waste disposal site and in the project activity the methane emissions are being mitigated by capturing and flaring the methane (ACM0001).
Purpose of data	Calculation of baseline emission
Additional comment	Considering as: • Boreal and Temperate (MAT < 20 °C) • MAT = 13.4[27] • PET[28] = 41.8 • MAP[29]/PET = 0.6 The option chosen is Dry (MAP/PET<1)

[27] Source: https://climatologia.meteochile.gob.cl/application/requerimiento/producto/RE3002

[28] Source: https://climatologia.meteochile.gob.cl/application/informacion/listadoDeComponentesDeUnElemento/330007/152

[29] Source: https://climatologia.meteochile.gob.cl/application/requerimiento/producto/RE2009

Data / Parameter	f_y
Unit	-
Description	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
Source of data	Select the maximum value from the following: (a) contract or regulation requirements specifying the amount of methane that must be destroyed/used (if available) and (b) historic data on the amount captured
Value(s) applied	0
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emission
Additional comment	According to ACM0001 methodology, the parameter f_y in the methodological tool “Emissions from solid waste disposal sites” shall be assigned a value of 0 (zero) because the amount of LFG that would have been captured and destroyed is already accounted for in equation 2 of this methodology. Also, according to ACM0001 methodology, the parameter *X* begins with the year that the SWDS started receiving wastes (2001). For this reason, the parameter f_y and *X* will not be monitored.

Data/Parameter	OX
Data unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.1
Choice of data or measurement methods and procedures	Default value used according to “Emissions from solid waste disposal sites”
Purpose of data	Calculation of baseline emission
Additional comment	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO_2. The oxidation factor represents the proportion of methane that is oxidized to CO_2.This should be distinguished from the methane correction factor (MCF) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer of SWDS.

Data/Parameter	F
Data unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories

Value(s) applied	0.5
Choice of data or measurement methods and procedures	Default value used according to “Emissions from solid waste disposal sites”
Purpose of data	Calculation of baseline emission
Additional comment	Upon biodegradation, organic material is converted to a mixture of methane and carbon dioxide

Data/Parameter	$DOC_{f,default}$
Data unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or measurement methods and procedures	The default value was used for type Application A). according to “Emissions from solid waste disposal sites”
Purpose of data	Calculation of baseline emission
Additional comment	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. This default value can be used for Application A.

Data/Parameter	$MCF_{default}$
Data unit	-
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	1.0
Choice of data or measurement methods and procedures	The project activity is an anaerobic managed solid waste disposal site with controlled placement of waste (i.e. waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and is include: (i) cover material; (ii) mechanical compacting and (iii) leveling of the waste;
Purpose of data	Calculation of baseline emission
Additional comment	-

Data/Parameter	DOC_j
Data unit	-
Description	Fraction of degradable organic carbon in the waste type j (weight fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)

<table>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th>Waste type j</th><th>DOCj
(% wet waste)</th></tr>
<tr><td>Wood and wood products</td><td>43%</td></tr>
<tr><td>Pulp, paper and cardboard (other than sludge)</td><td>40%</td></tr>
<tr><td>Food, food waste, beverages and tobacco (other than sludge)</td><td>15%</td></tr>
<tr><td>Textiles</td><td>24%</td></tr>
<tr><td>Garden, yard and park waste</td><td>20%</td></tr>
<tr><td>Glass, plastic, metal, other inert waste</td><td>0%</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>IPCC default value for municipal solid waste (MSW) disposal site is applied.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emission</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

<table>
<tr><td>Data/Parameter</td><td>k_j</td></tr>
<tr><td>Data unit</td><td>-</td></tr>
<tr><td>Description</td><td>Decay rate for waste type j</td></tr>
<tr><td>Source of data</td><td>2006 IPCC Guidelines for National Greenhouse Gas Inventories</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th colspan="2" rowspan="2">Waste type j</th><th>Boreal and Temperate
(MAT < 20 °C)</th></tr>
<tr><th>Dry
(MAP/PET<1)</th></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.04</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.02</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.05</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.06</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>IPCC default value for anaerobic managed solid waste disposal site is applied.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
</table>

Additional comment	Considering as: • Boreal and Temperate (MAT < 20 °C) • MAT = 13.4[30] • PET[31] = 41.8 • MAP[32]/PET = 0.6 The option chosen is Dry (MAP/PET<1)

Data/Parameter	MM_i
Data unit	kg/kmol
Description	Molecular mass of greenhouse gas i
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream
Value(s) applied	Compound / Structure / Molecular mass (kg/kmol): Methane / CH_4 / 16.04
Choice of data or measurement methods and procedures	According to "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	MM_k
Data unit	kg/kmol
Description	Molecular mass of gas *k*
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream
Value(s) applied	Compound / Structure / Molecular mass (kg/kmol): Nitrogen / N_2 / 28.01
Choice of data or measurement methods and procedures	According to "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	MM_{H2O}
Data unit	kg/kmol

30 Source: https://climatologia.meteochile.gob.cl/application/requerimiento/producto/RE3002

31 Source: https://climatologia.meteochile.gob.cl/application/informacion/listadoDeComponentesDeUnElemento/330007/152

32 Source: https://climatologia.meteochile.gob.cl/application/requerimiento/producto/RE2009

Description	Molecular mass of water
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream
Value(s) applied	18.0152
Choice of data or measurement methods and procedures	According to “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”
Purpose of data	Calculation of baseline emissions
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

>>

Emission reduction

Baseline emission calculation

The total of methane generation at the site has been estimated based on the waste tonnage of the landfill using the first order decay model presented in the *“Emissions from solid waste disposal sites”* and considering the following equation as mentioned previously.

Ex-ante estimation of $F_{CH4,PJ,y}$

The assumptions used to calculate $\mathbf{F_{CH4,PJ,y}}$ are:

- Methane content in LFG = 50% (default value);
- LFG collection efficiency = 75%: (Based on “LFG Collection and Valorization at El Molle Landfill Site, Valparaíso, Chile” prepared by Biothermica Technologies Inc. Canada. July 2004);
- Density of methane = 0.716 kg/m^3 (as per tool “Project emissions from flaring*”).*

The landfill gas collection and utilization system will capture only a portion of the generated landfill gas. Thus, an estimate of 75% LFG collection was applied to the estimate of LFG produced, under assumption that generated LFG is composed of 50% methane.

The ex ante estimation of the $F_{CH4,PJ,y}$ is presented below:

$$F_{CH4,PJ,y} = \eta_{PJ} \times \frac{BE_{CH4,SWDS,y}}{GWP_{CH4}}$$

Where:

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year y (tCH_4/yr)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y (tCO_2e/yr)
η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH4}	=	Global warming potential of CH_4 (tCO_2e/tCH_4)

The table below illustrates the ex-ante estimation of $F_{CH4,PJ,y}$ by the project activity during the crediting period.

Table 4 - Ex-ante estimation of $F_{CH4,PJ,y}$

Year	$F_{CH4,PJ,y}$ (tCH_4/yr)
From 15/12/2020	259
2021	6,124
2022	6,659
2023	7,175
2024	7,675
2025	8,159
2026	8,629
Until 14/12/2027	8,686

Determination of $F_{CH4,BL,y}$

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

Table 5 - Ex-ante estimation of $F_{CH4,BL,y}$

Year	$F_{CH4,BL,y}$ (tCH_4/yr)
From 15/12/2020	52
2021	1,225
2022	1,332
2023	1,435
2024	1,535
2025	1,632
2026	1,726
Until 14/12/2027	1,737

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

The equation of the $BE_{CH4,y}$ is:

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

Where the OX_{top_layer} = 0.1 (default value) and $F_{CH4,PJ,y}$ and $F_{CH4,BL,y}$ are calculated above. The results are presented below:

Table 6 - Baseline emissions of methane from the SWDS ($BE_{CH4,y}$)

Year	$BE_{CH4,y}$ (tCO_2/year)
From 15/12/2020	4,541
2021	107,175
2022	116,527
2023	125,567
2024	134,313
2025	142,784
2026	151,000
Until 14/12/2027	152,008

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

The ex-ante calculation is:

$$BE_{EC,y} = EC_{BL,k,y} \times EF_{grid,CM,y} \times (1+TDL_y)$$

As explained above:
- $EF_{grid,CM,y}$ = 0.3687 tCO_2/MWh
- TDLy = 20% (default value)

Table 7 - Baseline emissions associated with electricity generation ($BE_{EC,y}$)

Year	$EC_{BL,k,y}$ (MWh/yr)	$BE_{EC,y}$ (tCO_2/yr)
From 15/12/2020	1,689	747
2021	36,266	16,046
2022	36,266	16,046
2023	36,266	16,046
2024	36,266	16,046
2025	36,266	16,046
2026	36,266	16,046
Until 14/12/2027	34,677	15,342

The equation of the baseline emission calculation is:

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

The result is:

Table 8 - baseline emission calculation

Year	$BE_{CH4,y}$ (tCO_2/year)	$BE_{EC,y}$ (tCO_2/yr)	BE_y (tCO_2/yr)
From 15/12/2020	4,541	747	5,288
2021	107,175	16,046	123,221
2022	116,527	16,046	132,573
2023	125,567	16,046	141,613
2024	134,313	16,046	150,359
2025	142,784	16,046	158,830
2026	151,000	16,046	167,046
Until 14/12/2027	152,008	15,342	167,350

Therefore, the combined margin CO_2 emission factor will be ex-ante.

1. Project emission

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

Where:

PE_y = Project emissions in year y (tCO_2/yr)

$PE_{EC,y}$ = Emissions from consumption of electricity due to the project activity in year y (tCO_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 (tCO_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

Thus,

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

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

The project emission from consumption of electricity is:

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

Where:

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

In the option A1 of the “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”, states that a value of the combined margin emission factor ($EF_{grid,CM,y}$) may be used as the emission factor ($EF_{ELj/k/l,y}$) Therefore a value of 0.3687 tCO_2/MWh will be used.

Finally the technical transmission and distribution losses ($TDL_{j,y}$) value has been assumed to be TOOL05 Default Value 20%[33] .Table below summarizes the project emissions resulting from electrical consumption in the plant.

Table 9 - Electricity consumption from the grid resulting due to project activity

Year	Electricity consumption from the grid (MWh/year)	$PE_{el,grid}$ (tCO_2/year)
From 15/12/2020	0	0
2021	0	0
2022	0	0
2023	0	0
2024	0	0
2025	0	0
2026	0	0
Until 14/12/2027	0	0

It is noted that the power plant will be able to supply both the requirements of the power plant and of the blowers required to collect the LFG, thus $PE_{el,grid}$ should be considered as 0.

<u>$PE_{EC2,y}$ - Project emission from diesel generator(s)</u>

The emission factor from the diesel generator(s) is 1.3 tCO2/MWh. The following table represents the project emissions from the use of the standby generator over the crediting period. Table below presents the project emissions associated with fossil fuel combustion at the project site.

Table 10 - Project emissions from diesel generator

Year	$PE_{el,diesel}$ (MWh/year)	$PE_{el,diesel}$ (tCO_2/year)
From 15/12/2020	0	0
2021	0	0
2022	0	0
2023	0	0
2024	0	0
2025	0	0
2026	0	0
Until 14/12/2027	0	0

As the plant was not operational during the period from 2012 to 2015, there was no electricity consumption from the grid and diesel generators, thus considered as 0.

It is noted that from 2016 on, where electrical generation utilizing LFG as a fuel, the power plant will be able to supply both the requirements of the power plant and of the blowers required to collect the LFG, thus $PE_{el,diesel}$ should be considered as 0.

[33] TOOL05 Default Value

Calculation of $PE_{FC,y}$ – project emission from consumption of heat

For ex-ante calculation, this factor was considered zero because there is no estimation from LPG consumption in pilot flames of flares.

$PE_{FC,y} = 0$

2. Leakage:

No leakage effects need to be accounted under methodology ACM0001.

3. Emission reduction

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y	=	Emission reductions in year y (tCO_2e/yr);
BE_y	=	Baseline emissions in year y (tCO_2e/yr);
PE_y	=	Project emissions in year y (tCO_2e/yr);

Year	BEy (tCO_2)	PEy (tCO_2)	ERy (tCO_2)
From 15/12/2020	5,288	0	5,287
2021	123,221	0	123,220
2022	132,573	0	132,572
2023	141,613	0	141,612
2024	150,359	0	150,358
2025	158,830	0	158,829
2026	167,046	0	167,045
Until 14/12/2027	167,350	0	167,350

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

B.7. Monitoring plan

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
From 15/12/2020	5,288	0	0	5,287
2021	123,221	0	0	123,220
2022	132,573	0	0	132,572
2023	141,613	0	0	141,612
2024	150,359	0	0	150,358
2025	158,830	0	0	158,829
2026	167,046	0	0	167,045
Until 14/12/2027	167,350	0	0	167,350
Total	**1,046,273**	**0**	**0**	**1,046,273**
Total number of crediting years	**7**			
Annual average over the crediting period	**149,468**	**0**	**0**	**149,468**

B.7.1. Data and parameters to be monitored

Data/Parameter	TDL_y
Data unit	-
Description	Average technical transmission and distribution losses in the grid in year *y* for the voltage level at which electricity is obtained from the grid at the project site.
Source of data	TOOL05 Default Value
Value(s) applied	20%[34]
Measurement methods and procedures	For (a): *TDLj/k/l,y* should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation
Monitoring frequency	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years
QA/QC procedures	-
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	The technical transmission and distribution losses (TDLj,y) value has been assumed to be 20%, default value from TOOL05.

[34] TOOL05 Default Value

Data/Parameter	$EC_{PJ1,y} = EG_{EC1,y}$
Data unit	MWh/y
Description	Quantity of electricity consumed from the grid by the project activity during the year y;
Source of data	Measurement from Project participants.
Value(s) applied	**Year** / **$EC_{PJ1,y}$ (MWh/year)**: From 15/12/2020: 0; 2021: 0; 2022: 0; 2023: 0; 2024: 0; 2025: 0; 2026: 0; Until 14/12/2027: 0
Measurement methods and procedures	Continuously measured by electricity meters for the grid electricity consumption as per the “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” and methodology ACM0001.
Monitoring frequency	Continuously
QA/QC procedures	As per the “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” The electricity meter will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements. The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements set by the meter supplier or requirements set by the grid operators. The accuracy class of the meters should be in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements.
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	The data will be archived throughout the crediting period and two years thereafter. It is noted that the power plant will be able to supply both the requirements of the power plant and of the blowers required to collect the LFG, thus $PE_{el,grid}$ should be considered as 0.

Year	$EC_{PJ1,y}$ (MWh/year)
From 15/12/2020	0
2021	0
2022	0
2023	0
2024	0
2025	0
2026	0
Until 14/12/2027	0

Data/Parameter	$EC_{PJ2,y} = EG_{EC2,y}$
Data unit	MWh/y
Description	Quantity of electricity consumed from diesel generator by the project activity during the year y
Source of data	Measurement from Project participants.

Value(s) applied	<table><tr><th>Year</th><th>$PE_{el,diesel}$ (MWh/year)</th></tr><tr><td>From 15/12/2020</td><td>0</td></tr><tr><td>2021</td><td>0</td></tr><tr><td>2022</td><td>0</td></tr><tr><td>2023</td><td>0</td></tr><tr><td>2024</td><td>0</td></tr><tr><td>2025</td><td>0</td></tr><tr><td>2026</td><td>0</td></tr><tr><td>Until 14/12/2027</td><td>0</td></tr></table>
Measurement methods and procedures	Continuously measured by electricity meters for the diesel generators as per “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” and ACM0001 methodology.
Monitoring frequency	Continuously
QA/QC procedures	As per the “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” The electricity meter will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements. The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements set by the meter supplier or requirements set by the grid operators. The accuracy class of the meters should be in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements.
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	The data will be archived throughout the crediting period and two years thereafter.

Tool to calculate project or leakage CO2 emissions from fossil fuel combustion

Data/Parameter	$FC_{i,j,y}$
Data unit	kg
Description	Quantity of LPG combusted in pilot flames of flares during year y.
Source of data	Invoices of LPG suppliers.
Value(s) applied	0
Measurement methods and procedures	The mass of LPG purchased by the project developer will be stated in the invoices issued by the LPG supplier. Hard copies of the invoices will be kept in files during the crediting period and two years after.
Monitoring frequency	Continuously
QA/QC procedures	Scope of the LPG supplier.
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;

Additional comment	Where such data is not available, IPCC data will be used in a conservative manner. The data will be archived throughout the crediting period and two years thereafter.

Data/Parameter	$NCV_{fuel,y}$
Data unit	GJ per mass (GJ/ton)
Description	Weighted average net calorific value of fossil fuel i in year y
Source of data	Regional or national default values
Value(s) applied	47.3 for LPG (IPCC 2006)
Measurement methods and procedures	Values should be undertaken in line with regional or national default values. Monitoring frequency: Review appropriateness of the values annually
Monitoring frequency	Continuously
QA/QC procedures	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	The value was based on IPCC 2006. The data will be archived throughout the crediting period and two years thereafter

<table>
<tr><th>Data/Parameter</th><th>$EF_{CO2,LPG,y}$</th></tr>
<tr><td>Data unit</td><td>tCO2/GJ</td></tr>
<tr><td>Description</td><td>Weighted average CO_2 emission factor of LPG in year y</td></tr>
<tr><td>Source of data</td><td>The following data sources may be used if the relevant conditions apply:

<table><tr><th>Data source</th><th>Conditions for using the data source</th></tr><tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.</td><td>If a) is not available.</td></tr></table></td></tr>
<tr><td>Value(s) applied</td><td>0.0656</td></tr>
<tr><td>Measurement methods and procedures</td><td>For a) and b) Measurements should be undertaken in line with national or international fuel standards.</td></tr>
<tr><td>Monitoring frequency</td><td>-</td></tr>
<tr><td>QA/QC procedures</td><td>For a) and b): The CO_2 emission factor will be obtained for each fuel delivery, from which weighted average annual values should be calculated.
For c): Review appropriateness of the values annually.
For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
</table>

Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	-

ACM0001: Flaring or use of landfill gas

Data/Parameter	Management of SWDS
Data unit	-
Description	Management of SWDS
Source of data	Use different sources of data: - Original design of the landfill; - Technical specifications for the management of the SWDS; - Local or national regulations
Value(s) applied	-
Measurement methods and procedures	Project participants should refer to the original design of the landfill to ensure that any practice to increase methane generation have been occurring prior to the implementation of the project activity Any change in the management of the SWDS after the implementation of the project activity should be justified by referring to technical or regulatory specifications.
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	-

Data/Parameter	$EG_{PJ,y} = EC_{BL,k,y}$
Data unit	MWh
Description	Amount of electricity generated using LFG by the project activity in year y
Source of data	Electricity meter
Value(s) applied	36,266 in 2026 on
Measurement methods and procedures	Monitor net electricity generation by the project activity using LFG
Monitoring frequency	Continuous
QA/QC procedures	The electricity meter will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements. The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements set by the meter supplier or requirements set by the grid operators. The accuracy class of the meters should be in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements. The readings will be double checked by the electricity distribution company.
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks; (b) Calculation of project emissions or actual net GHG removals by sinks;

Additional comment	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"

Data/Parameter	$O_{pj,h}$
Data unit	-
Description	Operation of the equipment that consumes the LFG
Source of data	Measurements by Project participant using a device integrated with the operational software at the landfill gas plant.
Value(s) applied	n/a
Measurement methods and procedures	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. Opj,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, Opj,h=1
Monitoring frequency	Once per minute
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	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	-

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

Data/Parameter	$V_{t,db}$
Data unit	m³ /h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data	Measurements by Project participants using a flow meter(s)
Value(s) applied	n/a
Measurement methods and procedures	The volumetric flow rate of the residual gas which is sent to flare, LFG engines in the hour h will be measured by the installed flow meters with digital recordable electronic signal, according to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, the measurement option in the project activity will be: • Option (A) dry basis: when the temperature of gaseous stream is lower than 60ºC (333.15 K) at the flow measurement point; • Option (B) wet basis: when the temperature of gaseous stream is higher than 60o C (333.15 K) at the flow measurement point;
Monitoring frequency	Continuous recorded and hourly aggregated
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	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	This parameter will be monitored only in case Option A of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” is applied for the determination of $F_{CH4,flared,y}$, $F_{CH4,EL,y}$ and $F_{CH4,NG,y}$

Data/Parameter	$V_{t,wb}$
Data unit	m³ /h
Description	Volumetric flow of the gaseous stream in time interval t on a wet basis
Source of data	Measurements by Project participants using a flow meter
Value(s) applied	n/a
Measurement methods and procedures	The volumetric flow rate of the residual gas which is sent to flare, LFG engines in the hour h will be measured by the installed flow meters with digital recordable electronic signal, according to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, the measurement option in the project activity will be: • Option (A) dry basis: when the temperature of gaseous stream is lower than 60ºC (333.15 K) at the flow measurement point; • Option (B) wet basis: when the temperature of gaseous stream is higher than 60o C (333.15 K) at the flow measurement point;
Monitoring frequency	Continuous recorded and hourly aggregated
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	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	This parameter will be monitored only in case Options B or C of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” is applied for the determination of $F_{CH4,flared,y}$, $F_{CH4,EL,y}$ and $F_{CH4,NG,y}$

Data/Parameter	$v_{i,t,db}$
Data 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
Source of data	Measurements by Project participants using gas analyser
Value(s) applied	50%
Measurement methods and procedures	Continuous gas analyser operating in dry basis. Volumetric flow measurement should always refer to the actual pressure and temperature.
Monitoring frequency	Continuous recorded and hourly aggregated
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	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	This parameter will be monitored only in case Option A of the tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” is applied for the determination of $F_{CH4,flared,y}$, $F_{CH4,EL,y}$ and $F_{CH4,NG,y}$

Data/Parameter	$v_{i,t,wb}$
Data 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
Source of data	Measurements by Project participants using gas analyser
Value(s) applied	50%
Measurement methods and procedures	Calculated based on the dry basis analysis plus water concentration measurement or continuous in-situ analysers if not specified in the underlying methodology
Monitoring frequency	Continuous recorded and hourly aggregated
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	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	This parameter may be monitored only in case Option B of the tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” is applied for the determination of $F_{CH4,flared,y}$, $F_{CH4,EL,y}$ and $F_{CH4,NG,y}$

Data/Parameter	T_t
Data unit	K
Description	Temperature of the gaseous stream in time interval t
Source of data	Measurements by Project participant using a temperature meter
Value(s) applied	n/a
Measurement methods and procedures	Thermoresistance with digital recordable electronic signal will be used. The accuracy and uncertainty of the monitoring instrument will be in accordance with manufacturer specifications.
Monitoring frequency	Continuous
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	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	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
Data unit	Pa
Description	Pressure of the gaseous stream in time interval t
Source of data	Measurements by Project participant using a pressure meter
Value(s) applied	n/a
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) will be used. Examples include pressure transducers, etc. The accuracy and uncertainty of the monitoring instrument will be in accordance with manufacturer specifications.
Monitoring frequency	Continuous
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	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	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
Data unit	-
Description	Operational status of biogas destruction devices
Source of data	Provided by project participants
Value(s) applied	n/a
Measurement methods and procedures	Monitoring and documenting may be undertaken by recording the energy production from methane captured or the operation of the flare by means of a flame detector to demonstrate the actual destruction of methane, unless a different method is specified in the underlying methodology/tool. Emission reductions will not accrue for periods in which the destruction device is not operational.
Monitoring frequency	Continuous
QA/QC procedures	-
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	For Flame detector devices refer to the methodological tool “Project emissions from flaring”

Data/Parameter	$P_{H2O,t,Sat}$
Data unit	Pa
Description	Saturation pressure of H_2O at temperature Tt in time interval t
Source of data	Provided by project participants
Value(s) applied	n/a
Measurement methods and procedures	This parameter is solely a function of the gaseous stream temperature Tt and can be found at reference [1] for a total pressure equal to 101,325 Pa
Monitoring frequency	-
QA/QC procedures	-
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	[1] Fundamentals of Classical Thermodynamics; Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4º Edition 1994, John Wiley & Sons, Inc.

Methodological tool “Project emissions from flaring”

Data/Parameter	$F_{CH4,EG,t}$
Data unit	kg
Description	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period t
Source of data	Measurements undertaken by a third party accredited entity
Value(s) applied	-
Measurement methods and procedures	Measures of the mass flow of methane in the exhaust gas carried out according to an appropriate international standard (USEPA). The time period t over which the mass flow is measured must be at least one hour. The average flow rate to the flare during the time period t must be greater than the average flow rate observed for the previous six months The accuracy and uncertainty characteristics of the monitoring equipment will be under responsibility of the third party accredited entity.
Monitoring frequency	Biannual

QA/QC procedures	According to the standard applied
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	Monitoring of this parameter is required taking into account the LFG combustion in enclosed flares and also project participants selected Option B.1 to determine flare efficiency

Data/Parameter	$Flame_m$
Data unit	Flame on or Flame off
Description	Flame detection of flare in the minute m
Source of data	Project Participant
Value(s) applied	-
Measurement methods and procedures	Measurements by project participants using a continuous Ultra Violet flame detector
Monitoring 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
QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations
Purpose of data	Calculation of baseline and project emissions when the flame is on[35].
Additional comment	-

Data/Parameter	$Maintenance_y$
Data unit	Calendar dates
Description	Maintenance events completed in year y
Source of data	Project participants
Value(s) applied	-
Measurement methods and procedures	Record the date that maintenance events were completed in year y. Records of maintenance logs must include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced, or needing to be replaced, source of replacement parts, serial numbers and calibration certificates
Monitoring frequency	Daily
QA/QC procedures	Records must be kept in a maintenance log for two years beyond the life of the flare
Purpose of data	Calculation of baseline and project emissions when the flame is on[36].
Additional comment	Monitoring of this parameter is required for the case of enclosed flares and the project participant selects Option B to determine flare efficiency. These dates are required so that they can be compared to the maintenance schedule to check that maintenance events were completed within the minimum time between maintenance events specified by the manufacturer ($SPEC_{,flare}$).

Data/Parameter	$T_{EG,m}$
Data unit	º C

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

[36] When the maintenance is being carried out, neither baseline nor project emissions occurs since the LFG is not combusted and released to the atmosphere.

Description	Temperature in the exhaust gas of the enclosed flare in minute m
Source of data	Measurements by project participants
Value(s) applied	-
Measurement methods and procedures	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 500 ºC indicates that a significant amount of gases are still being burnt and that the flare is operating. Data will be recorded continuously and values will be averaged hourly or at a shorter time interval
Monitoring frequency	Once per minute
QA/QC procedures	Thermocouples will be replaced or calibrated every year
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	-

B.7.2. Sampling plan

>>

Not applicable

B.7.3. Other elements of monitoring plan

>>

The monitoring plan will be done according to the methodology ACM0001, the applicable tools, as well as per the CDM project standard for project activities. Details are available in section B.7.1 above. The monitoring equipment locations are presented in the picture below:

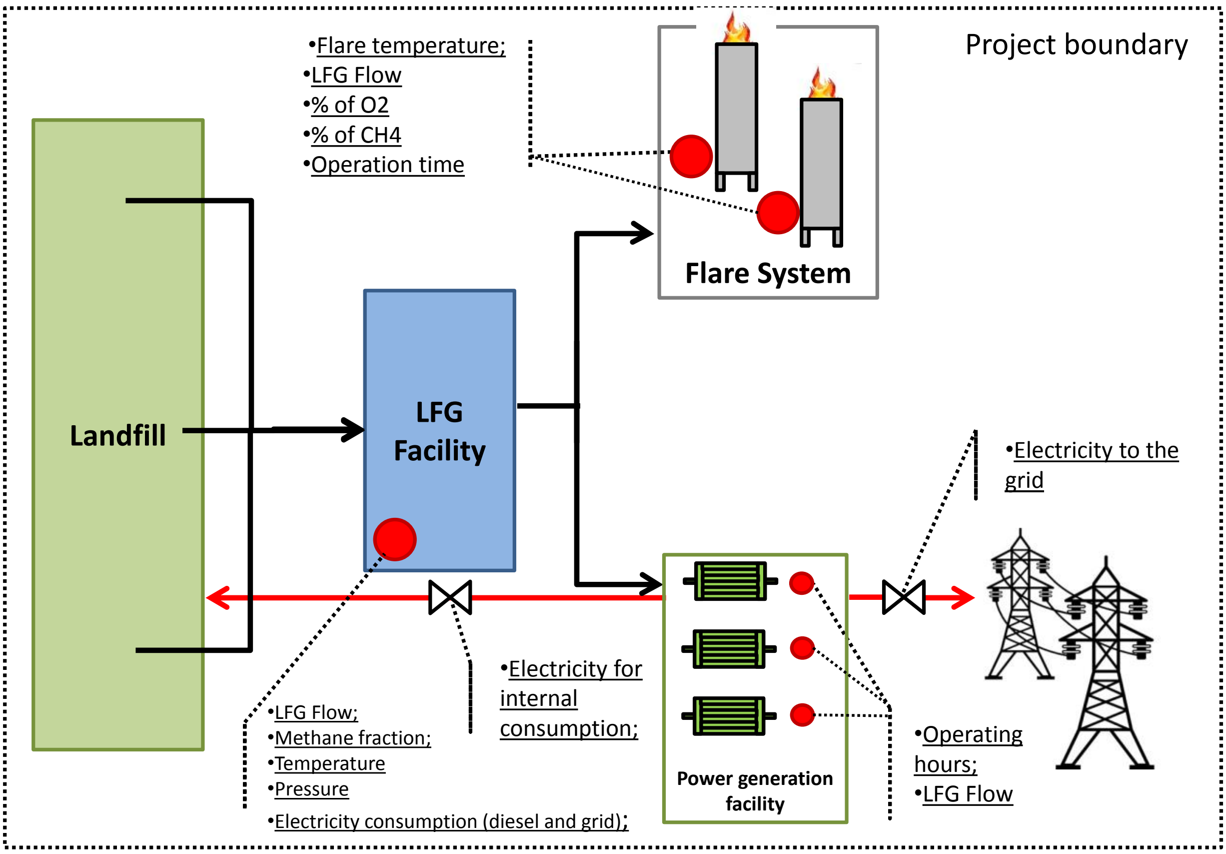

Figure 10 - Monitoring equipments locations

All continuously measured parameters (LFG flow, CH_4 concentration, flare temperature, flare operating hours, engine operating hours, and engine electrical output) will be recorded electronically via a datalogger, located within the Site boundary which will have the capability to aggregate and print the collected data at the frequencies as specified above. It will be the responsibility of the Site Operator to provide all requested data logs which will be stored over the duration of the reporting period at the Site office. The data logs will be summarized into emission reduction calculations prior to each verification. This task will be completed by GIRSpA and reported directly to the DOE. These logs will be available at the request of the DOE in order to prove the operational integrity of the Project.

1. Introduction and Objectives

The two primary purposes of the monitoring plan are:

- To collect the necessary system data required for the determination of emissions reductions; and
- To demonstrate successful compliance with established operating and performance criteria to verify the emission reductions and generate the respective CERs.

The operational data that is collected will be used to support the periodic verification report that will be required for CER auditing. The monitoring plan discussed herein is designed to meet or exceed the UNFCCC requirements (approved monitoring methodology ACM0001).

The routine system monitoring program required for the determination of the emission reductions is discussed in section 2 below, while the additional system data that is collected to ensure the safe, correct, and efficient operation of the LFG management system is discussed in section 3.

2. Training of monitoring personnel

Before commencement of the O&M phase, GIRSpA will conduct a training and quality control program to ensure that good management practices are carried out and implemented by all project operating personnel in terms of record-keeping, equipment calibration, overall maintenance, and procedures for corrective action.

3. Monitoring Work Program

The LFG monitoring program is a relatively simple, straight forward program designed to collect system operating data required to safely operate the system and for the verification of CERs. This data will be collected in real time, and will provide a continuous record that is easy to monitor, review, and validate.

The following sections will outline and discuss the following key elements of the monitoring program:

- Flow measurement;
- Gas quality measurements;
- Uncombusted methane;
- Electrical Consumption;
- Project electricity output;
- Regulatory requirements;
- Data records; and
- Data assessment and reporting.

3.1. Flow Measurement

One flow meter will be installed during Phase 1 (flaring) on the piping, straight before the flares.

During phase 2 (electricity generation) implementation, in order to follow ACM0001, other flow meters will also be installed to comply with item 6 “Monitoring Methodology”.

The flow of LFG collected by the system and subsequently utilized or flared are measured via individual flow measuring devices suitable for measuring the velocity and volumetric flow of a gas. One common example is an annubar. The flow measurements are taken within the piping itself, and the flow sensors are connected to transmitters that are capable of collecting and sending continuous data to a recording device such as a datalogger.

The flow sensors are calibrated according to a specified temperature and composition of the gas, thus the flow actually measured must be corrected to according to actual temperature, pressure, and composition, thus density, of the gas measured. The equipment selected will allow dynamic compensation for these parameters, normalized to a standard temperature, pressure, and gas composition. For reporting purposes, the flows are generally required to be normalized to 0°C and 1.01325 bar at standard gas composition of 50% methane and carbon dioxide each by volume.

The accuracy of a flow meter is dependent on the design of the equipment, and the specific type of sensor used, however equipment is available that will provide a minimum accuracy of +/- 2% by volume. The equipment selected for the site utilizes a continuous monitoring system as defined in ACM0001, which measures and aggregates flow data approximately once every minute.

3.2. Gas Quality

Fraction of methane is the most pertinent parameter to the validation of CERs. This parameter is measured via a common sample line that is ran to the main collection system piping, and measured in real time by sensors installed as per ACM0001.

Regular calibration of the equipment is especially important, as the accuracy of the methane sensor is greatest within the expected range of the gas stream to be measured. Equipment is readily available that will provide an accuracy of at least +/- 1% by volume. The equipment selected for the site aggregates gas compositions approximately once every 1 minutes as per the definition of a continuous monitoring system in ACM0001.

3.3. Uncombusted Methane

The efficiency of the enclosed flares will be measured per the methodological “Tool to determine project emissions from flaring gases containing methane”.

3.4. Electrical Consumption

The consumed electricity from the grid by the project activity will be continuously measured by electricity meters for the grid and diesel generators. The respective data will be electronically recorded.
Monthly electrical bills charged to the project will be monitored and can be considered as the actual energy consumption for the project.

3.5. Project Electricity Output

The generated electricity used for export to grid and the landfill internal consumption (i.e. administration offices, truck garage, recycling plant, leachate pumps), excluding the LFG Facility

electricity consumption by the project activity[37] will be continuously measured by an electricity meter and respective data will be electronically recorded.
Monthly electrical bills charged to the project will be monitored and can be considered as the actual energy generation for the project.

3.6. Regulatory Requirements

Regulatory requirements relating to LFG projects will be evaluated annually by investigating municipal, state and national regulations pertaining to LFG. This will be done through consultation with the appropriate regulatory bodies, ongoing discussion with regulators, and monitoring of publications delineating upcoming legislative changes governing landfills and LFG.

4. Data records and storage

Data collected from each of the parameter sensors is transmitted directly to an electronic database from which the CER volume calculations may be carried out. A copy backup or reports of the data may be carried out as required or recorded in Portable Document Format (PDF). Backup of the electronic data is conducted continuously.

5. Related monitoring and project performance review

GIRSpA will conduct an additional operational monitoring of the LFG collection system to check the project performance and ensure that the system is being operated both correctly and efficiently. Periodic adjustments to the horizontal trenches and to the extraction wells/drains will be required to optimize the capture and collection systems effectiveness. LFG collection field adjustments will be made based upon a review of the trench and well performance history considered within the context of the overall LFG collection field operation in order to maximize the collection of methane balanced against minimization of any oxygen in the system that could introduce unsafe operating conditions.

6. Emergency procedures

All data will be collected through site analytical unit and will be transmitted to a site server unit, which records the data on-site and automatically sends for storage and back-up. The plant Manager will check daily the records. In addition, there will be developed an Emergency Plan including others types of emergencies such as fire and *work accidents.*

7. Calibration

All the measurement instruments will be subject to regular calibration as per manufacturer's specifications. The regular check and calibration will be made by the operators. The plant Manager will be responsible for checking the equipment's proper working order, as well as checking and storing up the calibration certificates and records. Calibration certificates will be kept for all the equipment during the crediting period and two years after.

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

The date of completion the application of the methodology to the project activity study is 16/10/2021.

The person/entity determining the baseline is as follows:

[37] There will not be claimed CERs for LFG Facility electricity consumption because the electricity consumption is a consequence of the CDM Project.

Beng Engenharia Ltda, São Paulo, Brazil
Contact person: Mr. João Sprovieri
Mr. Francisco Santo
Ms. Ana Paula Beber Veiga (SEN CO_2 emission factor)
Email: joao.sprovieri@beng.eng.br
francisco.santo@beng.eng.br
ana.veiga@bengeng.br

Beng Engenharia Ltda is not a Project Participant.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>
Project starting date: 01/04/2006[38]

C.2. Expected operational lifetime of project activity

>>
20 years and 0 months

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
Renewable (3 x 7 years)

C.3.2. Start date of crediting period

>>
The 3rd crediting period will start on 15/12/2020.

C.3.3. Duration of crediting period

>>
7 years and 0 months.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
During the 1st CP validation, the Chilean Environmental Law was promulgated in 1995, its regulations were ratified on December 1997. El Molle Landfill's operations started in January, 1985. This means that for the selection of this landfill no Environmental Impact Assessment was performed to determine if this specific location was most suitable as a landfill in Valparaiso area. Later, after El Molle had already been constructed, the before mentioned legislation on the field of environmental control and area planning came into force. For certain classes of plants/facilities this new legislation required to make a kind of 'afterwards EIA', making an inventory of the environmental impact of the existing facility. This document is called "Proyecto de cierre, sellado y reincersión de la celda número 2 vertedero El Molle" and consists of a statement of the current environmental condition on site and presents a plan to adequate the procedures with the environmental law and its regulations. The mentioned document was approved in November 6th,

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[38] El Molle CDM project: http://cdm.unfccc.int/filestorage/L/C/F/LCF0D10WM2QADBKW8JEONHJV7IJQUZ/El%20Molle_PDD_v10_2005-12-03.pdf?t=bmt8b25icWMxfDAv_3jMmB7XWnjclZHIyMel

2002 through resolution number 001681 granted by the Ministry of Health. Valparaiso – San Antonio communities.

Due to the inclusion of the electricity plant, an Environmental Impact Declaration (DIA) was carried out and Environmental Qualification Resolution 126 (RCA 126) from 7th April 2015 was issued from Valparaiso Region Evaluation Commission from Chile Republic and also an operation authorization number 2651 was issued in 30th August 2013.

D.2. Environmental impact assessment

>>
All environmental assesses were analysed by Chilean Environmental Agency (Ministerio del Medio Ambiente) and El Molle landfill has all pertinent Licenses for the operation. Thus, no significant environmental impact was identified.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>
During the 1st CP validation, under the existing Chilean environmental legislation, the local DNA (CONAMA[39]) calls for a Public Consultation Process (PCP) to identify concerns of the local stakeholders and response of the developer, as part of the EIA.

However, due to the technical & legal characteristics of the proposed CDM project activity (see section F.1), CONAMA[40] did not considered necessary an open public consultation. In this case, what the common sense recommended, and it was done that way, was a focused public consultation, surveying the neighbors in the area of direct influence of the project and leaders or organized local groups in that same area.

Therefore the following independent PCP's activities was performed by the project developer:

a) 02 public announcements were performed in a regional newspaper.
b) Letters to all the public authorities and neighbors was sent explaining the project.
c) 02 public meetings were organized at the landfill site.

The PCP has been developed following crystal-clear procedures and tried to cover the interested parties and/or by those affected by the project.

E.2. Summary of comments received

>>
In general, the perception of the project is positive and related health benefits regarding the recovering of the landfill gas are well recognized by local stakeholders. Other concerns about the project construction and operation are seen as solvable and not as key within their general concerns about the landfill itself.

E.3. Consideration of comments received

>>
The project developer will take the suggestions up and will inform the stakeholders regularly on the progress of the project at El Molle landfill site.

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[39] CONAMA DNA was replaced by Ministry of Environment in 2010. Source: https://cdm.unfccc.int/DNA/view.html?CID=45

[40] CONAMA DNA was replaced by Ministry of Environment in 2010. Source: https://cdm.unfccc.int/DNA/view.html?CID=45

SECTION F. Approval and authorization

>>

In the proposed project, the project participant is presented below:

Thus, the Party involved is Chile.

In accordance with the “CDM project cycle procedure for project activities”, the project participant has already obtained a letter of approval from the host parties DNAs.

During the 1st CP validation, the registered CDM project activity has been granted with Letter of Acceptance (LoA) by the Designated National Authority (DNA) of the host party Chile (dated 01/07/2005). Copy of such LoA and related assessment details are made available at the project’s page at UNFCCC’s CDM website.

The former entity legal name Gestión Integral de Residuos S.A. (GIRSA) has changed to Gestión Integral de Residuos SpA (GIRSpA) and an updated Letter of Approval (LoA) from host country DNA is being requested.

Appendix 1. Contact information of project participants

Organization name	Gestión Integral de Residuos SpA
Country	Chile
Address	Sector Camino La Pólvora, km 7
Telephone	+56 32 23 2345
Fax	+56 32 25 6139
E-mail	travis.hipp@stericycle.com
Website	-
Contact person	Mr. Travis Hipp

Organization name	First Climate (Switzerland) AG
Country	Switzerland
Address	Brandschenkestrasse 51 – 8002 - Zurich
Telephone	-
Fax	-
E-mail	-
Website	-
Contact person	Yves Keller

Appendix 2. Affirmation regarding public funding

There is no Annex I public funding involved in the project activity.

Appendix 3. Applicability of methodologies and standardized baselines

BASELINE INFORMATION

The baseline scenario for the project activity is the uncontrolled release of landfill gas to the atmosphere and also the generation of electricity from other sources.

The table below shows the key elements used for estimate the emissions of the baseline scenario.

1. Key Parameters

Year landfilling operations started operator/historical logs	2001
Projected year for landfill closure - estimated based on current filling rate	2028
GWP for methane (UNFCCC and Kyoto Protocol decisions)	25
Methane concentration in LFG (% by volume) typical assumption for baseline scenario	50

LFG collection efficiency (%)	75
Flare efficiencies (%) operational data from flare manufacturer	99 %
Electricity consumption from the grid due to the project activity (MWh/year)	0
Electricity consumption from the diesel generator due to the project activity (MWh/year)	0
Combined margin emission factor for electricity displacement (tCO_2/MWh) calculated based on the Tool to calculate the emission factor for an electricity system	0.3687
Installed capacity of Power Plant (MW)	4.5
Load factor	92.00
Operational lifetime of the project activity (years)	20
Adjustment Factor (AF)	20%

2. Waste disposal

The forecast amount of waste disposal in El Molle landfill is presented below:

Year	Waste disposal (tonnes/yr)
2001	100,000
2002	100,000
2003	129,976
2004	108,282
2005	268,132
2006	276,685
2007	329,116
2008	357,985
2009	357,849
2010	356,115
2011	365,000
2012	370,000
2013	144,116
2014	34,304
2015	328,212
2016	408,125
2017	594,714
2018	655,572
2019	525,282
2020	527,458
2021	674,384
2022	683,151
2023	692,032
2024	701,028
2025	710,141
2026	719,374
2027	728,725
2028	360,567

3. Emission factors

The table below shows the Chilean combined margin emission factor. Data used in the calculation is publicly available and was retrieved from the Comisión Nacional de Energía website at https://www.cne.cl/en/normativas/electrica/consulta-publica/electricidad/. The CO_2 emission factor calculation spreadsheet is available with Project Participants and is attached to this PDD.

1. Operating Margin Emission factor

Year	Electricity generation by OM plants (MWh)	CO2 emissions by OM plants (tCO2)
2020	40,643,413	29,515,181
2019	42,089,147	29,797,810
2018	41,018,128	87,885,807
Total	123,750,688	147,198,799

$EF_{grid,OM,y}$	**0.7102**	**tonCO2/MWh**

2. Build Margin Emission Factor

$EF_{grid,BM,y}$	**0.2549**	**tonCO2/MWh**

3. Combined Margin Emissions Factor

$EF_{grid,CM,y}$	**0.3687**	**tonCO2/MWh**

Data	Value
w_{OM}	**25%**
w_{BM}	**75%**

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

Not applicable

Appendix 5. Further background information on monitoring plan

The monitoring will be made as described in items B.7.1. and B.7.2.

Appendix 6. Summary report of comments received from local stakeholders

In general, the perception of the project is positive and related health benefits regarding the recovering of the landfill gas are well recognized by local stakeholders. Other concerns about the project construction and operation are seen as solvable and not as key within their general concerns about the landfill itself.

Appendix 7. Summary of post-registration changes

A summary of the post registration changes is presented below:

<u>Approved PRC-0170-002:</u>

1) Inclusion of electricity generation plant installed capacity 4.5 MW. The plant was installed in 2016. It is important to highlight that this PRC does not impact negatively the methodology application, nor the project additionality and scale.

2) Legal name change from Gestión Integral de Residuos S.A (GIRSA) to Gestión Integral de Residuos SpA (GIRSpA). This change has been approved by the EB on 04/05/2018.

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Document information

Version	*Date*	*Description*
12.0	8 October 2021	Revision to: Improve consistency with version 03.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN).
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.

Version	*Date*	*Description*
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project activities, project design document