Project design document form for CDM project activities

(Version 08.0)

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Loma Los Colorados Landfill Gas Project
Version number of the PDD	1.6
Completion date of the PDD	24/06/2017
Project participant(s)	KDM S.A. URBASER S.A. The Kansai Electric Power Co., Inc. ALLCOT AG
Host Party	Chile
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	Selected Methodology: ACM0001 - “Flaring or use of landfill gas” (version 15.0)
Sectoral scope(s) linked to the applied methodology(ies)	Sectoral Scope: 13 - Waste handling and disposal 1 - Energy industries (renewable - / non-renewable sources) (project’s electricity generation component)
Estimated amount of annual average GHG emission reductions	1,317,482 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The objective of Loma Los Colorados Landfill Gas Project is to develop a landfill gas collection and utilization/destruction system. This involves investing in and operating a system for landfill gas (LFG) collection and electricity generation and/or flaring. Landfill gas flaring or its utilization for electricity generation involves methane combustion leading to greenhouse gas (GHG) emissions reductions.

As per the project design, collected landfill gas is to be used as fuel for electricity generation and additional GHG emissions reductions - from electricity generation using renewable energy source - are accrued and are to be credited within this project under the CDM (Clean Development Mechanism).

As per the project design, possible uses for collected landfill gas (LFG) are summarized as:

(i) Combustion of collected LFG in high temperature enclosed flares (flaring);
(ii) Utilization of collected LFG as fuel for electricity generation (to be consumed by the project activity and/or exported through the SIC (Central Interconnected Electricity Grid of Chile));

The Loma Los Colorados Landfill is a Municipal Solid Waste (MSW) landfill located in the community of Til-Til, 63.5 km North of Santiago, Chile, near a village named Montenegro. The site operations are managed by KDM S.A. The Loma Los Colorados Landfill is generally considered to be the most modern of landfill operations in Chile. In May 2003, construction of a railway access was completed and operation of a train was initiated to transport MSW to the Landfill from the transfer station located in the community of Quilicura, Santiago. In mid 2006 it was reported that more than 90 percent of the MSW deposited at the Landfill is delivered by rail[1].

Loma Los Colorados is the biggest landfill in Chile; the site comprises a total of about 800 hectares (ha), of which 200 ha are planned for landfill development. The area around the landfill may be considered semi-arid, with an average annual precipitation of 340 mm, with poor vegetation and animal life. Water is located deep in the soil, which generally consists of very low permeability clay, with measured permeability in the range of 10-5 to 10-7 cm/s. The lack of water and the presence of clay make this site appropriate for landfill operations.

The landfill began accepting waste in April 1996. In January 2006[2], more than 16.3 million ton of waste has been filled over 48.5 of the Landfill's 200 hectares. The total MSW disposal capacity of the Landfill is approximately 130 million ton. In January 2006, the landfill was being filled at a rate of about 5,000 ton per day, or greater than 1.7 million ton per year[3]. By assuming (in January 2006) an increase in current filling rates of about 2.5 percent per year, the landfill was anticipated to reach such total MSW disposal capacity around year 2045. In December 2004, KDM S.A. started receiving sludge coming from the largest wastewater treatment plant in Santiago, which

[1] In December 2013, the fraction of the total disposed MSW delivered (transported) by rail was about 90%.

[2] While data and facts used for the completion of the initial registered version of the PDD (version 4) are dated January 2006 and/or mid 2006, this revised version of the PDD refers to "*January 2006*" and/or "*mid 2006*" when describing related data and design information used for completing of the first registered version of the PDD. It is important to note that some of figures and facts related to Loma los Colorados landfill and aspects related to the implementation of the project activity which are included in the PDD were not any longer applicable or valid at the time of the renewal of the crediting period. For all relevant cases, references to updated data, information and/or facts were added as footnote complementary information disclaimers.

[3] In December 2013, about 6,000 ton of MSW were being daily disposed in the landfill.

has been disposed mixed with the MSW in the Loma los Colorados landfill. The average amount of sludge to be disposed in the site was estimated at 380 ton per day[4].

In January 2006, the MSW disposal service contract signed between the affected municipalities and KDM was expected to be valid until 2011 and it would be automatically renewed for additional 16 years more if none of the parties stated the contrary no later than August 2009[5]. The Loma Los Colorados landfill has the largest area in the Metropolitan Region available for waste disposal, with a total capacity of 130 million ton of waste (enough for at least 37 years more after year 2014). The landfill is also very well located, in a rural area, reducing potential problems with the community. Moreover, the railway link provides an excellent means for transporting waste from the city to the landfill site. For these reasons, waste is expected to be disposed at the landfill site for far longer than the longest possible CDM crediting period. In any case, waste availability and status of applicable contracts may be checked at the start of each renewal of the crediting period.

In mid 2006, prior to the implementation of the project activity, there were 79 active landfill gas wells installed over an area of 48.5 hectares; of these, 12 hectares were connected to an existent small-scale flaring station, through an active LFG extraction system. The rest of the wells were for venting landfill gas into the atmosphere. Such small-scale LFG flaring station had been burning LFG since 1998, with some long interruptions in system operation. The total amount of LFG flared at this flaring system was recorded daily by KDM S.A.[6], and the records are considered for the determination of amount of methane destroyed in the absence of the project activity in the context of determination of baseline emissions[7]. The small flare was decommissioned in the beginning of 2007, when the Loma Los Colorados Landfill Gas Project started its operation. At that stage all the existing LFG extraction wells were connected to the same LFG extraction facility and LFG was delivered to the high temperature enclosed flares and electricity generation plant.

In mid 2006, the predicted LFG recovery rate for the landfill for 2007 was about 7,100 Nm^3/h (assuming 50% capture of LFG generated). The overall predicted recovery rate was expected to continue to increase until the landfill closes, which is anticipated to occur in 2045, after which the rate will decrease as the organic fraction is degraded.

As per the project design, before the power plant (project's electricity generation component) is commissioned and also when the installed project's electricity generation component is not under full operation, all collected LFG and/or any surplus or fraction of collected LFG (which is beyond the LFG maximum consumption by the project's electricity generation component) are to be flared at enclosed high temperature flares, thus assuring complete combustion of collected methane as

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[4] In December 2013, about 150 tonnes of sludge from wastewater treatment were being daily disposed in the landfill. For the ex-ante estimates of emission reductions during the 2nd 7 year renewable crediting period, it is assumed an annual growth rate of wastewater sludge disposal of 1%.

[5] The renewal of this MSW disposal service contractual agreement was signed on 2009. As per this contractual agreement, MSW is expected to be disposed in the landfill under the terms and conditions specified by the contract until 2027.

[6] Historical data on the amount of methane that was captured (and destroyed by flaring in the voluntarily acquired and implemented small LFG flaring unit) are available, thus allowing the calculation of the parameter $F_{CH4,BL,x-1}$ - Historical amount of methane in the LFG which is captured and destroyed in the year prior to the implementation of the project activity (tCH_4/yr) – as defined in the applicable methodology ACM0001 (version 15.0).

[7] During the first 7-year renewable crediting period, the small amount of LFG flared in the baseline scenario was determined as 245 tCO_2e per year, and taken into account as the parameter MD_{reg}, according to the provisions of the methodologies applicable to the 1st 7 year renewable crediting period - ACM0001 (version 4) - Consolidated methodology for landfill gas project activities and ACM0002 ver. 6 - Consolidated methodology for grid-connected electricity generation from renewable sources. On the 2nd 7 year renewable crediting period, the new version of the methodology applicable to the present project activity (ACM0001 (version 15.0) - Flaring or use of landfill gas) considers the calculation of baseline emissions as the parameter $F_{CH4,BL,y}$. The calculations of $F_{CH4,BL,y}$ will be presented further on this document according to the case applicable to the situation of the project activity (Case 3, defined under table 3, item 5.4.1.3 of the applicable methodology ACM0001 (version 15.0)).

well as destruction of air pollutants present in collected LFG even when LFG cannot be combusted in the engine-generator sets.

Besides climate change mitigation, the project have important local environmental benefits. In the pre-project scenario most of the generated LFG was released into the atmosphere without any treatment. This implies a potential fire and explosion risk as well as bad odors. Moreover, landfill gas contains trace amounts of volatile organic compounds, which are air pollutants. Capturing and flaring and/or utilization of landfill gas under the project scenario greatly reduces all these risks and thereby contribute to sustainable development.

As described in the latest version of the registered PDD valid for the 1st 7-year crediting period (PDD version 5.3), in mid 2006 there were no national or regional laws applicable for the Loma Los Colorados landfill requiring landfill gas capture and flaring or its utilization. The common practice at Chile was the uncontrolled release of landfill gas into the atmosphere. It is also important to note that either at December 2013, there was no regulation in Chile that obligates landfills to collect and flare the generated LFG. Nevertheless, the amount of LFG captured and flared at the voluntarily acquired small LFG flaring station was considered in the determination of baseline emissions. Thus, the baseline scenario for the project activity is the continuation of the practice being adopted before the project was registered as a CDM project activity (uncontrolled release of landfill gas into the atmosphere with a small fraction of generated LFG being captured and flared at the voluntarily acquired small LFG flaring station).

Summarized description of the baseline scenario under the 2nd 7-year crediting period:
For the 2nd 7 year renewable crediting period, the baseline scenario for LFG management at the Loma Los Colorados Landfill remains being the same as the scenario existing prior to the implementation of the project activity with the earlier expected potential LFG alternatives not being implemented. Thus, LFG generated at the landfill (with high content of methane) would be freely emitted into the atmosphere without any treatment, collection, combustion or control through the surfaces and the passive flare of the landfill with very small fraction being destroyed in the voluntarily installed and not continuously operated small LFG flaring station. It is important to notice that under the baseline scenario, it is still being assumed that in the absence of the project activity, only a minor fraction of generated LFG would be combusted in such voluntarily installed and not continuously operated small LFG flaring station.

The baseline scenario for the project's renewable energy component is the equivalent amount of electricity being generated by the operation of grid-connected thermal power plants consuming fossil fuel and by the addition of new generation sources in the absence of the project activity.

GHG emission reductions to be achieved by the project activity during the 2nd 7 year crediting period:
The project activity is expected to promote total GHG emission reductions of 9,222,376 tCO_2e during the 2nd 7 year crediting period. This value is equivalent to average annual GHG emission reductions of 1,317,482 tCO_2e/year.

A.2. Location of project activity

A.2.1. Host Party

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Republic of Chile

A.2.2. Region/State/Province etc.

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Province of Chacabuco

A.2.3. City/Town/Community etc.

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Administrative district ("Comuna"): Til-Til
Village: Montenegro

A.2.4. Physical/Geographical location

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The Loma Los Colorados Landfill is located in the administrative district ("Comuna") of Til-Til, 63.5 km North of Santiago, Chile, near a village named Montenegro. Til-Til is located 578 meters above sea level. According to the last demographic census, it has a population of 18,000 inhabitants covering an area of 667.3 square kilometers (km^2). The distance between the landfill and the nearest settlement, Montenegro, is 3 km. Montenegro has a population of about 600 inhabitants. The exact geographic coordinates of the project site (in decimal geographical coordinates) are:

Format	Latitude	Longitude
DMS	32° 57' 23.04" S	70° 48' 4.6794" W
Decimal	-32.9564	-70.8013

FIGURE 1 – TIL-TIL LOCATION.

A.3. Technologies and/or measures

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In mid 2006, the Loma los Colorados landfill was operating with a small-scale active LFG collection and flaring system under operation. At that time, the existing pre-project active LFG collection system encompassed only a total of 12 LFG extracting wells. Some of these 12 wells were not being well operated due to elevated leachate levels. Site personnel also report that, historically, interruptions in system operation have been common, and these interruptions were primarily due to disruptions in electrical service. Historical data on the amount of LFG collected and flared by the pre-project small-scale active LFG collection and flaring system prior to the implementation of the project activity are available since start of its operation in March 1998.

In order to maximize LFG recovery rates, and thus GHG emission reductions, as part of the project design, the pre-project active forced LFG collection system is replaced and some existing elements are improved. The project LFG collection system consists of a series of vertical extraction wells interconnected by header piping. LFG is extracted from the landfill using a vacuum system and

conducted to multiple enclosed flares[8]. Also as part of the project design, LFG is used as gaseous fuel to generate electricity or may be utilized as other energy source within the landfill geographical limits. The essential characteristics of the LFG collection and flaring system improvements (when compared to the pre-project small-scale LFG collection and destruction system) are listed below:

- *Expansion of the existing piping network to include connection to a significant number of additional LFG extraction wells[9]. In general, connection should be made to those LFG extraction wells that have been constructed to final or intermediate grade, and to which the piping connection will have a minimal impact on current filling operations.*

- *Removal and replacement of approximately 350 meters of existing 160 mm piping serving the pre-project blower/flare station by new larger diameter piping which are more suitable for the significantly higher LFG flow rates.*

- *Installation of a pneumatic leachate pumping system to extract the excess of leachate from the LFG collecting wells.*

- *Installation of a condensate management system. The project's LFG collection piping is designed to include self-draining condensate traps and condensate manholes with pumps where necessary.*

- *Expansion of the LFG flow capacity by use of large scale blower and flaring station. As per the initially conceived project design, the pre-project blower and flaring station could eventually be incorporated into the new project's station in order to provide additional capacity or backup utility capacity, or could be removed and relocated to another site[10]. The project's flaring station includes high temperature enclosed flares which enables regular measurement of exhaust gas composition (sampling collection points for exhaust gas of the flares).*

- *Improving the reliability of electricity supply to the pre-project blower and flaring station[10], either by repairing or upgrading elements of the pre-project interconnection (if appropriate), or installing backup power capacity (e.g. backup captive off-grid electricity generator fuelled by diesel)[11]. Installation of a LFG-fuelled captive off-grid power generator was also considered.*

As per the conceived project design, once LFG recovery volumes enable use of LFG as fuel for power generation, the project proponent considers additional energy related applications for the LFG, in particular electricity generation which would be exported to the National Interconnected Electricity Grid of Chile (SIC power grid). This LFG use alternative is considered in the context of the assessment and demonstration of additionality. In mid 2006, the landfill operator (project proponent) was granted with an environmental license to install and operate a power generation

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[8] In December 2013, the project activity was operating with two enclosed high temperature flares with nameplate LFG destruction combustion capacity of 5,097 m^3/hour each.

[9] In December 2013, the project activity was under operation by encompassing about 300 LFG collection wells.

[10] Since 2007, the pre-project LFG flaring station has not operated.

[11] Electricity demand of the project activity (which has not been met by the project's electricity generation component) has been met by imports of electricity from the grid and also by captive off-grid electricity generators fuelled by diesel. In December 2013, there were 3 captive off-grid electricity generators (fuelled by diesel) installed in the project site as follows:

- One diesel captive electricity generator with 276 kW of output (connected to project's LFG flaring station and installed in March 2007)
- One diesel captive electricity generator with 352 kW of output (connected to CLLC-2 and installed in September 2011)
- One diesel captive electricity generator with 80 kW of output (connected to the power substation of the CLLC-2 (SELLC-2) and installed in September 2011)

facility with nameplate installed capacity up to 3 MW. As per the project design, whenever increment in the power generation nameplate installed capacity becomes technically feasible, the corresponding permits would be requested to the Ministry of the Environment (former CONAMA).[12]

As per the conceived project design, the electricity generation facility most likely consist of:

- Internal combustion engines, 0.8 – 1.4 MW capacity each, in a number according to the biogas collection.
- Electric generator, 0.8 – 1.4 MW capacity each, installed and connected (coupled) to each engine.
- Power transformers (from 380 V to about 23 kV) with capacity as needed for allowing generated electricity to be exported and sold through the grid.
- LFG cleaning equipment (if needed, for hydrogen sulphide and other corrosive compounds).

[12] The project activity was granted an environmental license enabling electricity generation with LFG as fuel with total equipment nameplate installed capacity up to 28 MW. This environmental permit for additional power generation installed capacity (beyond 3MW) was issued by CONAMA in May 2010 and it is registered under Resolution No. 344/2010.

- Building for housing the engines and generators.[13]

Regarding the electricity market, in mid 2006 Chile had one of the most liberalized, open-access electric power systems in the world. In mid 2006, there were two applicable laws, Law No. 20,018 and Law No. 19,940, which allow independent power producers (IPP) to sell energy and power.

[13] In December 2013, the project's electricity generation component was implemented as two independent electricity generation facilities (CLLC-1 and CLLC-2) as per the following configuration:

- Electricity generation facility CLLC-1: 2 internal combustion engine-generator sets with nameplate installed capacity of 1.0 MW each. Both units are manufactured by GE-Waukesha and are of model APG1000. Generated electricity is sourced at 400 V/50 Hz then transformed to 23 kV/50 Hz and connected to the 23kV section of the CLLC-2 power line. The LFG-to-electricity conversion efficiency of the engine generator sets are 550 Nm^3/h of LFG (with 50% CH4 content) for generating continuous power of 1 MW.

- Electricity generation facility CLLC-2: 13 internal combustion engine-generator sets with nameplate installed capacity of 1.4 MW each are installed and under operation. All units are manufactured by GE-Jenbacher and are of model J420. Generated electricity is sourced at 400 V/50 Hz then transformed to 110 kV/50 Hz and transmitted through a dedicated 21 km length aerial transmission line a power substation. The J420 GE-Jenbacher engine-generator set is regarded as similar to the GE-Waukesha model APG1000 in terms of LFG-to-electricity conversion efficiency and investment costs per installed MW (for investment analysis purposes). Jenbacher engine-generator sets are widely known by experts in LFG to electricity area to have a more sophisticated control system than the GE-Waukesha APG1000 engine-generator. By using a more advanced control system (use of advanced electronics), it is possible to better set/adjust the fuel-air mix for the J420 GE-Jenbacher units when compared to the GE-Waukesha model APG1000, thus improving the working conditions for the engine-generator set especially under circumstances with lower methane fraction in the collected LFG (typically LFG with CH_4 content lower than 45%) and higher flow variability of collected LFG. When LFG with CH_4 content within the range of 50% is utilized (which has been the case of the project activity), the LFG-to-electricity energy conversion efficiency for both the J420 GE-Jenbacher unit and GE-Waukesha model APG1000 can be regarded as equal (The LFG-to-electricity conversion efficiency of the engine generator sets are 550 Nm^3/h of LFG (with 50% CH4 content) for generating continuous power of 1 MW). Note that while the nameplate capacity of the GE-Jenbacher model J420 is 1.4 MW, each engine generator unit is expected to more than 550 Nm of LFG (with 50% CH4 content) per hour.

The "*Central Loma Los Colorados-2 (CLLC-2) electricity generation facility*" (CLLC-2) also comprises the following facilities/equipment:

- <u>LFG cooling and filtering facility</u>: all engine-generator sets of the CLLC-2 electricity generation facility are fuelled by LFG through a LFG supply pipeline of maximum LFG supply capacity of up to 20,000 m^3/h. A complete LFG cooling and filtering facility is also available. The LFG cooling and filtering facility is designed to cool LFG and also eliminate unwanted contaminants from the collected LFG (such as moisture and siloxanes). This facility is equipped with an efficient electric chiller (which is has its electricity demand met by the CLLC-2 electricity generation facility).

- Sub-station Loma los Colorados (SELLC): this sub-station is located inside the area of the Loma Los Colorados landfill and is the starting point of the 20 Km electricity line, that ends and the Punta Peuco sub-station. This sub-station also includes an additional emergency backup captive and off-grid electricity generator (fuelled by diesel and with internal reference "Diesel Backup Generator III") which has 80 kW of nameplate power. This backup generator is only used as a backup system during power failures to the SELLC.

- Punta Peuco sub-station: this sub-station is actually part of the SIC grid. It is located 20 km away from the project site (in the end of the project's 110 kV voltage transmission line) and it includes a power transformer and protection and control system for high voltage (which is equipped with switches, circuit breakers and transformers). An electricity meter (owned by KDM S.A.) is also installed at this sub-station for measuring electricity exported by the project activity.

These laws guarantee the right of any power producer to sell surplus electricity to the Spot Market at a marginal spot price for energy and a node price for installed capacity[14]. Thus, in the context of the licensing of the electricity generation facilities, just sending a communication letter to the CDEC (central power grid operator) within 3 to 6 months in advance is required. Such communication should inform about starting of power generation and intention to sell generated net electricity through the SIC power grid. In mid 2006, there was no other requirements for KDM S.A. in order to obtain the right for connection to the electricity grid.

In mid 2006, there were no other project based initiatives promoting LFG capturing and flaring (or otherwise use) in Chile. The current CDM project activity has been under analysis since 2003, when there were no landfill CDM projects in Chile. Since 2005, several other similar projects have been presented, for implementation under the CDM[15]. As per the project design, once registered under the CDM, engineering studies would be conducted and detailed designing made by a landfill gas specialty company from an Annex 1 country would be performed. As per the project design, some of the key project related equipment (flares, blowers, LFG treatment, flow measurement devices, gas analyzers, etc.) would be provided by specialty manufacturers from Annex 1 countries. Thus the project mean a significant opportunity for technology transfer, with design, equipment and installations complying with international standards with regard to quality, reliability, operational safety and environmental aspects.

KDM S.A. is a company with its quality assurance and environmental management systems certified under ISO 9001 and ISO 14001 standards. This means that KDM S.A. is obliged to qualify its personnel under rigorous procedures at the beginning of the project and on a monthly basis afterwards. As per the project design, in the first phase of the project, KDM S.A. would count on supervision from the flare supplier for training, commissioning and start-up. In a second project implementation phase (i.e. when installing power generation equipment), KDM S.A. would also acquired and would continue to acquire training either from equipment supplier and/or specialist consultant for all the services needed for operation and maintenance of the electricity generation system fuelled by collected LFG. KDM S.A.'s staff to be trained are those persons with extensive experience at the landfill.

While ACM0001 (version 15.0) requires ex-post monitoring whether equipment combusting LFG operates under compliance with operational requirements and/or recommendations as set by equipment manufacturer, the main operational characteristics and specifications of the high

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[14] In December 2013, the following additional laws were also applicable for electricity generation by Independent Power Producers (IPPs) in Chile:

- Decree N° 244 – Bylaw for non-conventional and small-scale electricity generation sources. This bylaw established regulations for law N°19,940. It establishes requirements for grid connection as well as options for commercialization of electricity at a stabilized price and some fee exemptions for using the main transmission system.
- Law N° 20,257 - Introduces modifications to the General Electrical Services law, establishing as mandatory for the electric generation companies to comply with a minimum of 5% of their energy injections to be supplied by non-conventional renewable energy sources (ERNC), either directly or indirectly. This percentage will be gradually increased to reach 10% by year 2024.
- Resolution N° 1,278 – ERNC Law regulation. This resolution normalizes the implementation of Law N° 20,257, which requires power generation companies to inject in the grid a determined share of electricity being generated from non-conventional renewable energy sources.

[15] In June 2012, there were 9 registered CDM project activities encompassing LFG collection and destruction and/or utilization in Chile. Source: UNFCCC.

temperature enclosed flares and the engine-generator sets[16] (as per the project's configuration in December 2013) are as follows:

LFG combustion flaring equipment	Characteristics/specifications
Flare 1 Flare 2 [17]	Manufacturer: LFG Specialties, L.L.C. - USA Model: EF1045I12 Height: 13.7 m Diameter: 3.0 m Min. LFG flaring capacity (for continuous operation): 850 Nm^3/h Max. LFG flaring capacity (for continuous operation): 5,097 Nm^3/h Required LFG pressure: 25 mbar Required min. temperature of the exhaust gas of the flare (to ensure LFG destruction under high CH_4 destruction efficiency): 500 ^oC Required max. temperature of the exhaust gas of the flare (to ensure LFG destruction under high CH_4 destruction efficiency): 1,095 ^oC Required frequency for inspection service (incl. inspection in the conditions of the flare's isolation ceramics revetment material): every 10 (ten) years
Flare 3	Manufacturer: LFG Specialties, L.L.C. - USA Model: EF1050I12 Height: 15.2 m Diameter: 3.0 m Min. LFG flaring capacity (for continuous operation): 510 Nm^3/h Max. LFG flaring capacity (for continuous operation): 5,097 Nm^3/h Required LFG pressure: 25 mbar Required min. temperature of the exhaust gas of the flare (to ensure LFG destruction under high CH_4 destruction efficiency): 500 ^oC Required max. temperature of the exhaust gas of the flare (to ensure LFG destruction under high CH_4 destruction efficiency): 1,095 ^oC Required frequency for inspection service (incl. inspection in the conditions of the flare's isolation ceramics revetment material): every 10 (ten) years
Waukesha engine-generator sets (CLLC-1 power plant)	The CLLC-1 comprises 2 internal combustion engine-generator sets with nameplate installed capacity of 1.0 MW each. Units are manufactured by GE-Waukesha and are of model APG1000. Generated electricity is sourced at 400 V/50 Hz then transformed to 23 kV/50 Hz and connected to the 23 kV section of the CLLC–2 power line.

[16] While the currently installed three high temperature enclosed flares and engine-generator sets comprised by the electricity generation facilities CLLC-1 and CLLC-2 are the only equipment combusting LFG installed as part of the project activity of which compliance with specifications should be monitored as per ACM0001 (version 15.0) and applicable methodological tools, specifications and characteristic of these equipment are thus reported in this Section. The specifications of other ancillary equipment (e.g. centrifugal blowers, valves, flow meters, gas analyzer, etc.) are not presented in the PDD. However, specifications of all equipment and instrument are expected to be regularly reported in the Monitoring Reports to be issued along the 2nd 7-year crediting period. This is in accordance with applicable guidelines for completing the PDD form and also in accordance with applicable methodological and monitoring requirements as set by ACM0001 (version 15.0) and applicable methodological tools.

[17] It is relevant to note that Flare 1 and Flare 2 are of identical design and nameplate LFG flaring capacities.

GE Jenbacher engine-generator sets (CLLC-2 power plant)[18]	The CLLC-2 is physically located next to the CLLC-1 however in a different building, thus named as CLLC-2. Nevertheless both power plants are connected to the same power line and electricity meter. CLLC-2 comprises internal combustion engine-generator sets with nameplate installed capacity of 1.4 MW each, as per schedule in the following table. All units are manufactured by GE-Jenbacher and are of model J420. Generated electricity is sourced at 400 V/50 Hz then transformed to 110 kV/50 Hz and transmitted through a dedicated 21 km length aerial transmission line a power substation.

Source: Equipment technical declarations made available by the respective equipment's manufacturers

Since electricity generation equipment is supplied in standard sizes, while the amount and quality (incl. fraction of CH_4) of LFG generated and captured may vary along the time, a reasonable schedule for addition (or replacement) of power generation equipment in both CLLC-1 and CLLC-2 electricity facilities is considered in estimating the amount of electricity actually generated by the project activity is shown in the table below:

End of Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Number off operational GE-Waukesha APG-1000 Units	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Number off operational GE-Jenbacher J420 Units	-	-	7	11	13	14	15	15	16	17	18	18	19	20	21	21	22	22
Total nameplate power generation capacity (MW)	2.0	2.0	11.9	17.5	204	21.8	23.2	23.2	24.6	26	27.4	27.4	28.9	30.3	31.7	31.7	33.1	33.1

Since the start of operation of the project activity, LPG has been used as a start-up fuel to ignite the high temperature enclosed flares whenever it is required (e.g. after maintenance/repair events, after temporary interruptions in grid electricity supply to the project activity, etc.).

LPG has been supplied to the project activity in standard cylinders by an authorized LPG distributor. The mass of consumed LPG by the project activity has been regularly monitored.

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Chile (host)	KDM S.A. (Private Entity)	No
Spain	URBASER S.A. (Private Entity)	No
Japan	The Kansai Electric Power Co., Inc. (Private Entity)	No
Switzerland	ALLCOT AG (Private Entity)	No

[18] It is considered that 0.8 MW of all installed power is consumed at CLLC -1 and CLLC -2 power plants.

A.5. Public funding of project activity

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The project sponsors will not receive any national or international public funding whatsoever for the development of this project.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

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The following CDM baseline and monitoring methodology is applied:

- Consolidated baseline and monitoring CDM methodology ACM0001 - “Flaring or use of landfill gas” (version 15.0) (http://cdm.unfccc.int/methodologies/DB/D44X8FH8SFCXREE6037AXJSBGGFVDO);

The following methodological tools are applied:

- Emissions from solid waste disposal sites (version 06.0.1, EB66) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v6.0.1.pdf);

- Tool to calculate baseline, project and/or leakage emissions from electricity consumption (version 1, EB39) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf);

- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 02, EB41) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf)

- Project emissions from flaring (version 02.0.0, EB 68) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v2.0.pdf);

- Methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0, EB 87)[19] (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf);

- Tool to calculate the emission factor for an electricity system (version 04.0, EB 75) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf);

- Combined tool to identify the baseline scenario and demonstrate additionality (version 05.0.0, EB 70) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v5.0.0.pdf);

- Methodological tool “Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period” (version 03.0.1, EB66)

[19] As a revision of the monitoring plan from the registered PDD, alternative monitoring approaches as per “Appendix - Additional data handling and monitoring guidance for determining the mass flow of methane in biogas” of the latest version of the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0) are considered as summarized in Appendix 6. Due to that, the applied version of the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” is upgraded in this revised version of the PDD from version 02.0.0 to version 03.0 in this revised version of the PDD.

(http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf).

B.2. Applicability of methodology and standardized baseline

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The approved baseline and monitoring methodology ACM0001 (version 15.0) is applied. In addition, the above-listed methodological tools (which are referred by this consolidated baseline and monitoring methodology or by other applied methodological tools) are also applied. Demonstration of applicability conditions for ACM0001 (version 15.0) and all above-referred methodological tools are included in the tables below:

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – “Flaring or use of landfill gas” (version 15.0)	**Justification**
“*The methodology is applicable under the following conditions:* *(a) Install a new LFG capture system in a new or existing SWDS where no LFG capture system was 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;* *(ii) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace; and/or*	As per the CDM Project Standard, in the context of the renewal of crediting period for a previously registered CDM project activity, the PDD valid for the additional new and 2nd 7-year crediting period should be completed by applying the latest version of the CDM baseline and monitoring methodology which was previously applied or, if applicable, the latest version of the CDM baseline and monitoring methodology of which the previously applied CDM methodology was consolidated into. The project activity was previously registered as a CDM project activity by applying the CDM baseline and monitoring methodology ACM0001 (version 4). While ACM0001 (version 15.0) is the latest valid version of ACM0001 baseline and monitoring methodology, it is thus the one to be applied in the context of the renewal of crediting period for the registered CDM project activity. In the context of the previous registration of the project activity under the CDM, as described in the latest version of the registered PDD valid for the 1st 7-year crediting period (PDD version 5.3, dated 02/08/2012), the project design encompasses the installation/improvement of an active (forced) LFG capture and flaring/utilization system in an existing SWDS partially replacing a previously existent active LFG combustion system (encompassed by a total of 12 LFG extracting wells and a small scale active LFG collection and flaring system). Historical amount of LFG flared in the pre-project scenario is available and was considered in the context of baseline emissions. In this sense, condition (b) – (ii) of the quoted applicability criteria is met. The pre-project practice for LFG management is outlined in the latest version of the registered PDD valid for the 1st 7-year crediting period. The project design encompasses collection of LFG and its destruction by flaring and/or its utilization for electricity generation. The project design does not

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 15.0)	**Justification**
(iii) Supplying the LFG to consumers through a natural gas distribution network. *(iv) Supplying compressed/liquefied LFG to consumers using trucks* *Do not reduce the amount of organic waste that would be recycled in the absence of the project activity."*	encompass any other utilization of collected LFG. Thus, the project activity meets condition (c) - (i). As a result of the previously occurred implementation of the project activity, there were no quantitative, qualitative, procedural or regulatory change occurred in terms of MSW management activities and policies valid for the Loma Los Colorados Landfill or applicable in any other potential waste treatment or disposal facility under the area of influence of this landfill (that would be promoted or triggered by the project activity) in comparison with what would occur in the absence of the project activity (baseline scenario). The situation is expected to remain the same during the 2nd 7-year crediting period. It is crucial to note that, mainly by taking into consideration the nature of the project activity and aspects related to recycling of organic fraction of MSW in the region of landfill and in the rest of Chile, the implementation and operation of the project activity per se are not expected to promote any quantitative change in waste disposal activities undertaken at the Loma Los Colorados Landfill. Furthermore, no quantitative or qualitative changes in terms of waste management practices are expected to occur in any other existent or potential waste disposal or waste treatment facility (located or to be located in the region of the project site) as a direct outcome or consequence of the operation of the project activity during the 2nd 7-year crediting period. Thus, the mere previously occurred implementation of the project and its continuous operation during the 2nd 7-year crediting period are not expected to promote or trigger any reduction (or prevention) of the amount of organic type of MSW (or any other type of solid waste) that would eventually be recycled or utilized in the region (e.g. no prevention by the project activity of the implementation or and non-promotion of any reduction of activity in an existent or hypothetical waste composting facility that would promote utilization/recycling of waste in the region (for example)). As demonstrated in construction, design and operational requirements valid for the Loma Los Colorados Landfill (as defined by KDM S.A. and confirmed in the environmental permits for the construction and operation of this landfill), the Loma Los Colorados Landfill is not expected to include any activity or initiative promoting recycling or utilization of organic fraction of waste to be disposed in this landfill (such as implementation of a large scale waste sorting or waste composting facility for example). Without any organic waste recycling activity being

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – “Flaring or use of landfill gas” (version 15.0)	Justification
	under operation within the limits of the Loma Los Colorados Landfill, it is thus clearly not expected that the implementation of the project activity could eventually reduce organic waste recycling activities in the Loma Los Colorados Landfill. The design, construction and operational aspects for the Loma Los Colorados Landfill were defined in accordance with the commercial agreements that the project participant KDM S.A. currently holds and is expected to hold in the position of operator and owner of the Loma Los Colorados Landfill and regional waste management company (service provider) providing MSW disposal services for Santiago and other municipalities located within its Metropolitan Region. Furthermore, it is also crucial to take into account that currently there is not even any existent or planned large scale MSW sorting, recycling or utilization facility for organic fraction of MSW (e.g. a large scale waste composting plant) with comparable size/capacity and located in the region of influence of the Loma Los Colorados Landfill. As a matter of fact, recycling and utilization of organic fraction of MSW is not a common practice in the whole country of Chile [20]. In this sense, the implementation and operation of the project activity thus does not represent any perverse incentive or driver for the promotion of any supposed quantitative or qualitative reduction or prevention of waste recycling related activities or initiatives for any type of organic fraction of solid waste or solid residues that would occur in the absence of the project activity at the Loma Los Colorados Landfill or in the region of influence of this landfill. The same is actually also applicable for recycling of inert waste material. Furthermore, regardless of the non-existence of any MSW recycling or utilization facility with comparable capacity that could eventually somehow compete with the Loma Los Colorados Landfill for organic fraction of MSW waste, aspects and actions related to promotion of recycling or utilization of organic fraction of solid waste are to be seen as fully dependent on public service policies in the case of Chile (including policies, laws, regulations and programmes) and are to be defined/triggered by competent governmental authorities (under a regional and national level)

[20] As demonstrated in the article available at http://hrd.apec.org/images/b/b3/65.2.pdf.

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 15.0)	Justification
	and/or to be eventually implemented/operated by practitioners of waste recycling. In Chile, the administrations of municipalities are the entities responsible for all MSW management services. Waste management companies such KDM S.A. normally acts as service providers, providing MSW collection and disposal services as per directives and contractual requirements set by the municipalities from where generated MSW are to be managed. In this sense, in the position of a MSW management company operating a LFG collection and destruction initiative in the landfill it operates, KDM S.A. is not under a position to trigger, establish or promote any promotion of reduction or prevention of organic waste recycling in the region where it operates. Finally, the implementation and operation of the project activity has never represented any incentive or driver for involved municipalities, any other public entity or any other relevant recycling practitioner for the promotion of changes in the policies and practices related to recycling of inert or organic solid waste in the region (or even outside the region) of influence of the Loma Los Colorados Landfill. No change in this sense is expected to occur during the 2^{nd} 7-year crediting period either. As outlined in Section B.6.1, so far, there is still no legal restriction or requirement for LFG gas collection and its destruction or utilization using high temperature enclosed flares or any other device/equipment in Chile. Actually, there is no applicable regulation that deals with LFG management in Chile at all. Thus, the implementation of more appropriate and environmentally safe management of LFG at the Loma Los Colorados Landfill (as a direct outcome of the implementation and operation of the project activity) *per se* does not represent any driver or incentive to dispose incremental amount of MSW in the Loma Los Colorados Landfill (when compared to the situation that would occur in the absence of the project). In this sense, under no circumstance the project activity *per se* potentially promote any displacement of volumes of organic waste stream from eventual treatments/utilization in an existent or hypothetical MSW recycling/utilization facilities (e.g. a MSW composting plant for example) to be disposed at the Loma Los Colorados Landfill because of the implementation and continuous operation of the project activity.

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – “Flaring or use of landfill gas” (version 15.0)	**Justification**
	Therefore condition (d) is also satisfied.
“*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 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* *For heat generation: that heat would be generated using fossil fuels in equipment located within the project boundary.”*	As further demonstrated in Section B.4, the most plausible baseline scenario remains being the partial release of LFG from the SWDS into the atmosphere (with a small share of generated LFG being flared at the small scale active LFG collection and flaring system). Since the project activity will generate electricity of which equivalent amount would otherwise be generated by existing grid connected power plants and new additions, the application of the procedure to identify the baseline scenario falls into (b) (i). The pre-project practice for LFG management is outlined in the latest version of the registered PDD valid for the 1st 7-year crediting period (PDD version 5.3, dated 02/08/2012). The quoted applicability condition is thus satisfactory met.
Non applicability conditions	**Justification**

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 15.0)	Justification
"This methodology is not applicable: *(a) 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.*	Neither options (a) and/or (b) occur. The only GHG emission reductions claimed are due to destruction of methane through combustion in high temperature enclosed flares and in the engine-generator sets and the emission reductions associated with electricity generation using LFG as fuel (which would otherwise be generated by existing grid connected power plants and new additions). After the implementation of the project activity in year 2007, the landfill operator has continued with MSW disposal activities at the Loma Los Colorados Landfill as per its normal and previously planned/defined operation conditions and practices (as per the practice prior to the implementation of the project activity). MSW disposal practices and management at the Loma Los Colorados Landfill are not expected to change during the 2nd 7-year crediting period[21]. The quoted applicability condition is thus satisfactory met.

Regarding the applied methodological tools, the table below summarizes how the project activity meets their applicability conditions:

Methodological tool	Version	Applicability conditions	Comments
"Project emissions from flaring"	02.0.0	*"This tool provides procedures to calculate project emissions from flaring of a residual gas. The tool is applicable to enclosed or open flares and project participants should document in the CDM-PDD the type of flare used in the project activity.* *This tool is applicable to the flaring of flammable greenhouse gases where:* *o Methane is the component with the highest concentration in the flammable residual gas; and*	As part of the project activity, all collected LFG (whose component with the highest concentration is methane) is combusted in the high temperature enclosed flares and/or used for electricity generation. LFG is a flammable gas generated from the anaerobic decomposition of organic waste material disposed in the Loma Los

[21] The operation of the Loma Los Colorados Landfill in terms of disposal of MSW (practices of waste disposal, covering, levelling, compacting, leachate management, etc.) has not changed after the implementation of the project activity and no change is expected to occur along the 2nd 7-year crediting period either. Thus there is no valid action promoting increase in methane generation (like e.g. through addition of liquids, pre-treating waste, changing the shape of the landfill) that was triggered or promoted by the project activity at the Loma Los Colorados Landfill when compared to the situation prior to the implementation of the project activity. This is confirmed in the currently available environmental permits for the Loma Los Colorados landfill, which are available at:

- http://seia.sea.gob.cl/expediente/ficha/fichaPrincipal.php?modo=ficha&id_expediente=3997973
- http://seia.sea.gob.cl/expediente/ficha/fichaPrincipal.php?modo=ficha&id_expediente=1220419
- http://seia.sea.gob.cl/seia-web/ficha/fichaPrincipal.php?modo=ficha&id_expediente=1033

Methodological tool	Version	Applicability conditions	Comments
		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 tool is not applicable to the use of auxiliary fuels and therefore the residual gas must have sufficient flammable gas present to sustain combustion. For the case of an enclosed flare, there shall be operating specifications provided by the manufacturer of the flare.* *This methodology refers to the latest approved version of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream". The applicability conditions of this tool also apply."*	Colorados landfill. LFG is thus a gas from a biogenic source. Methane is the component with the highest concentration in LFG. No auxiliary fuel is required to make the flammability of LFG sufficiently enough to be combusted in the project flares[22]. As demonstrated above, the applicability conditions for the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" are sufficiently met. Thus, the quoted applicability criteria defined in the methodological tool are sufficiently met.
"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"	01	*"This tool provides procedures to estimate the baseline, project and/or leakage emissions associated with the consumption of electricity.* *(…)* *The tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption:* <u>*Scenario A:*</u> *Electricity consumption from the grid. The electricity is purchased from the grid only. Either no captive power plant is installed at the site of electricity consumption or, if any on-site captive power plant exits, it is not operating or it can physically not provide electricity to the*	As established by ACM0001 (version 15.0), consumption of grid electricity by the project activity is to be accounted as project emissions. The electricity demand of the project activity is met by electricity generated in the CLLC-1 and CLLC-2 power plants as part of the normal operation of the project activity. In cases of interruption of the power plants, the electricity demand of the project is met by imports of electricity

[22] In accordance with the design of the three currently installed high temperature enclosed flares, Liquefied Petroleum Gas (LPG) has been used during short time periods for igniting the flares. For starting the flares, LPG is directed to the fuel injectors of the flare and once the flame is sufficiently stable, LFG is directed to the flares and supply of LPG to the injectors is thus interrupted. The use of LPG by the project activity is also outlined in the latest version of the registered PDD valid for the 1st 7-year crediting period (PDD version 5.3). By taking into account the type/purpose of use of LPG by the project activity, it is deemed correct to assume that LPG does not represent any auxiliary fuel (which would be required to make the flammability of LFG sufficiently enough to be combusted in the project flares). It is important to note that during the short time LPG is being combusted during the flare ignition process, no measurements of LFG directed to flares are performed with the flare meeting the operational requirements (as set by equipment manufacturer (e.g. min. flow, min. temperature of exhaust gas of the flare, etc.)). Thus, whenever the minor quantity of LPG is being combusted in the flare, no emission reductions due to methane combustion are claimed. It is important to note that, as outlined in Section B.6.1, all consumption of LPG by the project activity to ignite the flares are to be accounted as project emissions.

Methodological tool	Version	Applicability conditions	Comments
		source of electricity consumption. *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 consumption source and supply the source with electricity. The captive power plant(s) is/are not connected to the electricity grid.* *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 consumption source. The captive power plant(s) can provide electricity to the electricity consumption source. The captive power plant(s) is/are also connected to the electricity grid."*	sourced by the grid (SIC) and/or by electricity generated by the backup captive off-grid electricity generators (fuelled by Diesel). Thus, Scenario C of the tool is applicable.
"Emissions from solid waste disposal sites"	06.0.1	*"This tool provides stepwise approach to calculate baseline, emissions of methane from solid waste disposed or prevented from disposal at a SWDS. Application A is adopted. As per the tool: if "(…) the CDM project activity mitigates methane emissions from a specific existing SWDS.", application A should be used"*	The project mitigates methane emissions from a landfill. The applicability of the methodological tool is thus met. Application A in the methodological tool is selected and applied.
"Tool to calculate the emission factor for an electricity system"	04.0	*"This tool is also referred to in the "Tool to calculate project emissions from electricity consumption" 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."*	Project emissions due to the consumption of grid electricity by the project activity and emission reductions associated with electricity generation using LFG as fuel (which would otherwise be generated by existing grid connected power plants and new additions) are determined by applying applicable guidance of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (of which ACM0001 version 15.0 refers to). The "Tool to calculate the emission factor for an electricity system" is referred to in the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" for the

Methodological tool	Version	Applicability conditions	Comments
			purpose of calculating baseline and project emissions in cases where a project activity sources or consumes electricity from the grid, respectively. The CO_2 emission factor for the electricity grid which sources electricity to the project activity is determined as the combined margin CO_2 emission factor The relevant applicability condition of the methodological tool is thus fully met.
"Combined tool to identify the baseline scenario and demonstrate additionality"	05.0.0	"*This tool is only applicable to methodologies for which the potential alternative scenarios to the proposed project activity available to project participants cannot be implemented in parallel to the proposed project activity"* *(…)* *For example, in the following situations a methodology could refer to this tool:* - *For an energy efficiency CDM project where the identified potential alternative scenarios are: (a) retrofit of an existing equipment, or (b) replacement of the existing equipment by new equipment, or (c) the continued use of the existing equipment without any retrofits;* - *For a CDM project activity related to the destruction of a greenhouse gas in one site where the identified potential alternative scenarios are: (a) installation of a thermal destruction unit, or (b) installation of a catalytic destruction system, or (c) no abatement of the greenhouse gas.* *In these cases, the project proponents could not implement the three alternatives in parallel but they could only implement one of them."* *However, the tool is, for example, not applicable in the following situation: the CDM project activity is the*	As established by ACM0001 (version 15.0), this methodological tool is applied as per the methodology for the demonstration of the continuation of the baseline scenario. The continuation of the baseline scenario is demonstrated by applying the stepwise procedure of ACM0001 (version 15.0) for the determination of the baseline scenario. Baseline emissions are also determined by applying methodological approach also established by ACM0001 (version 15.0) and applicable methodological tools. As established by applicable CDM rules, the additionality of the project is not required to be demonstrated for the 2nd 7-year crediting period. The previously derived baseline scenario for the project activity is presented in the latest version of the registered PDD valid for the 1st 7-year crediting period The applicability condition

Methodological tool	Version	Applicability conditions	Comments
		installation of a Greenfield facility that provides a product to a market (i.e. electricity, cement, etc.) where the output could be provided by other existing facilities or new facilities that could be implemented in parallel with the CDM project activity."	of the methodological tool is thus met.
"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"	02	This tool provides procedure to determine and calculate project and/or leakage CO_2 emissions from the combustion of fossil fuels. It is used in cases where CO_2 emissions from fossil fuel combustion (for use other than for electricity generation) are calculated based on the quantity of fuel combusted and its properties.	As established by ACM0001 (version 15.0), this methodological tool is applied for the determination of project emissions 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 flares. The applicability condition of the methodological tool is thus met.
Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"	03.0	"*This tool is used to determine the mass flow of greenhouse gas i (CO_2, CH_4, N_2O, SF_6 or a PFC) in the time interval t."* *This tool provides procedures to determine $F_{i,t}$ (kg/h). The mass flow of a greenhouse gas (CO_2, CH_4, N_2O, SF_6 or a PFC) in the gaseous stream in time interval t. based on measurements of:* *(a) the total volume flow or mass flow of the gas stream,* *(b) the volumetric fraction of the gas in the gas stream and* *(c) the gas composition and water content.* *Typical applications of this tool are methodologies where the flow and composition of residual or flared gases or exhaust gases are measured for the determination of baseline or project emissions, which is the case of the present project activity"*	As established by ACM0001 (version 15.0), this tool is applied as per the methodology for determining the mass flow of CH_4. The applicability condition of the methodological tool is thus met.

Methodological tool	Version	Applicability conditions	Comments
Methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period"	03.0.1	"*This tool provides a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period, as required by paragraph 49 (a) of the modalities and procedures of the clean development mechanism. The tool consists of two steps. The first step provides an approach to evaluate whether the current baseline is still valid for the next crediting period. The second step provides an approach to update the baseline in case that the current baseline is not valid anymore for the next crediting period.*"	The application of this tool in the context of the renewal of the 7-year crediting period is required as per the CDM Project Standard. The applicability condition of the methodological tool is thus met.
"Tool to determine the remaining lifetime of equipment"	01	"*The tool provides guidance to determine the remaining lifetime of baseline or project equipment. The tool may, for example, be used for project activities which involve the replacement of existing equipment with new equipment or which retrofit existing equipment as part of energy efficiency improvement activities.* *Methodologies referring to this tool should clearly specify for which equipment the remaining lifetime should be determined. The remaining lifetime of relevant equipment shall be determined prior to the implementation of the project activity. Project participants using this tool shall document transparently in the CDM-PDD how the remaining lifetime of applicable equipment has been determined, including (references to) all documentation used.* *Under this tool, impacts on the lifetime of the equipment due to policies and regulations (e.g. environmental regulations) or changes in the services needed (e.g. increased energy demand) are not considered. Methodologies referring to this tool shall, where applicable, provide specific guidance on how regulations that warrant the replacement of the equipment before it has reached the end of its technical lifetime should be addressed.*"	As per ACM0001 (version 15.0), "*For each item of equipment which was in operation prior to the implementation of the project activity and in which the captured LFG is used after the implementation of the project activity, project participants shall estimate its remaining lifetime by applying the "Tool to determine the remaining lifetime of equipment". These items of equipment and their remaining lifetime shall be recorded in the CDM-PDD.* *Depending on the project activity, relevant items of equipment may include power plants, boilers, air heaters, glass melting furnace, or kilns.*" Since there was no installed equipment prior the implementation of the project activity in which captured LFG was still used after the implementation of the project activity, this methodological tool is thus not applied.

B.3. Project boundary

The project boundary of the project activity includes the landfill site where the LFG is captured and destroyed by combustion in enclosed high temperature flares and electricity is generated by using LFG as the only fuel; the backup captive off-grid electricity generators (fuelled by diesel) for emergency purposes are installed[23] and the the electricity grid to which the project's electricity generation component will be connected to for exporting electricity (SIC (Central Interconnected Electricity Grid of Chile)) as well as for importing electricity.

The table below provides a summary of the delineation of greenhouse gases (GHG) and sources included and excluded from the project boundary:

[23] The captive off-grid backup electricity generators (fuelled by diesel) are expected to be used only for emergency purposes (whenever supply of grid electricity to the project activity is temporarily interrupted). Thus, in the context of ex-ante estimates of emission reductions to be achieved by the project activity, there is no estimated amount of electricity to be generated by these generators nor amount of fossil fuel diesel to be consumed by the generators. Project emissions due to the consumption of electricity sourced by these generators are thus estimated as zero (null) in the context of ex-ante estimates of emission reductions to be achieved by the project activity . However, such project emissions will be determined ex-post along the crediting period (based on applicable monitoring and calculation requirements as presented in Section B.6.1) and will be accounted for the determination of emission reductions.

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Emissions from decomposition of waste at the SWDS site.	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.
		CH_4	Yes	The major source of emissions in the baseline.
		N_2O	No	N_2O emissions are very small when compared to CH_4 emissions from SWDS (in tCO_2e). This is conservative.
	Emissions from electricity generation	CO_2	Yes	Major 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.
Project scenario	Emissions from consumption of LPG by 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. It is important to note that residual CH_4 emission due to the combustion of LFG in enclosed flares are considered in the context of the determination of baseline emissions.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from consumption of grid electricity by 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 consumption of electricity sourced by the backup captive off-grid Diesel electricity generators	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.

The schematic flow diagram below summarizes the project boundary and delineates the project activity (equipment, parameters to be monitored, and GHG included in the project boundary).

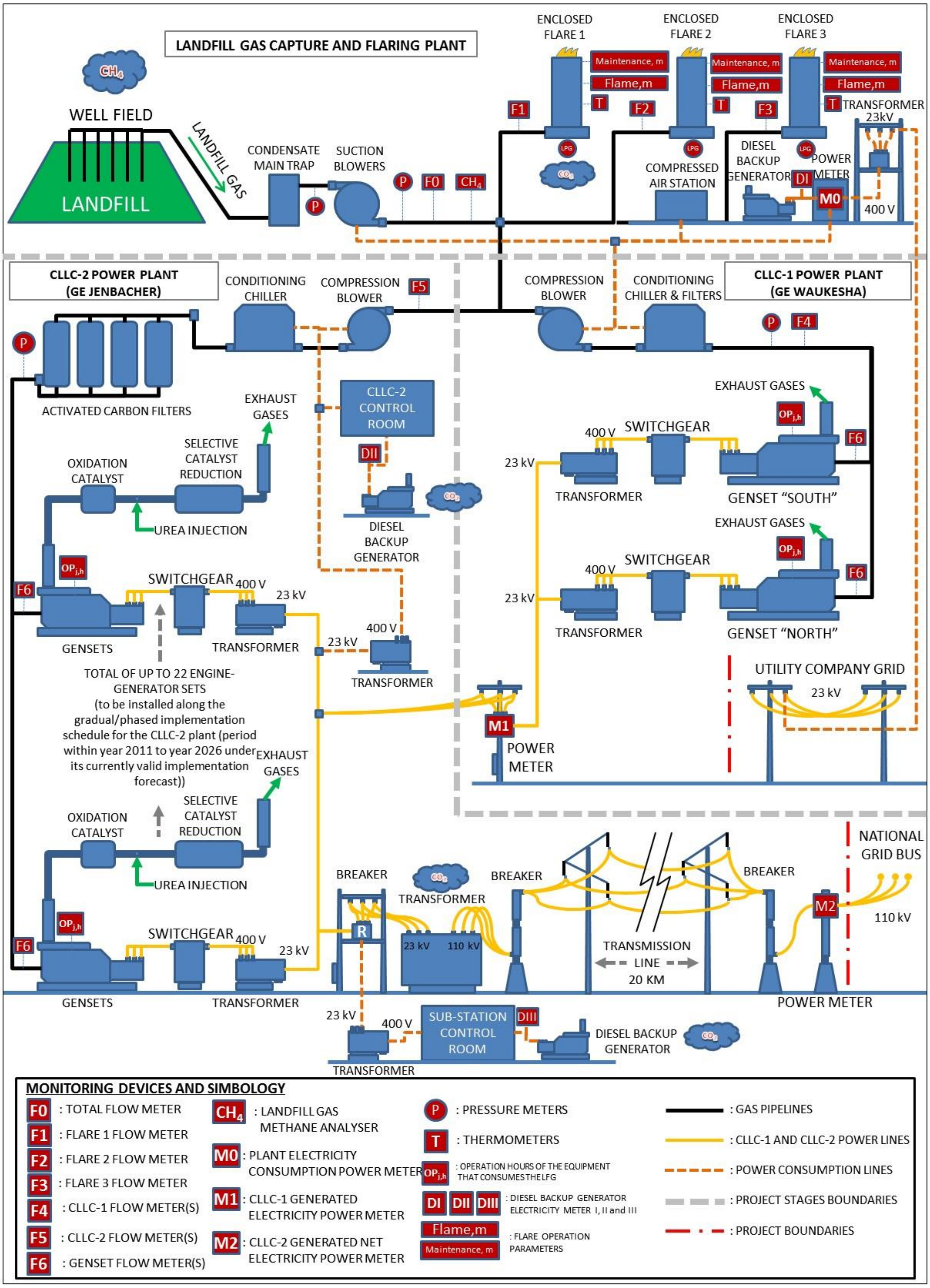

Figure 2 - Schematic flow diagram: delineation of the project boundary for the project activity during the 2nd 7-year crediting period

Note about figure 2:
As further explained in Sections B.7.1 and B.7.3, as an alternative monitoring approach, measurements of collected LFG supplied to available/operational biogas destruction/utilization devices (i.e flares and/or engine-generator sets) may be performed by a single or reduced number of LFG flow meters instead of applying an individual LFG flow meter for each device. The use of a single or reduced number of LFG flow meters may be considered in case applicable guidance of the Appendix "Additional data handling and monitoring guidance for determining the mass flow of methane in biogas" (under "*use of a single flow meter for multi-use of recovered biogas*") of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is selected as an alternative monitoring approach.

The configuration of the project activity (in terms of monitoring infrastructure and procedures) is planned to be changed in order to fully meet the monitoring requirements of ACM0001 (version 15.0) and applicable methodological tools during the 2nd 7-year crediting period.

B.4. Establishment and description of baseline scenario

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This Section includes the required application of the stepwise approach of the methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" for demonstrating the validity of the previously derived baseline scenario. This is performed by presenting the whole determination of the baseline scenario by following applicable guidance and stepwise procedure of ACM0001 (version 15.0)).

<u>Application of the stepwise approach of the methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period":</u>
In the context of the renewal of the 7-year crediting period, as per applicable guidance of the CDM Project Cycle Procedure, the stepwise approach of the methodological tool *"*Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" (version 03.0.1) is applied as follows. The objective of applying this methodological tool is demonstrating the continuation of validity of the baseline scenario (which was previously determined and assessed at the time of the validation of the project activity in year 2006).

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

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies
This project comprises the collection, flaring and/or utilization of landfill gas (as fuel for electricity generation), thus reducing greenhouse gas emissions. As part of the project activity, most of the captured LFG is to be used as fuel for electricity generation. By using LFG as fuel for electricity generation, GHG emissions are also resulted by displacement of an equivalent amount of electricity that would have been otherwise generated by the operation of grid-connected thermal power plants (connected to the SIC power grid) consuming fossil fuel and by the addition of new generation sources in the absence of the project activity.

The baseline scenario for the project's methane destruction component is defined as the most likely future scenario in the absence of the proposed CDM project activity. As further explained in Section B.6.1, prior to the registration of the project as a CDM project activity, there was no legal obligation to capture and destroy the LFG at the Loma Los Colorados landfill and in any other existing landfill in Chile. This situation currently prevails[24].

[24] In December 2013, there was still no legal requirement for LFG gas collection and its destruction using active or passive high temperature enclosed flares in Chile. Actually, there is still no applicable regulation that deals with LFG management in Chile. This is confirmed in the currently in force regulation applicable for landfills in Chile (available at http://www.leychile.cl/Navegar?idNorma=268137).

Although there was no regional or national legal requirement in Chile establishing LFG to be collected and destroyed in landfills at the time the project activity was validated, in the particular case of the Loma Los Colorados landfill, a small 1,000 Nm^3/h LFG flare was voluntarily acquired and implemented in the Loma Los Colorados Landfill. The small flare was connected to 12 of the existing 79 LFG extraction wells and KDM S.A. voluntarily started flaring a small amount of LFG. The rest of the wells were used only for venting[25] landfill gas into the atmosphere.

Loma Los Colorados was the first landfill in Chile that voluntarily entered into the Environmental Impact Evaluation System (Sistema de Evaluación de Impacto Ambiental, SEIA) in 1995. As a result of this evaluation by the competent environmental authorities, the Environmental Impact Study (EIS) submitted by Kenbourne Ingeniería Ambiental S.A. (the owner of the landfill at that time) stated their commitment of just collecting the landfill gas and venting it into the atmosphere with no flaring of LFG at any circumstances. The real objective of this commitment was to prevent the migration of landfill gas to the ground water, and polluting it with the soluble parts of LFG. Moreover, the Resolution of Environmental Qualification issued by the environmental authorities required LFG monitoring at key points of the landfill (e.g. at the vent wells) [26]. Such monitoring has been conducted regularly every three months. Later in 1998, on a voluntary basis, KDM has installed a limited active flaring system and started its operation on a non-regular basis.

The baseline scenario for the project's renewable energy component is the equivalent amount of electricity being generated by the operation of grid-connected thermal power plants consuming fossil fuel and by the addition of new generation sources in the absence of the project activity.

The demonstration of continuation of the baseline scenario for the project activity is thus in full compliance with mandatory national, regional and/or sectorial policies and requirements.

Step 1.2: Assess the impact of circumstances

The previously identified baseline scenario for the project activity is demonstrate as not changed at the time of requesting renewal of the crediting period.

While the baseline scenario identified at the validation stage of the project activity was the continuation of the current practice without any investment, an assessment of the changes in market characteristics is thus required for the renewal of the crediting period. This is required by the methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" (version 03.0.1).
As an outcome of such analysis, it is confirmed the following:

- The conditions and circumstances considered or taken into account to determine the baseline emissions in the previous crediting period are still valid. LFG (rich in CH_4) generated at the Loma los Colorados landfill would remain being freely emitted into the atmosphere (with minor share of generated LFG being destroyed at the small flaring station voluntarily acquired and implemented by KDM S.A.) in the absence of the project activity. Generated LFG would still be freely emitted into the atmosphere through both the surface of the landfill and through the conventional LFG venting drains which were not connected to the small LFG collection and flaring station[27]. Moreover, the equivalent amount of electricity generated by the project activity's electricity generation facilities would still be generated by the operation of grid-connected thermal power plants consuming fossil fuel and by the addition of new generation sources in the absence of the project activity.

[25] No combustion/destruction of LFG occurred in these wells.

[26] Source: http://www.e-seia.cl/documentos/documento.php?idDocumento=1506593

[27] As described in Section A.1, only 12 of the 79 existing LFG extraction wells were connected to the small LFG active collection and flaring station.

- There is no change in market or regulatory characteristics/aspects (incl. legal requirements) or new market or regulatory circumstances that would demand any type of re-assessment or re-evaluation for the determination of the baseline scenario for the 2nd 7-year renewable crediting period.

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

While the baseline scenario identified at the validation of the project activity was not selected as "*the continuation of use of the current equipment(s) without any investment and, the projects proponents or third party (or parties) would undertake an investment later due, for example, to the end of the technical lifetime of the equipment(s) before the end of the crediting period or the availability of a new technology",* this step is not applicable.

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

Some methodological requirements, ex-ante selected data and parameters which were determined in year 2006 prior to the start of the 1st 7-year crediting period as per the applicable requirements of the earlier applied CDM baseline and monitoring methodology will not any longer be valid/applicable during the 2nd 7-year crediting period. As per the applied latest version of the valid CDM baseline and monitoring methodology (ACM0001 (version 15.0)) and related methodological tools, there are differentiated methodological approaches which are applicable and thus should be considered (incl. some of the ex-ante determined parameters, other default values and even other assumptions). Due to that, other data and ex-ante determined parameters are thus applied in the context of the demonstration of the validity of the earlier derived baseline scenario and also applied in the determination of baseline emissions during the 2nd 7-year crediting period. Thus, some of data and parameters as presented in the latest version of the PDD valid for the 1st crediting period not any longer valid.

As a conclusion, since (i) the demonstration of validity of the earlier derived baseline scenario, (ii) determination of baseline emissions during the 2nd 7-year crediting period and (iii) ex-ante determined parameters and default values are all determined/calculated as per applicable guidance of ACM0001 (version 15.0) and related methodological tools, the validity of earlier defined ex-ante determined parameters is thus limited. The methodological approaches for the demonstration of validity of the earlier derived baseline scenario, baseline emissions during the 2nd 7-year crediting period, ex-ante determined parameters and monitored parameters are presented and justified in this Section, in Section B.6.1, Section B.6.2 and Section B.7.1 respectively.

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

Step 2.1: Update the current baseline

The determination of the baseline scenario (as per applicable guidance of ACM0001 (version 15.0) is included below under "*Determination of the baseline scenario*". It is important to note that while the baseline scenario for the project activity was not changed for the 2nd 7-year renewable crediting period, the applied methodological tool for the determination of baseline scenario and baseline emissions (as per ACM0001 (version 15.0)) is indeed different than the one required by ACM0001 (version 4) and ACM0002 (version 6). Thus, for completeness reasons, this PDD includes the whole determination of the baseline scenario and baseline emissions as per the related requirements of ACM0001 (version 15.0) regardless the fact baseline scenario remains being the same.

The determination of baseline emissions (by following all applicable guidance and requirements of ACM0001 (version 15.0) and applicable related methodological tools) is presented in Section

B.6.1. Related ex-ante estimations of baseline emissions during the 2nd crediting period are summarized in Section B.6.3.

Step 2.2: Update the data and parameters

All applicable and required ex-ante determined parameters valid for the 2nd 7-year renewable crediting period are presented in Sections B.6.1 and B.6.2.

While some of the ex-ante determined parameters (which are summarized in Sections B.6.1.and B.6.2) are applied only in the context of ex-ante estimations of emission reductions along the 2nd crediting period, other ex-ante determined parameters will however be used for the calculation/determination of emission reductions in an ex-post basis (in conjunction with parameters determined ex-post) along the 2nd 7-year crediting period.

It is also important to consider that ACM0001 (version 15.0) and related methodological tools include parameters (ex-ante or ex-post determined) which were not previously applied/considered in the PDD valid for the 1st 7-year crediting period (as this PDD was completed in accordance requirements and guidance of the baseline and monitoring methodology ACM0001 (version 4)). Furthermore, as also outlined in Section B.6.2, the value for the Global Warming Potential (GWP) for the GHG methane is also changed for the 2nd crediting period when compared to the value previously applied during the largest fraction of the 1st crediting period. The applied revised value for the ex-ante determined parameter GWP_{CH4} is in accordance with the "Standard for application of the global warming potential to clean development mechanism project activities and programmes of activities for the second commitment period of the Kyoto Protocol".

Determination of the baseline scenario (in order to demonstrate the continuation of earlier identified baseline scenario) by following applicable stepwise procedure of the "Combined tool to identify the baseline scenario and demonstrate additionality" as required by ACM0001 (version 15.0):

On the next steps, the continuation of the earlier identified baseline scenario for the project activity is confirmed through the application of the stepwise approach for determining baseline scenario as per the "Combined tool to identify the baseline scenario and demonstrate additionality"[28] (version 05.0.0) as required by ACM0001 (version 15.0).

Application of the stepwise approach for determining baseline scenario as per the "Combined tool to identify the baseline scenario and demonstrate additionality":

STEP 0: Demonstration whether the proposed project activity is the *First-of-its-kind*

This optional step is not applied for the renewal of the crediting period of a registered CDM project activity.

STEP 1: Identification of alternative scenarios

SUB-STEP 1a: Define alternatives to the proposed CDM project activity

[28] As outlined in Section B.5, this PDD does not include assessment and demonstration of additionality. This is in accordance with applicable procedures and rules for renewal of 7-year crediting period of registered CDM project activities.

Identification of alternatives for the destruction of LFG

In this step, the following baseline alternatives for the destruction of LFG are taken into consideration:

LFG1: The project activity (i.e. capture of landfill gas and its flaring and/or its use) undertaken without being registered as a CDM project activity. This is a plausible alternative scenario, however involves significant investment and additional costs of landfill operations with no associated revenues in the case of flaring of collected LFG.

LFG2: Atmospheric release of the landfill gas or partial capture of landfill gas and destruction to comply with regulations or contractual requirements, or to address safety and odour concerns. This scenario corresponds to the continuation of the current situation (the proposed project activity or any other alternatives are not implemented).

LFG3: LFG is partially not generated because part of the organic fraction of the solid waste is recycled and not disposed in the SWDS;

LFG4: LFG is partially not generated because part of the organic fraction of the solid waste is treated aerobically and not disposed in the SWDS;

LFG5: LFG is partially not generated because part of the organic fraction of the solid waste is incinerated and not disposed in the SWDS.

The project activity was implemented at a landfill site whose purpose is the final disposition of waste through adopting of landfilling practices and techniques. As further explained in Section B.2, the project activity has not previously promoted and is not expect to promote any change in waste recycling activities in the region where the Loma Los Colorados landfill located. In these contexts, it is crucial to note that with or without the project activity being implemented, no recycling of the organic fraction of waste disposed at the Loma Los Colorados landfill, neither aerobic treatment, neither incineration of disposed waste streams have occurred or have prevented (or would have occurred or would have prevented) at this landfill and/or in any other landfill, or recycling station located in the region where the Loma Los Colorados landfill.

Thus alternative scenarios LFG3, LFG4 and LFG5 are hereby automatically excluded from the determination of baseline alternatives. Such exclusion is in accordance with applicable guidance of ACM0001 (version 15.0). In fact, recycling of organic matter, aerobic treatment and incineration of Municipal Solid Waste (MS) has not been common practice in Chile. The implementation and operation of the project activity has never promoted and is not expected to promote any quantitative change (including reduction) in the amount of organic solid waste that could or would be eventually recycled. This is an applicability condition/criteria of ACM0001 (version 15.0) of which compliance is further explained in Section B.2.

In addition to the alternative baseline scenarios identified for the destruction of LFG, alternative scenarios for the use of LFG shall also be identified:

As per the project design, LFG will be used as fuel for electricity generation to meet the project's electricity demand and also to export to the local grid (SIC). Thus, realistic and credible alternatives for power generation in the absence of the project activity are also determined.

For electricity generation, the realistic and credible alternative(s) may include:

E1: Electricity generation from LFG, undertaken without being registered as CDM project activity;

E2: Electricity generation in existing or new renewable or fossil fuel based captive power plant(s);

E3: Electricity generation in existing and/or new grid-connected power plants.

Scenario E2 is excluded. Since all electricity demand of the landfill has been historically met by a reliable supply of grid electricity (since the start of operations of the landfill), the utilization of a captive electricity generator to supply electricity for the landfill site (using renewable or fossil energy sources) never occurred and it is not foreseen to occur in the project scenario either.

Heat generation scenarios using LFG collected at the landfill as fuel are not part of the project activity as there are no heat requirements at the landfill and the project activity does not encompass use of collected LFG for heating or thermal purposes (i.e. use of collected LFG as gaseous fuel in boiler, air heater, glass melting furnace(s) and/or kiln).. Therefore, scenarios H1 trough H7, are not considered on the present analysis. This is in accordance with ACM0001 (version 15.0).

Supply of LFG to a natural gas distribution network is not considered as part of the project activity either. There is no natural gas distribution network at the landfill. Moreover, this type of utilization for collected LFG is not part of the project activity either, therefore, not considered on the present analysis. This is also in accordance with ACM0001 (version 15.0).

Outcome of Step 1a: The only alternatives to be taken into consideration, after step 1a) are LFG1, LFG2, E1 and E3.

Step 1b: Consistency with mandatory applicable laws and regulations:

So far, there are still no legal restrictions or requirements for LFG collection and destruction/utilization in Chile. Therefore alternative LFG1 and LFG2 are thus under compliance with applicable mandatory laws and regulations.

Outcome of Sub-step 1b: The only remaining alternatives to be taken into consideration after step 1b) are identified as LFG1, LFG2, E1 and E3.

STEP 2: Barrier analysis + **STEP 3: Investment analysis + STEP 4: Common practice analysis**

As per the “Combined tool to identify the baseline scenario and demonstrate additionality”, STEP 2 (Barrier analysis) serves to identify barriers and to assess which alternative scenarios are prevented by these barriers.

The “Combined tool to identify the baseline scenario and demonstrate additionality” established the following regarding STEP 3 (Investment analysis):

“*(…) The objective of Step 3 is to compare the economic or financial attractiveness of the alternative scenarios remaining after Step 2 by conducting an investment analysis. The analysis should include all alternative scenarios remaining after Step 2, including scenarios where the project participants do not undertake an investment (S2 or S3)*.”

Finally the methodological tool outlines the following regarding STEP 4 (Common practice analysis):

"*If the proposed project activity is the first-of-its-kind then this step is not applicable. Otherwise, the previous Steps shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and applicable geographical area. This test is a credibility check to demonstrate additionality and complements the barrier analysis (Step 2) and, where applicable, the investment analysis (Step 3).*"

As per the applicable methodological guidance of both ACM0001 (version 15.0) and "Combined tool to identify the baseline scenario and demonstrate additionality", determining baseline scenario for a LFG collection and destruction/utilization initiative proposed as a CDM project activity is somehow combined with assessing and demonstrating additionality for such proposed CDM project activity.

While in the particular situation of the renewal of the 7-year crediting period of a registered CDM project activity it is not required to assess and demonstrate the validity of the earlier assessed/demonstrated additionality (of which in the particular case of the "Loma Los Colorados Landfill Gas Project" was previously assessed and demonstrated as presented in the latest version of the PDD valid for the 1st 7-year crediting period (PDD version 5.3)), the application of STEP 2, STEP 3 and STEP 4 are thus regarded as not applicable in the context of the demonstration of the continuation of the previously identified baseline scenario for the project activity during its 2nd 7-year crediting period as a requirement to the renewal of the crediting period. This is in accordance with the methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" and other applicable CDM guidelines and rules.

In summary, as also indicated in the latest version of the PDD valid for the 1st 7-year crediting period (PDD version 5.3), as part of the assessment and demonstration of additionality for the project activity it is demonstrated that the alternatives LFG1 (*"The proposed project activity undertaken without being registered as a CDM project activity"*), E1 ("*Electricity generation from LFG, undertaken without being registered as CDM project activity*") and E3 ("*Electricity generation in existing and/or new grid-connected power plants*") do not represent baseline alternatives. Thus, the only remaining baseline alternative is the alternative LFG2 ("*Atmospheric release of the LFG or partial capture of LFG and destruction to comply with regulations or contractual requirements, or to address safety and odors concerns*")[29].

Procedure for estimating the end of the remaining lifetime of existing equipment

While remaining lifetime of existing equipment and prior consideration of CDM are also aspects to be considered in the context of the determination of the baseline scenario, the following details are also relevant in the particular context of the demonstration of validity of the previously derived baseline scenario for the project activity:

As per ACM0001 (version 15.0), this procedure is only applicable (in the context of the determination of baseline scenario for the project activity) if LFG has been utilized in existing equipment that was in operation prior to the implementation of the project activity. The project activity started to operate in March 2007 in a landfill which started its operations in 1996. No type

[29] It is noteworthy that while ACM0001 (version 4) (applied in the PDD valid for the 1st 7-year crediting period) and ACM0001 (version 15.0) incorporate different methodological approaches and terms, the previously registered version of the PDD (valid for the 1st 7-year crediting period) defines the baseline scenario for the project activity by using slightly different terminology:

"(…) the baseline scenario is the LFG production being emitted into the atmosphere by the Loma los Colorados landfill (minus the historical flow rate of LFG burnt at the pre-project flaring station)".

of LFG utilization equipment was in place prior to the implementation of the project activity. It is also assumed that in the absence of the project activity, no LFG utilization equipment would be in place either.

This step of ACM0001 (version 15.0) is thus not required in the context of the demonstration of the continuation of the baseline scenario for the project activity.

Prior consideration of CDM

This step is not applicable for the renewal of the crediting period of a registered CDM project activity. As per currently valid applicable CDM rules, it is not required demonstrate prior consideration of the CDM for the project activity in the context of the renewal of its 7-year crediting period. This step of ACM0001 (version 15.0) is thus not required in the context of the demonstration of the continuation of the baseline scenario for the project activity.

Conclusion about the demonstration of the continuation of validity of the previously identified baseline scenario):

As an outcome of the application of the applicable guidance of the "Combined tool to identify the baseline scenario and demonstrate additionality" and ACM0001 (version 15.0), it is demonstrated the continuation of previously identified baseline scenario.

The baseline scenario for the project activity remains being identified as the atmospheric release of the LFG (with minor share of generated LFG being partially collected and destroyed the small scale collection and flaring station installed voluntarily by KDM S.A.).

B.5. Demonstration of additionality

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As also indicated in Section B.4, demonstration of additionality is not applicable/required for the renewal of the crediting period of a registered CDM project activity. Not including the demonstration of additionality in this section is thus in accordance with currently valid applicable CDM rules.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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In accordance with ACM0001 (version 15.0) and applicable methodological tools, yearly emission reductions to be achieved by the project activity (ER_y) during the 2nd 7-year crediting period are determined (in tCO_2e) as the difference between baseline emissions (BE_Y) and project emissions (PE_Y) as follows:

$$ER_y = BE_y - PE_y \quad \textbf{(0)}$$

Where:

BE_y	=	Baseline emissions in year *y* (in tCO_{2e}/yr)
PE_y	=	Project emissions in year *y* (in tCO_{2e}/yr)

Determination of Baseline Emissions (BE_y):

As per ACM0001 (version 15.0), baseline emissions (BE_y) are determined according to equation (1) and comprises the following sources:

a) Methane emissions from the SWDS in the absence of the project activity;

b) Electricity generation using fossil fuels or supplied by the grid in the absence of the project activity;

c) Heat generation using fossil fuels in the absence of the project activity; and

d) Natural gas used from the natural gas network in the absence of the project activity.

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

Where:

BE_y	=	Baseline emissions in year *y* (in tCO_2e/yr)
$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (in tCO_2e/yr)
$BE_{EC,y}$	=	Baseline emissions associated with electricity generation in year *y* (in tCO_2e/yr)
$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year *y* (in tCO_2e/yr)
$BE_{NG,y}$	=	Baseline emissions associated with natural gas use in year *y* (in tCO_2e/yr)

In the particular case of the project activity, as no collected LFG is expected to be used as gaseous fuel for heat generation purposes and as no collected LFG is expected to be injected in a natural gas distribution pipeline or even displace/complement the use of natural gas, $BE_{HG,}$y and $BE_{NG,y}$ are not applicable in the context of the determination of baseline emissions.

Thus, baseline emissions are summarized as follows:

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

In accordance with ACM0001 (version 15.0.0), baseline methane emissions are calculated according to the following stepwise approach:

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

Baseline methane emissions from the anaerobic waste decomposition in the considered SWDS ($BE_{CH4,y}$) are determined (in tCO_2e/yr) as per the formulas presented below. The determination of $BE_{CH4,y}$ is based on the amount of methane that is actually captured and combusted by the project activity (in the high temperature enclosed flare(s) and engine-generator sets) and also by taking in account the amount of methane that would be captured and destroyed in the landfill in the absence of the project activity (baseline scenario).

In addition, the effect of methane oxidation (that is assumed as existing in the baseline and not in the project scenario) is also taken into account as also required by ACM0001 (version 15.0)[30]:

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

Where:

OX_{top_layer}	=	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline scenario (dimensionless)
$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (in tCH_4/yr)
$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline (absence of project activity) in year *y* (in tCH_4/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (in tCO_2e/tCH_4)

Ex post determination of $F_{CH4,PJ,y}$

As per ACM0001 (version 15.0), the amount of methane in the LFG which is flared and/or utilized by the project activity ($F_{CH4,PJ,y}$) during the 2nd 7-year renewable crediting period is to be determined (in tCH_4/yr) as the sum of quantities of methane flared and used in power plant(s), boiler(s), air heater(s), glass melting furnace(s), kiln(s) and natural gas distribution network based on ex-post measurements, as follows:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y} \quad \textbf{(4)}$$

Where:

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year y (in tCH4)
$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year *y* (in tCH_4)
$F_{CH4,EL,y}$	=	Amount of methane in the LFG which is used for electricity generation in year *y* (in tCH_4/yr)
$F_{CH4,HG,y}$	=	Amount of methane in the LFG which is used for heat generation in year *y* (in tCH_4/yr). While the project design currently does not encompass use of LFG as gaseous fuel for heat generation, $F_{CH4,HG,y}$ is thus assumed as null (zero).
$F_{CH4,NG,y}$	=	Amount of methane in the LFG which is sent to the natural gas distribution network and/or to the trucks in year *y* (in tCH_4/yr). While the project design currently does not encompass collected LFG being injected in natural gas distribution network, $F_{CH4,NG,y}$ is thus assumed as null (zero).

As also established by ACM0001 (version 15.0), $F_{CH4,EL,y}$, $F_{CH4,HG,y}$ and $F_{CH4,NG,y}$ are determined by using the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous

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[30] As established by ACM0001 (version 15.0), the ex-ante determined parameter $OX_{top\text{-}layer}$ is the fraction of the methane that would be oxidized in the top layer of the considered SWDS (Loma Los Colorados landfill) in the absence of the project activity (baseline scenario). As per ACM0001 (version 15.0), it is assumed that for a typical landfill hosting a LFG collection and destruction and/or utilization CDM project activity, this effect is reduced as part of the LFG which is captured does not pass through the top layer of the considered SWDS. This oxidation effect is also accounted for in the methodological tool "Emissions from solid waste disposal sites". In addition to this effect, the installation of a LFG capture system under the project activity may result in the suction of additional air into the considered SWDS. In some cases, such as project activities where the LFG collection is based on high suction pressure, the suction effort may decrease the amount of methane that is generated in the landfill under the project scenario. However, in most circumstances where the LFG is captured and used this effect was considered to be very small, as the operators of landfills have, in most cases, an incentive to main a high methane concentration in the LFG. For this reason, this effect is neglected as a conservative assumption.

stream" (version 03.0), and by also monitoring the working hours of the power plant(s), boiler(s), air heater(s), glass melting furnace(s) and kiln(s) (if applicable), so that no emission reduction are claimed for methane destruction during non-working hours of the LFG utilization source in question. This is taken into account by monitoring the hours, *h*, that the equipment, *j*, utilizing the LFG is operating in year *y* ($Op_{j,h,y}$).

Monitoring requirements applicable for the monitoring parameter "Operational status of biogas destruction devices" (Status of the biogas destruction device)" (of which are detailed in Section B.7.1 and B.7.3) will also be considered[31].

In the particular case of the project activity, as no collected LFG is expected to be used as gaseous fuel for heat generation purposes and as no collected LFG is expected to be injected in a natural gas distribution system or trucks (displacing/complementing the use of natural gas), $F_{CH4,HG,y}$ and $F_{CH4,NG,y}$ are not applicable in the context of the determination of $F_{CH4,PJ,y}$.. Thus the amount of methane in the LFG which is flared and/or utilized by the project activity will be determined by:

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

Where:

$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year *y* (in tCH_4)
$F_{CH4,EL,y}$	=	Amount of methane in the LFG which is used for electricity generation in year *y* (in tCH_4/yr)

Determination of the amount of methane in collected LFG which is destroyed by flaring ($F_{CH4,flared,y}$)[32]

$F_{CH4,flared,y}$ is determined as the difference between the amount of methane supplied to the flare(s) and any methane emissions from the flare(s), as follows:

$$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}} \quad \textbf{(6)}$$

Where:

$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year *y* (in tCH_4/yr)
$F_{CH4,sent\_flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year *y* (in tCH_4/yr)
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year *y* (in tCO_2e/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (in tCO_2e/t CH_4)

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[31] As established by the applied methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0), the monitoring parameter "Status of biogas destruction device" is applicable for both the project's high temperature enclosed flares (hereby regarded as "*biogas destruction devices*") and for the engine-generator sets of the project's electricity generation infrastructure (hereby regarded as "*biogas utilization devices*"). Thus, despite of its name/description, monitoring details for this particular monitoring parameter includes both the terms "*biogas destruction device(s)*" and "*biogas utilization device(s)*" for sake of completeness and transparency and are thus applicable for both types of devices.

[32] $F_{CH4,flared,y}$ is determined for each flare using applicable guidance of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0), by applying the following requirements defined in ACM0001 (version 15.0): The determination will be made based on the available options for monitoring V_t, M_t and v_{CH4}

Determination of $F_{CH4,sent\_flare,y}$:

As per ACM0001 (version 15.0), for each individual installed high temperature enclosed flare $F_{CH4,flared,y}$ is determined by following applicable guidance of the Methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”. The following requirements apply for the determination of $F_{CH4,flared,y}$:

- The gaseous stream that shall be considered in the application of the methodological tool is the stream of collected LFG which is sent to the flares;
- CH_4 is the greenhouse gas for which the mass flow is determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in the methodological tool); and
- The mass flow should be calculated on a an hourly basis for each hour *h* in year *y*;

Determination of the amount of methane in collected LFG which is used for electricity generation ($F_{CH4,EL,y}$)[33]

$F_{CH4,EL,y}$ is determined directly using applicable guidance of the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0), by applying the following requirements defined in ACM0001 (version 15.0):

- The gaseous stream the methodological tool shall be applied to is the stream of collected LFG which is sent to each engine-generator set of the electricity generation facility.
- CH_4 is the greenhouse gas for which the mass flow is determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in the tool); and
- The mass flow should be calculated on a an hourly basis for each hour *h* in year *y*;
- The mass flow calculated for hour *h* is 0 if the engine-generator set is not working in hour *h* ($Op_{j,h}$ = equipment not working), the accumulated hourly values are then summed to a yearly unit basis.

Applicable guidance of the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0) will be applied to determine $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$ [34] by using Option 2: *Simplified calculation without measurement of the moisture content*, and one of the options A, C or D. The selection of the determination option will depend on project conditions and equipment to be installed.

Furthermore, monitoring approach as per Item *2.* “*Use of a single flow meter for multi-use of recovered biogas”* from “*Appendix. - Additional data handling and monitoring guidance for determining the mass flow of methane in biogas*” of the methodological tool “Tool to determine the

[33] $F_{CH4,EL,y}$ is determined for each stream of collected LFG which is sent to each engine-generator set, using applicable guidance of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, by applying the following requirements defined in ACM0001 (version 15.0).

[34] In the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0) the mass flow of greenhouse gas in a gaseous stream (which in the particular case of the project activity are the amount of methane sent to the flares ($F_{CH4,sent\_flare,y}$) and the amount of methane sent to the project’s electricity generation component ($F_{CH4,EL,y}$)) is actually represented as $F_{i,t.}$

mass flow of a greenhouse gas in a gaseous stream" (version 03.0) may be also applied as an alternative monitoring approach depending on project conditions and equipment to be installed[35].

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. If it is conservative to assume that the gaseous stream is dry, then $m_{H2O,t,db}$ is assumed to equal 0. If it is conservative 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 equation (7).

$$m_{H_2O,t,db,SAT} = \frac{p_{H2O,t,Sat} * MM_{H2O}}{(P_t - p_{H2O,t,Sat}) * MM_{t,db}} \qquad \textbf{(7)}$$

Where:

$m_{H2O,t,db,sat}$	= Saturation absolute humidity in time interval *t* on a dry basis (in kg H_2O/kg dry gas)
$p_{H20,t,sat}$	= Saturation pressure of H_2O at temperature T_t in time interval *t* (in Pa)
T_t	= Temperature of the gaseous stream in time interval *t* (in K)
P_t	= Absolute pressure of the gaseous stream in time interval *t* (in Pa)
MM_{H2O}	= Molecular mass of H_2O (in kg H_2O/kmol H_2O)

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[35] As an alternative monitoring approach, single or reduced number of LFG flow meters may be utilized (instead of applying an individual LFG flow meter for each LFG consuming element of the electricity generation infrastructure (each engine generator set) and/or each flare) in case monitoring approach as per Item *2.* "*Use of a single flow meter for multi-use of recovered biogas"* from "*Appendix. - Additional data handling and monitoring guidance for determining the mass flow of methane in biogas*" of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is selected. Under such circumstances, additional monitoring requirements as described in Section B.7.3 under *"Use of a single flow meter for multi-use of recovered biogas*" are to be considered as a condition for accounting of related achieved GHG emission reductions.

Appendix "*Additional data handling and monitoring guidance for determining the mass flow of methane in biogas*" from the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) (under the sub-section "*Use of a single flow meter for multi-use of recovered biogas*") includes the following monitoring requirements:

> *" (…) If the recovered biogas (e.g. landfill gas) 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, emission reductions from methane destruction for these periods may be claimed provided that verification confirms the fulfilment of all the following conditions indicated below. In such a case, the destruction efficiency of the least efficient destruction device in operation shall be used as the destruction efficiency for all destruction devices monitored by this single flow meter:*
>
>> *(a) All destruction devices are either equipped with valves on the input gas line that close automatically (e.g., normally closed valves) if the device becomes nonoperational (i.e., requiring no manual intervention), or designed in such a manner that it is physically impossible for the gas to pass through and into the atmosphere while the device remains non-operational; and*
>>
>> *(b) For any period where one or more destruction devices within this arrangement are not operational, it shall be demonstrated that the remaining operational devices have the capacity to destroy the actual gas flow recorded during the period. For devices other than flares, it shall be shown that the output corresponds to the flow of gas (e.g., through mass and/or energy balance).*
>
> *Measurement of methane content shall be conducted immediately downstream of the flow meter, while respecting the installation requirements of the flow meter. (…)"*

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

$$MM_{t,db} = \sum_{i} (v_{i,t,db} * MM_k) \quad \textbf{(8)}$$

Where:

$MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis (in 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 (in m³ gas k/m³ dry gas)

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

k = All gases, except H_2O, contained in the gaseous stream (e.g. N_2, CO_2, O_2, CO, H_2, CH_4, N_2O, NO, NO_2, SO_2, SF_6 and PFCs). See available simplification below.

As per the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0):

> *"The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (k) in the considered gaseous stream. However as a simplification, only the volumetric fraction of gases k that are greenhouse gases and are 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* [36]

Use of Option A or C or D:

Depending on the project conditions and specifications of related monitoring equipment/instruments to be in place during the 2nd 7-year crediting period, one of the following measurement options will be chosen.and the following formulas applied for the determination of as $F_{i,t}$ [37]:

Option	Flow of gaseous stream	Volumetric fraction
A	Volume flow dry basis	Dry or wet basis[38]
C	Volume flow wet basis	Wet basis
D	Mass flow dry basis	Dry or wet basis

[36] ACM0001 (version 15.0) does not include any restriction to such simplification. Thus, only the volumetric fraction of gases that are greenhouse gases and are considered in related calculations (CH_4 in the particular case of the project activity) and the difference to 100% is just considered as pure nitrogen.

[37] The selection of option A, C or D will be done on an ex-post basis during the 2nd 7-year crediting period.The selected option will depend on the environmental conditions (atmospheric and climatic conditions, humidity of the site etc.) and the specifications of monitoring equipment/instrument to be in place during the 2nd 7-year crediting period (mass flow meter, gas dryer, etc.). In December 2013, no individual flow meter for each one of the available three high temperature enclosed flares were yet installed. So the selected option can be changed in a future stage, and will be addressed ex-post.

[38] Flow measurement on a dry basis is not feasible at reasonable costs for a wet gaseous stream, so there will be no difference in the readings for volumetric fraction in wet basis analysers and dry basis analysers and both types can be used indistinctly for calculation Options A and D.

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. There are two ways to do this:

- Measure the moisture content of the gaseous stream ($C_{H2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H_2O/m^3 dry gas; or
- Demonstrate that the temperature of the gaseous stream (T_t) is less than 60ºC (333.15 K) at the flow measurement point.

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 corresponding option from the table above should be applied instead.

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

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t} \quad \textbf{(9)}$$

with

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \quad \textbf{(10)}$$

Where:

$F_{i,t}$ = Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (in kg gas/h)

$V_{t,db}$, = Volumetric flow of the gaseous stream in time interval *t* on a dry basis at normal conditions (in m³ dry gas/h)

$v_{i,t,db}$ = Volumetric fraction of greenhouse gas *i* in the gaseous stream in time interval *t* on a dry basis (in m³ gas *i*/m³ dry gas)

$\rho_{i,t}$ = Density of greenhouse gas *i* in the gaseous stream (in kg gas *i*/m³ gas *i*)

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

MM_i = Molecular mass of greenhouse gas *i* (in kg/kmol)

R_u = Universal ideal gases constant (in Pa.m³/kmol.K)

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

Option C

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

$$F_{i,t} = V_{t,wb,n} * v_{i,t,wb} * \rho_{i,n} \quad \textbf{(11)}$$

with

$$\rho_{i,n} = \frac{P_n * MM_i}{R_u * T_n} \quad \textbf{(12)}$$

Where:$F_{i,t}$ = Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (in kg gas/h)

$V_{t,wb,n}$ = Volumetric flow of the gaseous stream in time interval *t* on a wet basis at normal conditions (in m³ wet gas/h)

$v_{i,t,wb}$	= Volumetric fraction of greenhouse gas *i* in the gaseous stream in time interval *t* on a wet basis (in m³ gas *i*/m³ wet gas)
$\rho_{i,n}$	= Density of greenhouse gas *i* in the gaseous stream at normal conditions (in kg gas *i*/m³ wet gas *i*)
P_n	= Absolute pressure at normal conditions (in Pa)
T_n	= Temperature at normal conditions (in K)
MM_i	= Molecular mass of greenhouse gas *i* (in kg/kmol)
R_u	= Universal ideal gases constant (in Pa.m³/kmol.K)

The following equation should be used to convert the volumetric flow of the gaseous stream from actual conditions to normal conditions of temperature and pressure:

$$V_{t,wb,n} = V_{t,wb} * (T_n/T_t) * (P_t/P_n) \qquad \textbf{(13)}$$

Where:

$V_{t,wb,n}$	= Volumetric flow of the gaseous stream in a time interval *t* on a wet basis at normal conditions (in m³ wet gas/h)
$V_{t,wb}$	= Volumetric flow of the gaseous stream in time interval *t* on a wet basis (in m³ wet gas/h)
P_t	= Pressure of the gaseous stream in time interval *t* (in Pa)
T_t	= Temperature of the gaseous stream in time interval *t* (in K)
P_n	= Absolute pressure at normal conditions (in Pa)
T_n	= Temperature at normal conditions (in K)

Option D

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. There are two ways to do this:

- Measure the moisture content of the gaseous stream ($C_{H2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H_2O/m³ dry gas; or
- Demonstrate that the temperature of the gaseous stream (T_t) is less than 60ºC (333.15 K) at the flow measurement point.

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 corresponding option from the above table should be applied instead.

The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using equations (11) and (12). The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the mass flow of the gaseous stream to a volumetric flow as follows:

$$V_{t,db} = M_{t,db}/\rho_{t,db} \qquad \textbf{(14)}$$

Where:

$V_{t,db}$	= Volumetric flow of the gaseous stream in time interval *t* on a dry basis (in m³ dry gas/h)
$M_{t,db}$	= Mass flow of the gaseous stream in time interval *t* on a dry basis (in kg/h)
$\rho_{t,db}$	= Density of the gaseous stream in time interval *t* on a dry basis (in kg dry gas/m³ dry gas)

The density of the gaseous stream ($\rho_{t,db}$) should be determined as follows:

$$\rho_{t,db} = \frac{P_t * MM_{t,db}}{R_u * T_t} \quad \textbf{(15)}$$

Where:

$\rho_{t,db}$ = Density of the gaseous stream in a time interval *t* on a dry basis (in kg dry gas/m^3 dry gas)

$MM_{t,db}$ = Molecular mass of the gaseous stream in a time interval *t* on a dry basis (in kg dry gas/kmol dry gas), estimated using equation (8).

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

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

Depending on operational conditions, monitoring approach as per Item *1. "Data substitution for methane content or biogas flow"* of *"Appendix. Additional data handling and monitoring guidance for determining the mass flow of methane in biogas"* of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) may be applied in case missing data are encountered in the course of determining the methane mass flow as part of the determination of $F_{CH4,sent\_flare,y}$ *and* $F_{CH4,EL,y}$ along the 2nd 7-year crediting period[39].

[39] As an alternative monitoring approach, the determination of flow of methane to the project's biogas destruction/utilization devices (i.e flares and/or engine-generator sets) for a specific time interval within the 2nd 7-year crediting period may, as an alternative monitoring approach, be performed by addressing eventually missing data of flow of collected LFG (monitoring parameter $V_{t,db,j}$, $V_{t,wb,j}$, $V_{t,wb,j}$ or $M_{t,db,j}$) and/or methane content in collected LFG (monitoring parameter $v_{CH4,t,wb,j}$ or $v_{CH4,t,db,j}$) through data substitution. Under such circumstances, additional monitoring requirements as described in Section B.7.3 under *"Data substitution for methane content or biogas flow"* are to be considered as a condition for accounting of related achieved GHG emission reductions.

Item *1. "Data substitution for methane content or biogas flow"* of *"Appendix. Additional data handling and monitoring guidance for determining the mass flow of methane in biogas"* of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) establishes the following:

(…) If missing data are encountered in the course of determining the methane mass flow, it may be substituted with conservative data sets (see below) from specific periods. However, data substitution shall only be applied to either the methane concentration or the biogas volumetric flow readings, but not to both simultaneously. If data is missing for both parameters during a given period of time, no data substitution shall be allowed for that period.

Substitution as outlined in Table 1 below may be undertaken only if the following conditions are met:

(a) For methane concentration, biogas flow rates during the period where data gap occurred (data gap period) shall be consistent with normal operation (i.e. the average flow rates during the gap period shall not deviate from the average flow rates of the period taken for data substitution (data substitution period)1 by more than +/- 20%); and

(b) For biogas flow rate, methane concentration during the data gap period shall be consistent with the methane concentration observed during normal operations (i.e. the average methane concentration during the data gap period shall not deviate from the average methane concentration of the data substitution period by more than +/- 20%); and

(c) Project participants shall demonstrate that the methane is being destroyed during the period of the data gap. If corroborating parameters fail to demonstrate any of these requirements, no substitution shall be allowed.

Table 1. Data substitution procedure

Duration of missing data	*Data Substitution procedure*
Less than six hours	*Use the weighted average of the four hours period immediately before and four hours period immediately after the outage*
Six to 24 hours	*Use the upper bound or lower bound of 95% confidence interval of the data spanning 24 hours prior to and 24 hours after the outage, whichever results in more conservative estimate of emission reductions*
One to seven days	*Use the upper bound or lower bound of 95% confidence interval of the data spanning 72 hours prior to and 72 hours after the outage, whichever results in more conservative estimate of emission reductions*
Greater than one week	*No data may be substituted*

(…)"

Determination of $PE_{flare,y}$ (required for the determination of $F_{CH4,flared,y}$):
As established by ACM0001 (version 15.0), $PE_{flare,y}$ is determined by following applicable guidance of the methodological tool "Project emissions from flaring".

While under the project activity, collected LFG has been combusted by flaring in a set of installed high temperature enclosed flares (and this is expected to continue during the 2nd 7-year crediting period), then $PE_{flare,y}$ is the sum of the related emissions for each individual flare of which are calculated separately (as established by the methodological tool).

For each individual flare, the calculation procedure in the refereed methodological tool is applied to determine project emissions from flaring the residual gas ($PE_{flare,y}$) based on the flare efficiency ($\eta_{flare,m}$) and the mass flow of methane to the flare in question ($F_{CH4,RG,m}$). The flare efficiency is determined for each minute *m* of year *y* based either on monitored data or default values.

Calculation procedure for the determination of project emissions from flaring applied as follows under a stepwise approach:

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 methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) shall be used to determine, in kg, the mass flow of methane in the residual gaseous stream in the minute *m*: $F_{CH4,m}$

The following requirements apply for the determination of the mass flow of methane in the gaseous stream in minute *m*:

- The methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) shall be applied to the residual gas.
- The flow of the gaseous stream shall be measured continuously;
- CH_4 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.

Step 2: Determination of flare efficiency

As required by ACM0001 (version 15.0), the flare efficiency values will be determined for each flare. Also as per ACM0001 (version 15.0), flare efficiency represents the combustion efficiency of LFG in the flare in terms of CH_4 by considering *inter alia* the time that the flare in question is operating. For determining the combustion efficiency for the enclosed flare in question, there is the option to apply a default efficiency value or determining the flare efficiency based on monitored data (based on applicable measurements and calculations).

The time each one of the project's high temperature enclosed flares has operated is determined by monitoring the flame combustion status/condition by using a flame detector and, for the case of enclosed high temperature flares, the monitoring requirements related to operational requirements/conditions (as provided by the manufacturer's specifications for operating conditions) shall be met in addition to the confirmation of flare status/condition.

In the case of the project activity, the flare efficiency for each minute *m* ($\eta_{flare,m}$) will be, as a priority, determined by following applicable guidance as per Option B.1 of the methodological tool "Project emissions from flaring", where the flare efficiency will be determined on the basis of biannual basis related measurements. In case biannual related measurements are not available for a particular monitoring period, applicable guidance as per Option A (application of default values) of the methodological tool "Project emissions from flaring" will be used as an alternative.
Both options are summarized below:

Option A: Apply default value for flare efficiency[40].

Option B: Measure the flare efficiency.

Option A: Default value

For each one of the high temperature enclosed flares installed as part of the project activity, the flare efficiency for each minute *m* ($\eta_{flare,m}$) is 90% when the following two operational conditions/requirements are simultaneously met (in order to demonstrate that the flare is operating as per the recommendations and requirements set by the equipment manufacturer for the minute *m* in question):

(1) The temperature of the exhaust gases o the flare (monitoring parameter $T_{EG.m}$) and the flow rate of LFG to the flare (monitoring parameter $F_{RG,m}$) is within the manufacturer's specification/requirements for the flare (monitoring parameter $SPEC_{flare}$) in minute *m*;
(2) Flame is detected in the flare in minute *m* (monitoring parameter $Flame_m$).

If for the minute *m*, conditions (1) and/or (2) are not met, $\eta_{flare,m}$ is set as 0% for the minute in question

Option B: Measured flare efficiency

For each one of the high temperature enclosed flares which are part of the project activity, the flare efficiency in the minute *m* is determined as a value which is calculated based on performed related measurements ($\eta_{flare,m} = \eta_{flare,calc,m}$) when the following two conditions are simultaneously met (in order to demonstrate that the flare is operating):

[40] The methodological tool establishes that, for high temperature enclosed flares that are defined as low height flares, the flare efficiency in the minute *m* ($\eta_{flare,m}$) shall be adjusted, as a conservative approach, by subtracting 0.1 from the efficiency as determined in Options A or B. 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%. In December 2013, there was no low height flare installed as part of the project activity and it is not expected that any low height flare will ever installed as part of the project activity during the 2nd renewable crediting period. All high temperature enclosed flares which are installed as part of the project activity are high height flares.

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

(2) Flame is detected in the flare in minute *m* (monitoring parameter $Flame_m$).

Otherwise $\eta_{flare,m}$ is set as 0%.

In applying Option B, the project participants choose to determine $\eta_{flare,calc,m}$ using Option B.1 where the measurement is performed by an accredited independent third party entity (e.g. an independent inspection/analysis service company) on a biannual basis with the following calculation formula being applied:

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:

$$\eta_{flare,calc,y} = 1 - \frac{1}{2}\sum_{t=1}^{2}\left(\frac{F_{CH4,EG,t}}{F_{CH4,RG,t}}\right) \quad \textbf{(16)}$$

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* (in 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* (in 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

Note:
$F_{CH4,\ EG,t}$ is measured for each individual flare according to an appropriate national or international standard. $F_{CH4,RG,t}$ is calculated for each flare according to Step 1[41], and consists of the sum of methane flow in the minutes *m* that makes up the time period *t*.

Step 3: Calculation of project emissions from flaring

For each individual flare, 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:

$$PE_{flare,y} = GWP_{CH4} * \sum_{m=1}^{525,600} F_{CH4,RG,m} * \left(1 - \eta_{flare,m}\right) * 10^{-3} \quad \textbf{(17)}$$

[41] As per Step 1 $F_{CH4,RG,t}$ is equal to the sum of methane flow values $F_{CH4,sent\_flare,y}$, in the minutes *m* that make up the time period *t*.

Where:

$PE_{flare,y}$	= Project emissions from flaring of the residual gas in year *y* (in tCO_{2e})
GWP_{CH4}	= Global warming potential of methane valid for the commitment period (in tCO_{2e}/tCH_4)
$F_{CH4,RG,m}$	= Mass flow of methane in the residual gas in the minute *m* (in kg)
$\eta_{flare,m}$	= Flare efficiency in minute *m*

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

An *ex-ante* estimate of $F_{CH4,PJ,y}$ is required to estimate methane baseline emission from the Loma Los Colorados landfill in order to estimate the emission reductions to be achieved by project activity during the 2nd 7-year crediting period. As established by ACM0001 (version 15.0), $F_{CH4,PJ,y}$ is estimated as follows:

$$F_{CH4,PJ,y} = \eta_{PJ} * BE_{CH4,SWDS,y} / GWP_{CH4} \quad \textbf{(18)}$$

Where:

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

$BE_{CH4,SWDS,y}$ is determined using the methodological tool "Emissions from solid waste disposal sites". The following guidance should be taken into account when applying the tool:

- f_y as per the methodological tool shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for when applying ACM0001 (version 15.0);
- In the tool, *x* begins with the year that the SWDS started receiving wastes (e.g. the first year of SWDS operation); and
- Sampling to determine the fractions of different waste types is not necessary because the waste composition can be obtained from previous studies.

Thus, for the ex-ante estimation of the amount of methane destroyed/combusted by the project activity ($F_{CH4,\ PJ,y}$) during each year y of the 2nd 7-year crediting period, the calculation of $BE_{CH4,SWDS,y}$ is given by:

$$BE_{CH4,SWDS,y} = \varphi_y * (1 - f_y) * GWP_{CH4} * (1 - OX) * \frac{16}{12} * F * DOC_{f,y} * MCF_y * \sum_{x=1}^{y} \sum_{j} W_{j,x} * DOC_j * e^{-k_j \cdot (y-x)} * (1 - e^{-k_j}) \quad \textbf{(19)}$$

Where:

$BE_{CH4,SWDS,y}$	= Baseline methane emissions occurring in year *y* generated from waste disposal at a SWDS during a time period ending in year *y* (in tCO_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 The default value (as per Option 1 of applicable guidance in the methodological tool) is selected. Thus, $\varphi_y = \varphi_{default}$

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*. f_y in the methodological tool "Emission from solid waste disposal sites" shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for when applying ACM0001 (version 15.0). While as per the methodological tool "Emissions from solid waste disposal sites", f_y is presented as a parameter to be monitored ex-post; by considering the related methodological approach of ACM0001 (version 15.0.) and assigned value for f_y, this parameter will thus not be monitored ex-post during the 2nd 7-year credtiting period.

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

The value and source of information for each of the variables above are given in section B.6.2. It is important to note that the approach to take into account characteristics of the disposed waste (used as inputs for the ex-ante estimation) are the ones recommended by IPCC. Due to that, no sampling of waste is necessary. This is in accordance with both the methodological tool "Emissions from solid waste disposal sites" and ACM0001 (version 15.0). While the project activity only involves collection and destruction/utilization of LFG at the Loma Los Colorados landfill (without promoting any change in the management and operation of the landfill), it does not prevent any waste from being deposited at the Loma Los Colorados landfill.

The determination of $BE_{CH4,SWDS,y}$ in the context of the calculation of ex-ante estimations of emission reductions to be achieved by the project activity during the 2nd 7-year renewable crediting period is included in Section B.6.3. An emission reduction calculation spreadsheet which includes all related calculations for figures presented in Section B.6.3 is enclosed to this PDD.

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

As required by ACM0001 (version 15.0), this step represents the application of the stepwise procedure for the determination of the amount of methane that would have been captured and destroyed in the baseline scenario (absence of the CDM project activity) at the Loma Los Colorados landfill due to eventually applicable regulatory or contractual requirements, or to address eventually existent applicable safety and odors concerns (which are collectively referred to as "*requirement"* under this step).

The four cases summarized in the table below are distinguished in ACM0001 (version 15.0). As also required by ACM0001 (version 15.0), the appropriate case for the particular baseline context of the project activity is identified and justified below:

Cases for determining methane captured and destroyed in the baseline

Situation at the start of the project activity	Requirement to destroy methane	Existing LFG capture and destruction system
Case 1	No	No
Case 2	Yes	No
Case 3	No	Yes
Case 4	Yes	Yes

<u>Requirement to destroy methane</u>

Non-existence of regional or national regulatory or contractual requirements related to LFG management in the region of the project site:

Like the situation valid prior to the start of the 1st 7-year crediting period, currently there is still being no legal obligation to capture and destroy the LFG at the Loma Los Colorados landfill. Furthermore, this situation is currently not expected to be changed during the time period to be encompassed by the 2nd 7-year crediting period either.

Non-existence of requirements to destroy methane due to safety or odor concerns: In the case of the project activity, there are no applicable requirements to destroy methane due to safety or odor concerns either.

In the particular case of the Loma los Colorados Landfill, as per the project design and licensing requirements, no LFG is to be destroyed by combustion in LFG venting drains in order to address odors or safety concerns. Direct venting of LFG through LFG venting drains (with no combustion) is enough to prevent dangerous accumulation of LFG in the inner section of the landfill. While as per the methodological approach of ACM0001 (version 15.0) for determination of $F_{CH4,BL,y}$ any destruction of LFG to address safety and/or odor concerns would be regarded as an existing requirement to destroy methane, it is thus assumed that, in the particular case of the Loma Los Colorados landfill, there is no requirement to destroy methane.

By taking this assumption into account, thus, Case 2 and Case 4 are not applicable for the determination of $F_{CH4,BL,y}$.

Existence of LFG capture and destruction system at the Loma Los Colorados landfill:
<u>As outlined in Section A.3,</u> in mid 2006 (year prior the start of operation of the project activity), the Loma los Colorados landfill was operating with a small-scale active LFG collection and flaring system under operation. At that time, the existing pre-project active LFG collection system encompassed only a total of 12 LFG extracting wells. Some of these 12 wells were not operating correctly due to elevated leachate levels. Operational staff of KDM S.A. also report that, historically, interruptions in the system's operation were common, and these interruptions were primarily due to disruptions in electrical services. Historical data on the amount of LFG collected and flared by the pre-project small-scale active LFG collection and flaring system, prior to the implementation of the project activity, are available since start of its operation, in March 1998. KDM S.A. emphasizes that such small-scale LFG collection and flaring station was voluntarily acquired and implemented in the Loma Los Colorados Landfill.

Thus, by taking into account the definitions of "LFG capture system" and "existing LFG capture system" as per ACM0001 (version 15.0)[42], it is thus assumed that there was an existing LFG capture system at theLoma Los Colorados prior to the implementation of the project activity. Therefore, Case 3 is applicable

In summary, the only option/case applicable for the Loma Los Colorados landfill (in the absence of the project activity) is Case 3.

The following is thus valid in the context of the application of the stepwise procedure for the determination of $F_{CH4,BL,y}$ for the project activity during the 2nd crediting period:

- Requirement to destroy methane = NO
- Existing LFG capture and destruction system = YES

$F_{CH4,Bl,y}$ is thus calculated as:

$$F_{CH4,BL,y} = F_{CH4,BL,sys,y} \tag{20}$$

In the particular case of the project activity, the amount of methane captured with the previously existing system cannot be monitored as this system was decommissioned before the beginning of operations of the project activity in March 2007. Thus, Case 3 - (b) of ACM0001 (version 15.0) is applied:

"*If there is no monitored data available, but there is historic data on the amount of methane that was captured in the year prior to the implementation of the project activity, then in this situation*

$$F_{CH4,BL,sys,y} = F_{CH4,hist,y} \tag{21}$$

In determining $F_{CH4,hist,y}$, it is assumed that the fraction of LFG that was recovered in the year prior to the implementation of the project activity will be the same fraction recovered under the project activity:

$$F_{CH4,hist,y} = F_{CH4,BL,x-1} / F_{CH4,x-1} * F_{CH4,PJ,y} \tag{22}$$

Where:

$F_{CH4,hist,y}$	*= Historical amount of methane in the LFG which is captured and destroyed (t CH_4/yr)*
$F_{CH4,BL,x-1}$	*= Historical amount of methane in the LFG which is captured and destroyed in the year prior to the implementation of the project activity (t CH_4/yr)*
$F_{CH,x-1}$	*= Amount of methane in the LFG generated in the SWDS in the year prior to the implementation of the project activity (t CH_4/yr)*
$F_{CH4,PJ,y}$	*= Amount of methane in the LFG which is captured in the project activity in year y (t CH_4/yr)*

$F_{CH4,x-1}$ shall be estimated using the methodological tool "Emissions from solid waste disposal sites". The guidance and requirements described in section 5.4.1.2 for applying the tool shall be followed. The year y in the tool is equivalent to the year prior to the implementation of the project activity."

[42] As per ACM0001 (version 15.0), "*LFG capture system*" is defined as follows: "*A system to capture LFG. The system may be passive, active or a combination of both active and passive components. Passive systems capture LFG by means of natural pressure, concentration, and density gradients. Active systems use mechanical equipment to capture LFG by providing pressure gradients. Captured LFG can be vented, flared or used."*
As per ACM0001 (version 15.0), "*existing LFG capture system*" is defined as follows: "*An existing active LFG capture system is a system that has been in operation in the last calendar year prior to the start of the operation of the project activity."*

Thus, in the particular case of the Loma Los Colorados Landfill Gas Project,

$F_{CH4,BL,y} = F_{CH4,hist,y} = F_{CH4,BL,x-1} / F_{CH4,x-1} * F_{CH4,PJ,y}$ **(23)**

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

Baseline emissions associated with electricity generation in year *y* ($BE_{EC,y}$) shall be calculated by applying applicable guidance of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". When applying this methodological tool:

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

This methodological tool declares:

> *"In the generic approach, project, baseline and leakage emissions from consumption of electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses (…)"*

Specifically for baseline emissions, the following equation is applicable:

$$BE_{EC,y} = \sum_{j} EC_{BL,k,y} * EF_{EL,k,y} * (1 + TDL_{k,y}) \quad \textbf{(24)}$$

Where:

$BE_{EC,y}$	=	Baseline emissions associated with electricity generation (in tCO_2/yr).
$EC_{BL,k,y}$	=	Net amount of electricity generated using LFG in year *y* (in MWh)
$EF_{EL,k,,y}$	=	Emission factor for electricity generation for source *k* in year *y* (in tCO_2/MWh). $EF_{EL,j/k/l,y}$ represents the combined margin (CM) emission factor for the electricity grid to which the project activity is connected to *($EF_{grid,CM,y} = EF_{EL,grid,y}$)*.
$TDL_{k,y}$	=	Average technical transmission and distribution losses for providing electricity to source *k* in year *y.*
k	=	sources of electricity generated identified in the selection of the most plausible baseline scenario

By following the above-quoted applicable guidance of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", baseline emissions for electricity generation by the project activity ($BE_{EC,y}$), are determined as follows:

$BE_{EC,grid,y} = EC_{BL,y} * EF_{EL,grid,y} * (1 + TDL_{grid,y})$ **(24.1)**

Where:

$EC_{PJ,grid,y}$	=	Net amount of electricity generated using LFG in year y (in MWh).
$EF_{EL,grid,y}$	=	Emission factor for grid sourced electricity in year *y* (in tCO_2/MWh). $EF_{EL,grid,y}$ is determined as the combined margin (CM) emission factor ($EF_{grid,CM,y}$).
$TDL_{grid,y}$	=	Average technical transmission and/or distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the project activity.

Determination of combined margin (CM) emission factor ($EF_{grid,CM,y}$ = $EF_{EL,grid,y}$):

Option A.1 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" is selected for determining $EF_{EL,k,,y}$. Thus, according to the selected option:

> *"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" ($EF_{EL,j/k/l,y}$ = $EF_{grid,CM,y}$)."*

The "Tool to calculate the emission factor for an electric system" indicates that the CO_2 emission factor of the electricity grid is determined by the following six steps:

1. Identify the relevant electric systems;
2. Choose whether to include off-grid power plants in the project electricity system;
3. Select a method to determine the operating margin (OM);
4. Calculate the operating margin emission factor according to the selected method;
5. Identify the group of power units to be included in the build margin (BM).
6. Calculate the build margin (BM) emission factor;

Step 1: Identify the relevant electric systems

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

In the specific case of Chile, there are four separate electricity systems as follows [43]:

- Central Interconnected System (SIC) serving the central region of Chile;
- Great North Interconnected System (SING) serving the desert mining in the northern of Chile;
- Electric System of Aysén (SEA) serving the Aysén del General Carlos Ibañez del Campo region of Chile;
- Electric System of Magallanes (SEM) serving the Magallanes and Antartica Chilena region of Chile.

Since Loma Los Colorados Landfill Gas Project is located in the central region of Chile, thus within the boundaries of Central Interconnected System (SIC), the relevant electrical system identified in this case is SIC [44].

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

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

[43] National Energy Commission (CNE) http://www.cne.cl

[44] It is important to note that there are no connected electricity system In Chile which is located partially or totally in Annex I countries.

Option I: Only grid power plants are included in the calculation;
Option II: Both grid power plants and off-grid power plants are included in the calculation;

Option I is selected.

Step 3: Select a method to determine the operating margin (OM)

The methodological "Tool to calculate the emission factor for an electricity system" provides four methods to calculate the Operating Margin emission factor(s) ($EF_{grid,OM,y}$) as follows:

(a) Simple OM
(b) Simple adjusted OM
(c) Dispatch Data Analysis OM
(d) Average OM.

Option (b) is chosen due to the low-cost/must-run resources in the Interconnected Central System grid, which accounts for more than 50% of total grid generation as shown in the table below[45]:

AVERAGE OF POWER GENERATION IN THE 5 LAST YEARS

YEAR	Low-Cost/Must-Run gross generation (MWh)	Other sources gross generation (MWh)	Low-Cost/Must-Run Generation (%)	Other sources Generation (%)
2008	24.394.643	17.474.357	58,26%	41,74%
2009	25.578.048	16.212.152	61,21%	38,79%
2010	22.415.023	20.739.577	51,94%	48,06%
2011	21.682.964	24.459.036	46,99%	53,01%
2012	21.538.264	27.434.636	43,98%	56,02%
		AVERAGE L-C/ M-R (%)	**52,48%**	**47,52%**

The Simple adjusted OM emissions factor can be calculated using either of the two following approaches:

- Ex-ante approach: A 3-year generation weighted average, based on the most recent data available at the time of submission of the PDD to the DOE for validation, without the requirement to monitor and recalculate the emission factors during the crediting period.

- Ex-post approach: The year in which the project activity displaces grid electricity, requiring the emission factors to be updated annually during the crediting period.

The Operating Margin will be calculated ex-ante and will be also fixed for the 2nd 7-year crediting period.

Step 4: Calculate the operating margin emission factor ($EF_{grid,OM,y}$) according to the selected method

The Simple adjusted OM emission factor ($EF_{grid,OM-adj,y}$) is a variation of the Simple OM, where power plants/units are separated in low-cost must run power sources (k) and other

[45] http://www.cdec-sic.cl/datos/anuario2013/english/sic.php

power sources (m). It is calculated based on the net electricity generation of each power unit and an emission factor for each power unit as follows:

$$EF_{grid,OM\text{-}adj,y} = (1-\lambda_y) * (\sum_m EG_{m,y} * EF_{EL,m,y}) / (\sum_m EG_{m,y}) + \lambda_y * (\sum_k EG_{k,y} * EF_{EL,k,y}) / (\sum_k EG_{k,y})$$

(25)

Where:

$EF_{grid,OM\text{-}adj,y}$	= Simple adjusted operating margin CO_2 emission factor in year *y* (tCO_2e/MWh)
λ_y	= Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year *y*
$EG_{m,y}$	= Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EG_{k,y}$	= Net quantity of electricity generated and delivered to the grid by power unit *k* in year *y* (MWh)
$EF_{EL,m,y}$	= CO_2 emission factor of power unit *m* in year *y* (tCO_2e/MWh)
$EF_{EL,k,y}$	= CO_2 emission factor of power unit *k* in year *y* (tCO_2e/MWh)
m	= All grid power units serving the grid in year *y* except low-cost/must-run power units
k	= All low-cost/must run grid power units serving the grid in year *y*
y	= The relevant year as per the data vintage chosen in Step 3[46].

The parameter λ_y is calculated as follows:

λ_y (%) = Number of hours low-cost/must-run are on the margin in year *y* / 8760 hours per year [47]

Step (i) – Plot a load duration curve. Collect chronological load data (typically in MW) for each hour of the year y, and sort the load data from the highest to the lowest MW level. Plot MW against 8760 hours in the year, in descending order;

Step (ii) – Collect electricity generation data from each power plant/unit. Calculate the total annual generation (in MWh) from low-cost/must-run power plants/units (i.e. $\sum_k EG_{k,y}$);

Step (iii) – Fill the load duration curve. Plot a horizontal line across the load duration curve such that the area under horizontal line and the curve right from the instersection point (MW times hours) equals the total generation (in MWh) from low-cost/must-run power plants/units (i.e. $\sum_k EG_{k,y}$);

Step (iv): Determine the “Number of hours for which low-cost/must-run sources are on the margin in year y. First, locate the intersection of the horizontal lone plotted in Step (iii) and the load duration curve plotted in Step (i). The number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and λ_y is equal to zero.

The emission factor of each power unit ($EF_{EL,m,y}$ and $EF_{EL,k,y}$) are calculated by following “Option A1” of the simple OM method, mentioned in Step 3 of the “Tool to calculate the

[46] According to the source “2003-2012 CDEC-SIC Operation Statistics Yearbook (http://www.cdec-sic.cl/datos/anuario2013/espanol/cdec_sic_12_esp.pdf)”, the available data refers to years 2010, 2011 and 2012. It is important to note that the year 2013 is not considered due to the fact that by the time of the PDD’s renewal procedure this data was not available yet.

[47] 8784 hours in the case of year 2012, which is a leap year.

emission factor for an electricity system”. Option A1 has been chosen since data on fuel consumption and power generation of the power units m are available, so it is possible to apply this option. According to “Option A1”, the emission factor of each power unit m is determined as follows:

$$EF_{EL,m,y} = (\sum_i FC_{i.m.y} * NCV_{i,y} * EF_{CO2,i,y}) / EG_{m,y} \ (tCO_2e/MWh) \quad \textbf{(26)}$$

Where:

$EF_{EL,m,y}$	= CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$FC_{i.m.y}$	= Amount of fuel type *i* consumed by power unit *m* in year *y* (Mass or volume unit)
$NCV_{i,y}$	= Net calorific value (energy content) of fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	= CO_2 emission factor of fuel type *i* in year *y* (tCO_2/GJ)
$EG_{m,y}$	= Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m	= All power units serving the grid in year *y* except low-cost/must-run power units
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 related parameters used for calculating the Operating Margin are obtained as follows:

- $FC_{i.m.y}$ is obtained from 2003-2012 CDSEC-SIC Operation Statistics Yearbook [48]
- $NCV_{i,y}$ is obtained from National Energy Balance 2009, National Energy Commission [49]
- $EG_{m,y}$ is obtained from 2003-2012 CDSEC-SIC Operation Statistics Yearbook [50]
- $EF_{CO2,i,y}$ factors can be found in the “Reviewed 2006 IPCC Guidelines for Greenhouse Gas Inventories: Workbook”.

Step 5. Calculate the build margin (BM) emission factor ($EF_{grid,BM,y}$)

In terms of vintage of data, the following guidance of the methodological tool is applicable:

> ***“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*

[48] Source: 2003-2012 CDEC-SIC Operation Statistics Yearbook, pages 74-75 (http://www.cdec-sic.cl/datos/anuario2013/espanol/cdec_sic_12_esp.pdf).

[49] Source: National Energy Balance, 2009 (http://www.cne.cl/estadisticas/balances-energeticos)

[50] Source 2003-2012 CDEC-SIC Operation Statistics Yearbook, pages 52–66 (http://www.cdec-sic.cl/datos/anuario2013/espanol/cdec_sic_12_esp.pdf).

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."

Option 1 is selected.

The calculation of the Build Margin emission factor $EF_{grid,BM,y}$ is based on the most recent information available on plants already built for sample group *m* by the time the PDD's renewal procedure has been carried out.

In accordance with the "Tool to calculate the emission factor for an electricity system", no capacity additions from retrofits are included in the calculation of the Build Margin emission factor.

The sample group of power units *m* used to calculate the Build Margin has been determined as per the procedure of the mentioned tool, which is shown next:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5-units}$) and determine their annual electricity generation ($AEG_{SET5-units}$ in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total} in MWh);
Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEGSET_{\geq 20\%}$ in MWh);

(c) From $SET_{5-units}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});
Identify the date when the power units in SET sample started to supply electricity to the grid.
If none of the power units in SET sample started to supply electricity to the grid more than 10 years ago, then use SET sample to calculate the Build Margin. Ignore steps (d), (e) and (f).

Otherwise:

(d) Exclude from SET sample the power units which starts to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activity, starting with power units that startesd to aupply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation o the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) on the extent is possible. Determine for the resulting set ($SET_{sample-CDM}$) the annual electricity generation ($AEGSET_{sample-CDM}$ in MWh);
If the annual electricity generation of that set is comprised at least 20% of the annual electricity generation of the project electricity system (i.e. $AEGSET_{sample-CDM} \geq 0.2 * AEG_{total}$), then use the sample group $SET_{sample-CDM}$ to calculate the Build Margin. Ignore steps (e) and (f).

Otherwise:

(e) Include in the sample group $SET_{sample-CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);

(f) The sample group of power units *m* used to calculate the Build Margin is the resulting set ($SET_{sample-CDM>10yrs}$).

Once followed paragraphs (a), (b) and (c), it was found that $SET_{\geq 20\%}$ had a larger production than $SET_{5-units}$, so $SET_{\geq 20\%}$ is considered the sample set (SET_{sample}).

The Build Margin emission factor is calculated by following the equation below, as indicated in the "Tool to calculate the emission factor for an electricity system" (version 04.0).

$$EF_{grid,BM,y} = \left(\sum_m EG_{m,y} * EF_{EL,m,y} \right) / \sum_m EG_{m,y} \quad \textbf{(27)}$$

Where:

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

According to the "Tool to calculate the emission factor for an electricity system" (version 04.0), the CO_2 emission factor for each power unit *m* ($EF_{EL,m,y}$) should be determined as per the guidance in Step 4 (a) for the simple OM, using options A1, A2 or A3, using for *y* the most recent historical year for which electricity generation data is available, and using for *m* the power units included in the build margin. Hence, since data on fuel consumption and power generation of each plant is available, option A1 (the same of the Operating Margin Emission Factor) has been used:

$$EF_{EL,m,y} = \left(\sum_i FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y} \right) / EG_{m,y} \; (tCO_2e/MWh) \quad \textbf{(28)}$$

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$FC_{i,m,y}$ = Amount of fuel type i consumed by power unit *m* in year *y* (mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = CO_2 emission factor of fuel type *i* in year *y* (tCO_2/GJ)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
m = All power units serving the grid in year y except low-cost/must-run power units
i = All fuel types combusted in power unit m in year y
y = The relevant year as per the data cintage chosen in Step 3

The parameters used for calculating the Build Margin are obtained as follows:

- $FC_{i.m.y}$ is obtained from 2001-2010 CDSEC-SIC Operation Statistics Yearbook [51]
- $NCV_{i,y}$ is obtained from National Energy Balance 2009, National Energy Commission [52]
- $EG_{m,y}$ is obtained from 2001-2010 CDSEC-SIC Operation Statistics Yearbook [53]

[51] Source: 2003-2012 CDEC-SIC Operation Statistics Yearbook, pages 74-75 (http://www.cdec-sic.cl/datos/anuario2013/espanol/cdec_sic_12_esp.pdf).

[52] Source: National Energy Balance, 2009 (http://www.cne.cl/estadisticas/balances-energeticos)

- $EF_{CO2,i,y}$ factors are obtained from the "Reviewed 2006 IPCC Guidelines for Greenhouse Gas Inventories: Workbook".

Step 6: Calculate the combined margin (CM) emission factor ($EF_{grid,CM,y}$)

The combined margin emission factor ($EF_{grid,CM,y}$) is calculated (in tCO_2/MWh) as the weighted average of the operating margin and builds margin emission factors. To weight these two factors, the default values applicable to both for 2nd crediting period are applied. The combined margin emission factor is thus obtained as follows:

$$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y} \quad \textbf{(29)}$$

Where:

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

The values for w_{OM} and w_{BM} are ex-ante selected as per applicable guidance of the "Tool to calculate the emission factor for an electric system", which includes the following as a requirement:

"The following default values should be used for w_{OM} and w_{BM}:
(a) Wind and solar power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods;
(b) All other projects: w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period,6 unless otherwise specified in the approved methodology which refers to this tool."

All related calculations for the ex-ante parameter $EF_{grid,OM,y}$, $EF_{grid,BM,y}$ and $EF_{grid,CM,y}$ are presented in the spreadsheet "Loma Los Colorados EF ex-ante", which is enclosed to this PDD.

Baseline emissions associated with heat generation ($BE_{HG,y}$)

As the project design does not encompass any utilization of collected LFG for heat generation (in boiler, air heater, glass melting furnace(s) and/or kiln), baseline emissions associated with heat generation in year *y* ($BE_{HG,y}$) are not considered. Thus, this step is not applicable.

[53] Source 2003-2012 CDEC-SIC Operation Statistics Yearbook, pages 52–66 (http://www.cdec-sic.cl/datos/anuario2013/espanol/cdec_sic_12_esp.pdf).

Baseline emissions associated with natural gas use ($BE_{NG,y}$)

As the project design does not encompass any utilization of collected LFG displacing the use of natural gas or injection of collected LFG into a natural gas distribution network or used by trucks, baseline emissions associated with natural gas use in year *y* ($BE_{NG,y}$) are not considered. Thus, this step is not applicable.

Monitoring of the management of the landfill:

As required by ACM0001 (version 15.0), during the 2nd 7-year crediting period, the design and operational conditions of the Loma Los Colorados landfill will be annually monitored on the basis of different sources, including *inter alia*:

- Original design of the landfill;
- Technical specifications for the management of the Loma Los Colorados landfill;
- Applicable local or national regulations

During the 2nd 7-year crediting period, original operational design of the landfill should be confirmed not to be modified in order to ensure that no practice to increase methane generation at the landfill have been occurring during the 2nd crediting period, when compared to the landfill management and operation condition prior to implementation of the project activity and/or during the 1st crediting period. As required by ACM0001 (version 15.0), any change in the management of the landfill after the implementation of the project activity should be justified by referring to technical or regulatory specifications and impacts of such changes in the determination of baseline emissions should in this case be taken into account appropriately. Such monitoring requirement will be used for the determination/confirmation of baseline emissions and/or confirmation of the project's implementation as described in the PDD (in terms of operation and management conditions of the landfill from which LFG is combusted). Further monitoring details are included in Section B.7.1 (under parameter "Management of SWDS").

<u>Determination of project emissions (PE_y):</u>

As established by ACM0001 (version 15.0), project emissions (PE_y) are calculated (in tCO_2/yr) as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} \quad \textbf{(30)}$$

Where:

PE_y	= Project emissions in year *y* (in 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)
$PE_{DT,y}$	= Emissions from the distribution of compressed/liquefied LFG using trucks, in year y (tCO_2/yr)

Since the project activity will not sell any compressed/liquefied LFG, there will be no project emissions from the distribution of compressed/liquefied LFG using trucks ($PE_{DT,y}$ = 0).

Determination of project emissions from consumption of fossil fuels due to the project activity (for purpose other than electricity generation) ($PE_{FC,y}$):

Since its start of operations, the project activity has consumed Liquefied Petroleum Gas (LPG) for igniting the high temperature enclosed flares. As required by ACM0001 (Version 15.0), project emissions *from consumption of fossil fuels due to the project activity (for purpose other than electricity generation) ($PE_{FC,y}$)* shall be calculated using the "Tool to calculate project or leakage CO_2 emissions from fossil fuel". ACM0001 (version 15.0) establishes the following when applying this methodological tool:

- "*Processes j in the tool correspond to the sources of fossil fuel consumption due to the project activity other than for electricity generation or and any on-site transportation by trucks or cars;(…)".* In the particular case of the project activity, process *j* corresponds to the use of LPG for igniting the flares.

- *"If in the baseline a proportion of LFG is captured and flared ($F_{CH4,BL,y}$ > 0), then the fossil fuels consumption used in calculation ($F_{Ci,j,y}$) should refer to the net of that consumed in the baseline. The determination of the amount of fossil fuels consumed in the baseline shall be transparently documented in the CDM-PDD."* In the particular case of the project activity, while no fossil fuel has been used in the pre-project and baseline scenarios for collecting and destroying LFG, this requirement is thus not applicable.

Thus,

$$PE_{FC,y} = PE_{LPG,y} \quad \textbf{(31)}$$

Where:

$PE_{LPG,y}$ = Project emissions due to the consumption of Liquefied Petroleum Gas by the project activity in year *y* (in tCO_2/year)

In order to determine $PE_{LPG,y}$, applicable guidance of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 2) is applied as follows:

$$PE_{LPG,y} = FC_{LPG,y} * COEF_{LPG,y} \quad \textbf{(32)}$$

Where:

$FC_{LPG,y}$ = Quantity of LPG consumed (in ton LPG);
$COEF_{LPG,y}$ = CO_2 emission coefficient for LPG (in tCO_2/ton LPG).
$COEF_{LPG,y}$ is determined by following applicable guidance of Option B of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" as follows:

$$COEF_{LPG,y} = NCV_{LPG,y} * EF_{CO2,LPG,y} \quad \textbf{(33)}$$

Where:
$NCV_{LPG,y}$ = Net calorific value of the fuel LPG (in GJ/ton LPG)
$EF_{CO2,LPG,y}$ = CO_2 emission factor of fuel LPG (in tCO_2/GJ LPG)

Determination of project emissions from consumption of electricity due to the project activity ($PE_{EC,y}$)*:*

As required by ACM0001 (version 15.0), project emissions from consumption of electricity by the project activity ($PE_{EC,y}$) shall be calculated by applying the methodological approach established by the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". This methodological tool establishes the following:

> "*In the generic approach, project, baseline and leakage emissions from consumption of electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses (…)*" *"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"*

ACM0001 (version 15.0) establishes the *following* when applying this methodological tool:

- *"$EC_{PJ,k,y}$[54] in the tool is equivalent to the amount of electricity consumed by the project activity in year y ($EC_{PJ,y}$)."* In the particular case of the project activity, electricity sources *j* in the tool corresponds to the sources of electricity consumed due to the project activity. In the particular case of the project activity, grid-sourced electricity and electricity generated by the backup captive off-grid electricity generators (fuelled by Diesel) have been consumed for the operation of the project activity. No other sources of electricity are currently expected to be used to meet the electricity demand of the project activity during the 2nd 7-year crediting period either.

- *"If in the baseline a proportion of LFG is destroyed ($F_{CH4,BL,y} > 0$), then the electricity consumption in the tool ($EC_{PJ,j,y}$) should refer to the net quantity of electricity consumption (i.e. the increase due to the project activity). The determination of the amount of electricity consumed in the baseline shall be transparently documented in the CDM-PDD"*.

In the particular case of the project activity, since no records of consumption of grid electricity in the pre-project scenario (small fraction of LFG being collected and flared in a voluntarily installed small LFG flaring station) are available, it is assumed that no grid electricity was consumed in the pre-project scenario (which is the same as the identified baseline scenario). This will represent an increment in the determination of project emissions (since the net quantity of grid electricity consumed in the project scenario will be considered as the total grid electricity consumed by project activity (without discounting the small amount of grid electricity which was consumed in the baseline scenario)), which is deemed conservative.

According to the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", project emissions due to electricity consumption by the project activity ($PE_{EC,y}$) are calculated as follows:

$$PE_{EC,y} = \sum EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y}) \quad \textbf{(34)}$$

Where:

As per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", $EC_{PJ,j,y}$ is the quantity of electricity consumed by the project electricity consumption source *j* in year *y*.

[54] As per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", $EC_{PJ,j,y}$ is the quantity of electricity consumed by the project electricity consumption source *j* in year *y*.

$EC_{PJ,j,y}$	*= Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)*
$EF_{EL,j,y}$	*= Emission factor for electricity generation for source j in year y (tCO_2/MWh)*
$TDL_{j,y}$	*= Average technical transmission and distribution losses for providing electricity to source j in year y*

In the particular case of the project activity, as grid sourced electricity and electricity generated by the backup captive off-grid electricity generators (fuelled by Diesel) are the only sources of electricity consumed by the project activity, $PE_{EC,y}$ can thus be calculated as:

$$PE_{EC,y} = PE_{EC,grid,y} + PE_{EC,captive,y} \quad \textbf{(35)}$$

Where:

$PE_{EC,grid,y}$	= Project emissions from consumption of grid electricity due to the project activity in year *y* (in tCO_2/yr)
$PE_{EC,captive,y}$	= Project emissions from consumption of electricity generated by a captive off-grid electricity generator fuelled by fossil fuel (diesel) in year *y* (in tCO2/yr)

$PE_{EC,grid,y}$ and $PE_{EC,captive,y}$ are calculated according to the following approach:

<u>Project emissions due to the consumption of grid electricity by the project activity ($PE_{EC,grid,y}$):</u>

By following applicable guidance of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, project emissions due to grid electricity consumption by the project activity ($PE_{EC,grid,y}$), are determined as follows:

$$PE_{EC,grid,y} = EC_{PJ,grid,y} * EF_{EL,grid,y} * (1 + TDL_{grid,y}) \quad \textbf{(36)}$$

Where:

$EC_{PJ,grid,y}$	= Quantity of grid sourced electricity consumed by the project activity in year *y* (in MWh)
$EF_{EL,grid,y}$	= Emission factor for grid sourced electricity in year *y* (in tCO_2/MWh). Related calculations for the parameter $EF_{EL,grid,y}$ are further demonstrated on the sub-section *Baseline emissions associated with electricity generation ($BE_{EC,y}$)*
$TDL_{grid,y}$	= Average technical transmission and/or distribution losses for providing electricity to the grid and for grid sourced electricity consumed by the project activity.

<u>Project emissions due to the consumption of electricity sourced by backup captive off-grid electricity generators (fuelled by Diesel) ($PE_{EC,captive,y}$):</u>

Project emissions from the consumption of electricity generated by the backup captive off-grid diesel generators will be calculated by using following one of the four approaches below which are based on the existent determination options of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (B1, B2, B3 or B4) as follows:

Alternative approach 1 and alternative approach 2:
As per Option B1 and B2 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", $PE_{EC,captive,y}$ is calculated as follows:

$$PE_{EC,captive,y} = EC_{captive,y} * EF_{EL,captive,y} * (1 + TDL_{captive,y}) \quad \textbf{(37)}$$

Where:

$EC_{captive,y}$ = Amount of electricity sourced by the captive electricity generator (fuelled by Diesel) and consumed by the project activity. $EC_{captive,y}$ will be measured and monitored in MWh as per the provisions of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

$TDL_{captive,y}$ = Average technical transmission and distribution losses for electricity sourced by the captive electricity generator. In accordance with the applicable provisions of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", as a simplification, $TDL_{captive,y}$ is ex-ante determined as zero (fixed value along the whole crediting period).

$EF_{EL,captive,y}$ = CO_2 emission factor for electricity sourced by the captive off-grid electricity generators (tCO_2/MWh).

- *Alternative approach 1:*
  By following Option B1 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", $EF_{EL,captive,y}$ is determined as follows:

$$EF_{EL,captive,y} = (FC_{Diesel,y} * NCV_{Diesel,y} * EF_{CO2,Diesel,y}) / EG_{Diesel\text{-}generator} \quad \textbf{(38)}$$

Where:

$FC_{Diesel,y}$ = Quantity of fuel Diesel combusted by the captive off-grid electricity generator (liters)

$NCV_{Diesel,y}$ = Net calorific value of the fuel Diesel (GJ/liters)

$EF_{CO2,Diesel,y}$ = CO_2 emission factor of fuel Diesel (tCO_2/GJ)

$EG_{Diesel\text{-}generator}$ = Quantity of electricity generated by captive off-grid electricity generators fuelled by Diesel (MWh). It is important to note that If all electricity generated by the captive electricity generator is consumed by the project activity, $EG_{Diesel\text{-}generator} = EC_{captive,y}$

- *Alternative approach 2:*
  By following Option B2 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", $EF_{EL,captive,y}$ is determined as 1.3 tCO_2/MWh.

Alternative approach 3:
By following Option B3 the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", $PE_{EC,captive,y}$ is calculated by determining the CO_2 emissions from <u>all Diesel</u> fuel combustion in the captive electricity generator. These emissions are calculated by adopting applicable provisions of the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 2). This option provides an accurate estimate as all electricity generated by the captive off-grid generator is expected to be consumed by the project activity.

As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 2), $PE_{EC,captive,y}$ is determined as follows:

$$PE_{EC,captive,y} = FC_{Diesel,y} * COEF_{Diesel,y} \quad \textbf{(39)}$$

Where:

$FC_{Diesel,y}$ = Quantity of fuel Diesel combusted by the captive off-grid electricity generator (liters)

$COEF_{Diesel,y}$ = The CO_2 emission coefficient for the fuel Diesel (tCO_2/liters) which is calculated by following Option B of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" as follows:

$$COEF_{Diesel,y} = NCV_{Diesel,y} * EF_{CO2,Diesel,y} \quad \textbf{(40)}$$

Where:
$NCV_{Diesel,y}$ = Net calorific value of the fuel Diesel (in GJ/liters)
$EF_{CO2,Diesel,y}$ = CO_2 emission factor of fuel Diesel (tCO_2/GJ)

Alternative approach 4:
By taking into account Option B4 the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", $PE_{EC,captive,y}$ is calculated based on the rated capacity of the installed captive off-grid electricity generator and by assuming a CO_2 emission factor of 1.3 tCO_2/MWh for electricity generated by the captive off-grid electricity generator (which is assumed as being operation of 8,760 hours per year) as follows:

$$PE_{EC,captive,y} = 11,400\ tCO_2/MWh * PP_{Diesel\text{-}generator} \quad \textbf{(41)}$$

Where:

$PP_{Diesel\text{-}generator}$ = Rated capacity of the installed captive off-grid electricity generator (fuelled by Diesel) (in MW)

Determination of leakage emissions (LE_y):

No leakage emissions are expected to occur. Moreover, no leakage effects are accounted for under ACM0001 (version 15.0).

B.6.2. Data and parameters fixed ex ante

Data / Parameter	OX_{top_layer}
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” (version 06.0.1)
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	Default value as per the applied CDM baseline and monitoring methodology ACM0001“Flaring or use of landfill gas” (version 15.0)
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$F_{CH4,BL,x-1}$
Unit	tCH_4/yr
Description	Historical amount of methane in the LFG which is captured and destroyed in the year prior to the implementation of the project activity (2006).
Source of data	Technical study developed by KDM S.A. related to year 2006.
Value(s) applied	516.16
Choice of data or Measurement methods and procedures	Value applied according to information provided by the SWDS operator (KDM S.A.).
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	**GWP_{CH4}**
Unit	tCO_2e/tCH_4
Description	Global Warming Potential of CH_4
Source of data	"Global Warming Potential for Given Time Horizon" in table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon. Available at: www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14 The applied value is also in accordance with the "Standard for application of the global warming potential to clean development mechanism project activities and programmes of activities for the second commitment period of the Kyoto Protocol".
Value(s) applied	25
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	The applied value shall be updated according to any future COP/MOP decisions and/or decision by the CDM-EB.

Data / Parameter	η_{PJ}
Unit	Dimensionless
Description	Efficiency of the LFG capture system that will be installed in the project activity
Source of data	Value obtained from technical literature

Value(s) applied	0.9280
Choice of data or Measurement methods and procedures	Value obtained from technical literature[55] and also by taking into consideration the design and operational characteristics/aspects of the Loma Los Colorados landfill + the general construction, design and forecasted implementation of the project's LFG collection network during the 2nd 7-year crediting period.
Purpose of data	Calculation of baseline emissions
Additional comment	Selected value can also be represented as percentage, since 0.9280 = 92.80%

Data / Parameter	$\mathbf{R_u}$
Unit	Pa.m^3/kmol.K
Description	Universal ideal gases constant
Source of data	Default value as per the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0)
Value(s) applied	8,314
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	**-**

[55] The technical paper "*Measuring landfill gas collection efficiency using surface methane concentration*" (which was published by Raymond L. Huitric and Dung Kong, from the Solid Waste Management Department of the Los Angeles County Sanitation Districts), states the following regarding LFG collection efficiency for a well-managed LFG collection system:

> *"Measuring landfill gas collection efficiency is important for gauging emission control effectiveness and energy recovery opportunities. Though researched for years, practical measures of collection efficiency are lacking. Instead, a default efficiency of 75% based on surveys of industry estimates is commonly used, for example, by the United States Environmental Protection Agency (US EPA). Though few, actual emission measurements indicate substantially higher efficiencies ranging from 85 to 98%."*

This document also mentions that *"(…) landfill gas collection efficiencies should routinely reach 100%."*
Practical results, shown on table 4 of the study: Weighted average collection efficiency, show a collection efficiency of 92.8 to 96.1% on well-engineered landfills with vacuum systems to extract LFG.
The paper "*Measuring landfill gas collection efficiency using surface methane concentration*" is available at http://www.arb.ca.gov/cc/ccea/comments/april/huitric_kong.pdf

Data / Parameter	**MM_k**
Unit	kg/kmol
Description	Molecular mass of gas *k*
Source of data	Default values as per the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0)
Value(s) applied	For considered gases *k* that are greenhouse gases (GHGs), the values below are applied for MMi. As per the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”: *“The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (k) in the considered gaseous stream. However as a simplification, only the volumetric fraction of gases k that are greenhouse gases and are 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.* ACM0001 (version 15.0.0) does not include any restriction to such simplification. Thus, only the volumetric fraction of gases that are greenhouse gases and are considered in related calculations (CH_4 in the particular case of the project activity) and the difference to 100% is just considered as pure nitrogen. Compound / Structure / Molecular mass (kg / kmol): Nitrogen / N_2 / 28.01
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Compound	Structure	Molecular mass (kg / kmol)
Nitrogen	N_2	28.01

Data / Parameter	**MM_i**
Unit	kg/kmol
Description	Molecular mass of greenhouse gas *i*
Source of data	Default values as per the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0)

Value(s) applied	The following values of molecular mass are applicable for CH_4 (the only GHG which is considered): Compound / Structure / Molecular mass (kg/kmol) Methane / CH_4 / 16.04
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Compound	Structure	Molecular mass (kg/kmol)
Methane	CH_4	16.04

Data / Parameter	$\mathbf{P_n}$
Unit	Pa
Description	Total pressure at normal conditions
Source of data	Default values as per the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0)
Value(s) applied	101,325
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$\mathbf{MM_{H2O}}$
Unit	kg/kmol
Description	Molecular mass of water
Source of data	Default values as per the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0)
Value(s) applied	18.0152
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	**T_n**
Unit	K
Description	Temperature at normal conditions
Source of data	Default values as per the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)
Value(s) applied	273.15
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	**$TDL_{grid,y}$**
Unit	-
Description	Average technical transmission and distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the project activity.
Source of data	Applicable default values as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01).
Value(s) applied	3% (for generated electricity exported through the electricity grid the project activity is connected to ($TDL_{grid,export,y}$)) 20% (for electricity imported by the project activity through the electricity grid the project activity is connected to ($TDL_{grid,import,y}$))

Choice of data or Measurement methods and procedures	The “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) defines, as alternative, default value of 20% for project consumption sources (applicable for determination of project emissions due to consumption of grid-sourced electricity by the project activity) and default value of 3% for baseline electricity consumption sources (applicable for the determination of baseline emissions for electricity generation by the project activity). The selection of these default values are under conformance with applicable guidance of ACM0001 (version 15.0). While transmission and distribution sources applicable for both grid-sourced electricity to be consumed by the project activity and for electricity generation by the project activity (equivalent to electricity consumption of baseline electricity consumption sources when applying the underlaying tool) do not fit under Scenario B and/or Scenario C (case II) of the such tool, the selected 20% value for $TDL_{grid,import,y}$ and 3% values for $TDL_{grid,export,y}$ are thus under conformance with applicable guidance of the tool. The selection of 20% value for $TDL_{grid,import,y}$ and 3% values for $TDL_{grid,export,y}$ meets applicable guidance for Scenarios A and C (cases I and III) of the Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) (whichever of these scenarios are applicable for the particular case of the project activity, where, as per the tool, in the case of doubts, case C.III should be identified as a conservative approach). It is relevant to note that as per the project design, the amount of electricity to be consumed by the project activity (project electricity consumption sources) to which scenario C of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) refers is smaller than the so-called electricity consumption of baseline electricity consumption sources ($EC_{BL,k,y}$) as per such tool (where $EC_{BL,k,y}$ in the tool is equivalent to the net amount of electricity generated using LFG in year y ($EG_{PJ,y}$) as defined by ACM0001 (version 15.0)). In summary, the project activity generates more electricity than it requires for its operation, with the largest amount of generated electricity being exported through the electricity grid the project activity is connected to. Under these particular conditions, also considering the 3% default value for electricity imported by the project activity (through the electricity grid the project activity is connected to) in thesis would represent an acceptable alternative. However, as a conservative approach, the generic 20% default value of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) applicable for project consumption sources is selected. This approach results in higher project emissions, thus reducing emission reductions to be achieved by the project activity accordingly.
Purpose of data	Calculation of both baseline emissions and project emissions.
Additional comment	-

Data / Parameter	w_{BM}
Unit	%
Description	Weighting of build margin emissions factor
Source of data	Applicable default value as per the "Tool to calculate the emission factor for an electricity system" (version 4.0)
Value(s) applied	0.75 (75%) during the 2nd 7-year crediting period
Choice of data or Measurement methods and procedures	The applicable value valid for 2nd crediting period as per the "Tool to calculate the emission factor for an electricity system" (Version 4.0) is selected.
Purpose of data	Calculation of baseline emissions associated with electricity generation and project emissions due to the consumption of grid electricity by the project activity.
Additional comment	-

Data / Parameter	w_{OM}
Unit	%
Description	Weighting of operating margin emissions factor
Source of data	Applicable default value as per the "Tool to calculate the emission factor for an electricity system" (version 4.0)
Value(s) applied	0.25 (25%) during the 2nd 7-year crediting period
Choice of data or Measurement methods and procedures	The applicable value for the 2nd crediting period as per the "Tool to calculate the emission factor for an electricity system" (version 4.0) is selected.
Purpose of data	Data is used for determination of baseline emissions associated with electricity generation and project emissions due to the consumption of grid electricity by the project activity.
Additional comment	-

Data / Parameter	$\varphi_{default}$
Unit	Dimensionless

Description	Default value for model correction factor to account for model uncertainties
Source of data	Default value applicable for determination of baseline emissions as per the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1). Value applicable for humid/wet conditions as per Application A is selected (based on the climate conditions valid for the location of the project activity). Source for weather condition data: http://www.bbc.com/weather/3871336
Value(s) applied	0.75
Choice of data or Measurement methods and procedures	Determined based on default value of table 3 of the referred methodological tool as per Option 1, Application A (value applicable for humid/wet conditions).
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	**OX**
Unit	Dimensionless
Description	Oxidation factor (reflecting the amount of methane from the considered SWDS that is oxidized in the soil (or other material covering the waste))
Source of data	Applicable default value as per the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1)
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	**F**
Unit	Dimensionless
Description	Fraction of methane in the SWDS gas (volume fraction)

Source of data	Applicable default value as per the methodological tool “Emissions from solid waste disposal sites” (version 06.0.1)
Value(s) applied	0.4962
Choice of data or Measurement methods and procedures	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the considered SWDS. The applied value is determined as the average fraction of methane in collected LFG during the year of 2012 (calculated based on monitored data for the monitoring periods encompassed by year 2012).
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	$DOC_{f,default}$
Unit	Dimensionless
Description	Fraction of degradable organic carbon (DOC) in MSW that decomposes in the considered SWDS.
Source of data	Applicable default value as per the methodological tool “Emissions from solid waste disposal sites” (version 06.0.1), which refers to applicable value as per IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. The default value was applied as per Application A of the methodological tool “Emissions from solid waste disposal sites” (version 06.0.1): “*The CDM project activity mitigates methane emissions from a specific existing SWDS”.*
Purpose of data	Calculation of baseline emissions.
Additional comment	Application A of the methodological tool “Emissions from solid waste disposal sites” (version 06.0.1) is the applicable case of the project activity.

Data / Parameter	**$MCF_{default}$**
Unit	Dimensionless
Description	Methane correction factor.
Source of data	Value is sourced by the methodological tool “Emissions from solid waste disposal sites”, that refers to IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Value(s) applied	1.0
Choice of data or Measurement methods and procedures	Value is selected as per Application A of the methodological tool, under the following conditions: “*1.0: for anaerobic managed solid waste disposal sites. These must have 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 will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste;”* The day-to-day MSW disposal activities at the Loma Los Colorados landfill encompasses utilization of appropriate MSW landfilling practices (covering, leveling and mechanical compacting of disposed material, etc.) as part of the operation of this landfill. The Loma Los Colorados landfill is regarded as a well-managed landfill site.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	**DOC_j**
Unit	Dimensionless
Description	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
Source of data	Values are selected as per applicable guidance of the methodological tool “Emissions from solid waste disposal sites” (version 06.0.1), that refers to 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>

Waste type *j*	DOC_j (% wet waste)
Wood and wood products	43
Pulp, paper and cardboard (other than sludge)	40
Food, food waste, beverages and tobacco (other than sludge)	15
Textiles	24
Garden, yard and park waste	20
Glass, plastic, metal, other inert waste	0

</td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>The selected values are based on wet waste basis (moisture concentrations in the waste streams as waste is delivered to the SWDS). The IPCC 2006 Guidelines also specifies DOC values on a dry waste basis, which refers to the moisture concentrations after complete removal of all moisture from the waste. However, this selection is not practical for the situation/practice at the Loma Los Colorados landfill.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions.</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>k_j</td></tr>
<tr><td>Unit</td><td>1/yr</td></tr>
<tr><td>Description</td><td>Decay rate for the waste type j</td></tr>
<tr><td>Source of data</td><td>Values are selected as per applicable guidance of the methodological tool “Emissions from solid waste disposal sites” (version 06.0.1). The methodological tools refers to values as per IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3).
Source of data for mean annual temperature (MAT) and mean annual precipitation (MAP): http://www.bbc.com/weather/3871336</td></tr>
<tr><td>Value(s) applied</td><td>

Degradation speed	Waste type	k_j
Slowly degrading	Wood, wood products	0.06
	Pulp, paper and cardboard (other than sludge), textiles	0.03
Moderately Degrading	other (non-food) organic putrescible Garden, yard and park waste	0.10
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.185

</td></tr>
</table>

Choice of data or Measurement methods and procedures	Parameters are selected in accordance to the climate zone valid for the project site: Mean Annual Temperature (MAT) = 14.75 ºC Mean Annual Precipitation (MAP) = 363 mm – (wet climate). Potential Evapotranspiration (PET) = 113,071 mm
Purpose of data	Calculation of baseline emissions.
Additional comment	Domestic sludge was assumed to be rapidly degrading and rubber and leather slowly degrading waste.

Data / Parameter	$\mathbf{W_j}$
Unit	Dimensionless
Description	Weight fraction of the waste type *j*
Source of data	Values are selected as per applicable guidance of IPCC 2006 Guidelines for National Greenhouse Gas, Volume 5, Chapter 2, tables 2.3-2.5, MSW composition regional default values for South-America.
Value(s) applied	See table below
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	No composition analysis for MSW disposed at the Loma Los Colorados landfill is currently available.

Waste type *j*	$\mathbf{W_j}$ **(% wet waste)**
Wood and wood products	4.7
Pulp, paper and cardboard (other than sludge)	17.1
Food, food waste, beverages and tobacco (other than sludge)	44.9
Textiles	2.6
Garden, yard and park waste	0.0
Glass, plastic, metal, other inert waste	30.7

<table>
<tr><td>Data / Parameter</td><td>$SPEC_{flare}$</td></tr>
<tr><td>Unit</td><td>°C (for temperature values)
Nm^3/h (for LFG flow values)
Number of days (for maintenance schedule interval values)</td></tr>
<tr><td>Description</td><td>Manufacturer’s flare specifications for temperature, flow rate and maintenance schedule interval.</td></tr>
<tr><td>Source of data</td><td>Flare manufacturer[56]</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th>$SPEC_{flare, Flare 1}$
$SPEC_{flare, Flare 2}$
$SPEC_{flare, Flare 3}$</th><th colspan="2">Min.</th><th>Max.</th></tr>
<tr><td rowspan="3">Operational LFG flow (for continuous operation):</td><td>Flare 1</td><td>850 Nm^3/h</td><td>5,097 Nm^3/h</td></tr>
<tr><td>Flare 2</td><td>850 Nm^3/h</td><td>5,097 Nm^3/h</td></tr>
<tr><td>Flare 3</td><td>510 Nm^3/h</td><td>5,097 Nm^3/h</td></tr>
<tr><td rowspan="3">Required temperature of the exhaust gas of the flare (to ensure LFG destruction (combustion) under high CH_4 destruction efficiency):</td><td>Flare 1</td><td>760 °C</td><td>1,093 °C</td></tr>
<tr><td>Flare 2</td><td>760 °C</td><td>1,093 °C</td></tr>
<tr><td>Flare 3</td><td>760 °C</td><td>1,093 °C</td></tr>
<tr><td rowspan="3">Required minimum frequency for inspection and maintenance service (incl. inspection in the conditions of the flare isolation ceramics revetment material):</td><td>Flare 1</td><td colspan="2" rowspan="3">Min. every year</td></tr>
<tr><td>Flare 2</td></tr>
<tr><td>Flare 3</td></tr>
<tr><td rowspan="3">Required/recommended minimum frequency for replacement of the flare isolation ceramics revetment material:</td><td>Flare 1</td><td colspan="2" rowspan="3">After 10 years of regular and appropriate operation</td></tr>
<tr><td>Flare 2</td></tr>
<tr><td>Flare 3</td></tr>
</table>
</td></tr>
</table>

[56] The manufacturer of the 3 flares is “LFG Specialties, L.L.C. - USA”, which is a flaring equipment manufacturer based in North America.

Choice of data or Measurement methods and procedures	As established by the methodological tool “Project emissions from flaring”, the flare specifications and operational + maintenance requirements (as set/recommended by the equipment manufacturer) are documented and considered for the ex-ante determination of applicable values for the parameter $SPEC_{flare}$. During the 2nd 7-year crediting period, ex-ante selected data will be compared against monitored data related to the operation of the flares, including: a) Minimum and maximum monitoring records for data regarding inlet LFG flow rate, (b) Minimum and maximum monitoring records for data of temperature in the exhaust gas of each individual high temperature enclosed flare; and (c) Duration in days of time periods between maintenance events for each individual high temperature enclosed flare.
Purpose of data	Calculation of baseline emissions[57].
Additional comment	All flare specification and operation details/requirements are based on information provided by the equipment manufacturer.

Data / Parameter	$EF_{grid,BM,y}$
Unit	tCO_2/MWh
Description	Build margin CO_2 emission factor in year *y*
Source of data	Data is ex-ante determined as per applicable guidance of the “Tool to calculate the emission factor for an electricity system” valid for 2nd crediting period, with data provide by the CDEC-SIC.
Value(s) applied	0.7046
Choice of data or Measurement methods and procedures	Data is determined as per applicable guidance of the “Tool to calculate the emission factor for an electricity system” valid for 2nd crediting period.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

[57] As also highlighted in Section B.3, it is important to note that residual project emissions of CH_4 due to the combustion of LFG in enclosed flares are considered in the context of the determination of baseline emissions (although ACM0001 (version 15.0) refers to the term “project emissions from flaring”.

Data / Parameter	$EF_{grid,OM,y}$
Unit	tCO_2/MWh
Description	Operating margin CO_2 emission factor in year *y*
Source of data	Data is ex-ante determined as per applicable guidance of the "Tool to calculate the emission factor for an electricity system" valid for 2nd crediting period, with data provide by the CDEC-SIC. As per the selected approach from the "Tool to calculate the emission factor for an electricity system", $EF_{grid,OM,y} = EF_{grid,OM\text{-}adj,y}$.
Value(s) applied	0.7479
Choice of data or Measurement methods and procedures	Data is determined as per applicable guidance of the "Tool to calculate the emission factor for an electricity system" valid for 2nd crediting period.
Purpose of data	Calculation of baseline emissions.
Additional comment	It is important to note that the value of $EF_{grid,OM\text{-}adj,y}$ represents the average of years 2010, 2011 and 2012.

Data / Parameter	$PP_{CP,Diesel\text{-}generator}$
Unit	MW
Description	Rated capacity of the installed captive backup electricity generators fuelled by diesel
Source of data	Name plate capacity of the captive generators, manufacturer's specifications or catalogue references
Value(s) applied	The specifications of the installed captive backup electricity generators (fuelled by diesel) are shown in the table below:

Equipment id/tag	Manufacturer:	Model Number	Power (MW)
Diesel Backup Generator I	Atlas Copco (using a Volvo diesel generator)	QAS 325 Vd	0.276
Diesel Backup Generator II	Cummins	SDC - 400	0.352
Diesel Backup Generator III	Protelec	S 100 - 10	0.080

Thus, the Rated capacity of the installed captive backup electricity generators fuelled by diesel is considered as 0.708 MW for the 2nd crediting period.

Choice of data or Measurement methods and procedures	Not applicable
Purpose of data	Calculation of project emissions.
Additional comment	-

Data / Parameter	$\mathbf{TDL_{captive,y}}$
Unit	-
Description	Average technical transmission and distribution losses for electricity sourced by the captive electricity generator
Source of data	Applicable default as per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01).
Value(s) applied	0
Choice of data or Measurement methods and procedures	Data is determined as per applicable guidance of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01).
Purpose of data	Calculation of project emissions.
Additional comment	-

Data / Parameter	$\mathbf{EF_{EL,captive,y}}$
Unit	tCO_2/MWh
Description	CO_2 emission factor for electricity sourced by the captive off-grid electricity generators
Source of data	Applicable default as per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) (in case the *Alternative approach 2* is selected (by following option B2 of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”).
Value(s) applied	1.3
Choice of data or Measurement methods and procedures	Data is determined as per applicable guidance of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01).
Purpose of data	Calculation of project emissions.
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

>>

As presented in Section B.6.1, while emission reductions to be achieved by the project activity are determined as the difference between baseline emissions (BE_y) and project emissions (PE_y), as established by ACM0001 (version 15.0), the following relevant equations and conditions are applied for the ex-ante estimation of emission reductions to be achieved by the project activity during the 2nd 7-year renewable crediting period:

<u>Determination of ex-ante estimations for baseline emissions (BE_y):</u>

While the project activity encompasses collection of LFG and its destruction in high temperature enclosed flares or its utilization for electricity generation, by following the applicable methodological approaches and assumptions + ex-ante determined values presented in Section B.6.1 and B.6.2 respectively, baseline emissions (BE_y) are thus determined as follows:

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

Where:

$BE_{CH4,y}$	= Baseline emissions of methane from the SWDS in year y (tCO_2e/yr)
$BE_{EC,y}$	= Baseline emissions associated with electricity generation in year y (tCO_2e/yr)

For the 2nd 7-year crediting period $BE_{CH4,y}$ is determined as follows:

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

Where:

OX_{top_layer}	= Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline. OX_{top_layer} is ex-ante determined as 0.1. See Section B.6.2 for further details.
$F_{CH4,BL,y}$	= Amount of methane that would be flared in the baseline in year y (t CH_4/yr). See Section B.6.1 for further details.
GWP_{CH4}	= Global warming potential of CH_4 (tCO_2e/t CH_4). GWP_{CH4} is ex-ante determined as 25. See Section B.6.2 for further details.
$F_{CH4,PJ,y}$	= Amount of methane in the LFG which is flared and/or used in the project activity in year y (tCH_4/yr). In the context of ex-ante estimation of emission reductions, as established by ACM0001 (version 15.0), $F_{CH4,PJ,y}$ is determined (in tCH_4/year) as follows in the particular case of the project activity:

<u>Determination of ex-ante estimations of $F_{CH4,PJ,y}$:</u>

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

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)
η_{PJ}	= Efficiency of the LFG capture system that will be installed in the project activity.

η_{PJ} is ex-ante determined as 0.9280. See Section B.6.2 for further details.

GWP_{CH4} = Global warming potential of CH_4 (tCO_2e/tCH_4). GWP_{CH4} is ex-ante determined as 25.
See Section B.6.2 for further details.

$BE_{CH4,SWDS,y}$ = Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (in tCO_2e/yr). $BE_{CH4,SWDS,y}$ is estimated as follows:

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

For the determination of $BE_{CH4,SWDS,y}$, the ex-ante determined values for all parameters in the formulae above are applied. See Section B.6.2 for details about such ex-ante determined values.

Regarding project's electricity generation component, $BE_{EC,y}$ is determined as follows:

$BE_{EC,y} = EC_{BL,y} * EF_{EL,grid,y} * (1 + TDL_{grid,y})$

Where:

$BE_{EC,y}$ = Baseline emissions associated with electricity generation (in tCO_2/yr).

$EC_{BL,y}$ = Net amount of electricity generated using LFG in year *y* (in MWh). It is important to note that, as per the conceived project design, the electricity generation facility CLLC-2 will be expanded (by increasing the number of installed engine-generator sets, thus increasing the electricity generation capacity of this power plant) during the 2nd 7-year crediting period as follows:

End of Year	2014	2015	2016	2017	2018	2019	2020	2021
Number of operational GE-Waukesha APG-1000 Units	2	2	2	2	2	2	2	2
Number of operational GE-Jenbacher J420 Units	14	15	15	16	17	18	18	19
Total nameplate power generation capacity (MW)	21. 6	23	23	24.4	25.8	27.2	27.2	28.6

$EF_{EL,grid,,y}$ = Emission factor for grid sourced electricity in year *y* (0.7154 tCO_2/MWh is adopted for the 2nd 7-year creiditng period). Details about the estimated value for $EF_{EL,grid,y}$ for the 2nd 7-year crediting period are presented in Sections B.6.1 and B.6.2. Moreover, a spreadsheet with all related calculations for the emission factor of the SIC grid is enclosed to this PDD.

$TDL_{grid,y}$ = Average technical transmission and distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the project activity. For the particular case of determination of $BE_{EC,y}$, $TDL_{,grid,y}$ is ex-ante determined as being 3% ($TDL_{grid,export,y}$). Further details are included in Sections B.6.1 and B.6.2.

An emisison reduction calculation spreadsheet is enclosed to this PDD. This calculation spreadsheet includes all required related calculations for the ex-ante estimation of $BE_{CH4,y}$ and $BE_{EC,y}$ during the 2nd 7-year crediting period.

The ex-ante estimation of $BE_y = BE_{CH4,y} + BE_{EC,y}$ is thus summarized as follows:

BE_y = $BE_{CH4,y}$	Estimation of $F_{CH4,PJ,Y}$ (tCH_4)	Estimation of $F_{CH4,BL,y}$ (tCH_4)	Estimation of $BE_{CH4,y}$ (tCO_2e)	Estimation of $EC_{BL,y}$ (MWh)	Estimation of $BE_{EC,y}$ (tCO_2)	Estimation of baseline emissions (tCO_2e)
Year	$F_{CH4,PJ,y} = n_{PJ} * BE_{CH4,SWDS,y} / GWP_{CH4}$	$F_{CH4,BL,r,y} = F_{CH4,BL,x-1} * F_{CH4,PJ,y} / F_{CH4,x-1}$	$BE_{CH4,y} = ((1 - OX_{top\_layer}) * F_{CH4,PJ,y} - F_{CH4,BL,y}) * GWP_{CH4}$	$EC_{BL,y}$	$BE_{EC,y} = EC_{BL,y} * EF_{EL,grid,y} * (1 + TDL_{grid,y})$	$BE_y = BE_{CH4,y} + BE_{EC,y}$
2014	38,721	484	859,113	109,240	80,495	939,608
2015	50,391	630	1,118,042	146,658	108,067	1,226,109
2016	52,070	651	1,155,301	146,658	108,067	1,263,367
2017	53,773	672	1,193,095	155,824	114,821	1,307,916
2018	55,502	694	1,231,448	164,990	121,575	1,353,023
2019	57,257	716	1,270,386	174,156	128,329	1,398,715
2020	59,039	738	1,309,935	174,156	128,329	1,438,264
2021	12,504	156	277,423	37,803	27,856	305,279
Total	379,256	4,741	8,414,743	1,109,485	817,538	9,232,281

Note: All values applicable for years 2014 and 2021 are valid for the fractions of these years which are forecasted to be encompassed by the 2^{nd} 7-year renewable crediting period: from 17/03/2014 to 31/12/2014 and from 01/01/2021 to 16/03/2021 respectively.

Determination of ex-ante estimations for project emissions (PE_y):

As outlined in Section B.6.1, the sources of project emissions to be considered in the context of the determination of emission reductions to be achieved by the project activity are those due to the consumption of both electricity and LPG by the project activity. The related ex-ante estimations of the corresponding project emissions are determined as follows:

Determination of ex-ante estimations of project emissions due to consumption of grid electricity by the project activity ($PE_{EC,grid,y}$):

By following the applicable methodological approaches and assumptions + ex-ante determined values presented in Section B.6.1 and B.6.2 respectively, $PE_{EC,grid,y}$ is determined as follows:

$$PE_{EC,grid,y} = EC_{PJ,grid,y} * EF_{EL,grid,y} * (1+ TDL_{grid,y})$$

Where:

$PE_{EC,grid,y}$ = Project emissions due to consumption of grid sourced electricity by the project activity in year *y* (in tCO_2/yr).

$EC_{PJ,grid,y}$ = Quantity of grid sourced electricity consumed by the project activity in year *y* (in MWh). For the 2^{nd} 7- year crediting period, $EC_{PJ,grid,y}$ is estimated as being 1,647 MWh per year. Further details are included in Section B.7.1. This value is assumed based on the installed nominal power output for the main electrical equipment currently installed as part of the project activity (e.g installed centrifugal blowers) plus an additional 20kW for ancillary equipment and also by assuming that such equipment will work continuously (24 hours a day) under full

power during the whole 2nd 7-year crediting period[58].

$EF_{EL,grid,y}$ = Emission factor for grid sourced electricity in year *y* (0.7154 tCO_2/MWh is adopted for the 2nd 7-year creiditng period). Details about the estimated value for $EF_{EL,grid,y}$ for the 2nd 7-year crediting period are presented in Sections B.6.1 and B.6.2. Moreover, a spreadsheet with all related calculations for the emission factor of the SIC grid is enclosed to this PDD.

$TDL_{grid,y}$ = Average technical transmission and distribution losses for grid sourced electricity consumed by the project activity in year *y.* For the particular case of determination of $PE_{EC,grid,y}$, $TDL_{,grid,y}$ is ex-ante determined as being 20% ($TDL_{grid,import,y}$). Further details are included in Section B.6.2.

Determination of ex-ante estimations of project emissions due to consumption of electricity sourced by the backup captive off grid electricity generators fuelled by Diesel by the project activity ($PE_{EC,captive,y}$):

The captive off-grid backup electricity generators (fuelled by diesel) are expected to be used only for emergency purposes (whenever supply of grid electricity to the project activity is temporarily interrupted). Thus, in the context of ex-ante estimates of emission reductions to be achieved by the project activity, there is no estimated amount of electricity to be generated by these generators nor estimated amount of fossil fuel diesel to be consumed by the generators. Project emissions due to the consumption of electricity sourced by these generators are thus estimated as zero (null) in the context of ex-ante estimates of emission reductions to be achieved by the project activity . However, such project emissions will be determined ex-post along the crediting period (based on applicable monitoring and calculation requirements as presented in Section B.6.1) and will be accounted for the determination of emission reductions.

Determination of ex-ante estimations of project emissions due to consumption of LPG by the project activity ($PE_{LPG,y}$):

By following the applicable methodological approaches and assumptions presented in Section B.6.1, $PE_{LPG,y}$ is determined as follows:

$$PE_{LPG,y} = FC_{LPG,y} * COEF_{LPG,y}$$

Where:

$FC_{LPG,y}$ = Quantity of LPG consumed by the project activity in year *y*. $FC_{LPG,y}$ is estimated to be 200 kg (0.200 ton) of LPG per year. This value is assumed based on reported and verified LPG consumption figures as part of the latest periodic verifications for the project activity within the currently expired 1st crediting period.

$COEF_{LPG,y}$ = CO_2 emission coefficient for LPG (in tCO_2/ton LPG). By applying option B of the methodological tool, $COEF_{LPG,y}$ is determined as follows:

[58] It is important to note that additional power consuming equipment (e.g. additional centrifugal blowers) may be installed as part of the project activity in order to accommodate projected increment in the quantity of LFG to be collected and destroyed by the project activity. In this sense, the conservative approach hereby assumed for estimating $EC_{PJ,grid,y}$ during the 2nd 7-year crediting period (equipment continuously operating under full power) is appropriate (and under a certain level incorporates an increase in grid electricity consumption by the project activity that may occur.

$COEF_{LPG,y} = NCV_{LPG,y} * EF_{CO2,LPG,y}$

Where:

$COEF_{LPG,y}$ is estimated by taking into account the assumed following values and assumptions for $NCV_{LPG,y}$ and $EF_{CO2,LPG,y}$:

$NCV_{LPG,y}$ = Net calorific value of the fuel LPG. The estimated value for $NCV_{LPG,y}$ within the whole 2nd 7-year crediting period is 0.0522 TJ/ton LPG (52.2 GJ/ton LPG) (value is selected as per 2006 IPCC Guidelines on National GHG Inventories (applicable value at upper limit of uncertainty at 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy))).

$EF_{CO2,LPG,y}$ = CO_2 emission factor of fuel LPG. The estimated value for $EF_{CO2,LPG,y}$ within the whole 2nd 7-year crediting period is 65.6 tCO_2/TJ LPG (0.0656 tCO_2/GJ LPG) (value is selected as per 2006 IPCC Guidelines on National GHG Inventories (applicable value at upper limit of uncertainty at 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy))).

Ex-ante estimations of total project emissions during the 2nd 7-year crediting period are thus summarized as follows:

PE_y	Grid electricity consumption by the project activity (MWh)	Project emissions due to grid electricity consumption (tCO_2)	LPG consumption by the project activity (ton)	Project emissions due to LPG consumption (tCO_2)	Total Project emissions (tCO_2)
Year	$EC_{PJ,grid,y}$	$PE_{EC,y} = EC_{PJ,grid,y} * EF_{grid,y} * (1+TDL_{grid,y})$	$FC_{,LPG,y}$	$PE_{LPG,y} = FC_{LPG,y} * EF_{LPG}$	PE_y
2014	1,308	1,123	0.159	0.54	1,124
2015	1,647	1,414	0.200	0.68	1,415
2016	1,647	1,414	0.200	0.68	1,415
2017	1,647	1,414	0.200	0.68	1,415
2018	1,647	1,414	0.200	0.68	1,415
2019	1,647	1,414	0.200	0.68	1,415
2020	1,647	1,414	0.200	0.68	1,415
2021	338	291	0.041	0.14	291
Total	11,528	9,897	1.4	4.79	9,905

Note: All values applicable for years 2014 and 2021 are valid for the fractions of these years which are encompassed by the 2nd 7-year renewable crediting period: from 17/03/2014 to 31/12/2014 and from 01/01/2021 to 16/03/2021 respectively.

Summarized ex-ante estimations of emission reductions (ER_y):

By taking into account the above summarized values for baseline and project emissions, the ex-ante estimations of the emission reductions for the project activity along the 2nd 7-year renewable crediting period are summarized as follows:

ER_y	Emission reductions (tCO_2e)
Year	$ER_y = BE_y - PE_y$
2014	938,484
2015	1,224,694
2016	1,261,952
2017	1,306,501
2018	1,351,608
2019	1,397,300
2020	1,436,849
2021	304,988
Total	9,222,376

Note: Values of ER_y applicable for years 2014 and 2021 are valid for the fractions of these years which are encompassed by the 2^{nd} 7-year renewable crediting period: from 17/03/2014 to 31/12/2014 and from 01/01/2021 to 16/03/2021 respectively.

Details about all the ex-ante determined parameters which are used for the ex-ante estimations of emissions reductions are included in the previous section. An emission reduction calculation spreadsheet with all related calculations for the ex-ante estimations of emission reductions to be achieved by the project activity during the 2^{nd} crediting period is enclosed to this PDD.

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

Year	**Baseline emissions (t CO_2e)**	**Project emissions (t CO_2e)**	**Leakage (t CO_2e)**	**Emission reductions (t CO_2e)**
2014	939,608	1,124	0	938,484
2015	1,226,109	1,415	0	1,224,694
2016	1,263,367	1,415	0	1,261,952
2017	1,307,916	1,415	0	1,306,501
2018	1,353,023	1,415	0	1,351,608
2019	1,398,715	1,415	0	1,397,300
2020	1,438,264	1,415	0	1,436,849
2021	305,279	291	0	304,988
Total	9,232,281	9,905	0	9,222,376
Total number of crediting years	7			
Annual average over the crediting period	1,318,897	1,415	0	1,317,482

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	Management of SWDS
Unit	Dimensionless
Description	Management of the SWDS
Source of data	Measurements/monitoring performed by the project participants. The design and operational conditions of the solid waste disposal site (SWDS) Loma los Colorados Landfill will be annually monitored on the basis of different sources, including *inter alia*: - Original construction and operational design of the Loma los Colorados landfill; - Technical specifications and requirements for the management of the Loma los Colorados landfill; - Applicable local or national regulations dealing with management and operation of existing landfills. Any occurred or planned relevant change in terms of management of the landfill will be reported and justified.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Original construction and operational design of the Loma los Colorados landfill should be confirmed as not being modified during the 2nd 7-year crediting period. This is to ensure that no practice aiming to increase methane generation in the landfill has been occurring after the implementation of the project activity. As required by ACM0001 (version 15.0), any change in the management of the landfill after the implementation of the project activity should be justified by referring to technical or regulatory specifications.
Monitoring frequency	Annually.
QA/QC procedures	Not applicable.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	$V_{t,wb}$
Unit	m^3 wet gas/h
Description	Volumetric flow of LFG stream in time interval *t* on a wet basis
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG flow meter(s). One individual volumetric LFG flow meter may be used for measuring the flow of LFG sent to each high temperature enclosed flare and/or each engine-generator set, with separated measurement data being recorded and reported for each flare and each engine-generator set of the electricity generation infrastructure). In case monitoring approach as per Item 2. "Use of a single flow meter for multi-use of recovered biogas" from "Appendix. - Additional data handling and monitoring guidance for determining the mass flow of methane in biogas" of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied as a monitoring alternative; a single or reduced number of LFG flow meters may be utilized instead[59].
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) and considering aspects/characteristics of the landfill.

[59] **Disclaimer applicable for the monitoring parameters $V_{t,db,j}$, $V_{t,wb,j}$, $V_{t,wb,j}$ or $M_{t,db,j}$ and $v_{CH4,t,wb,j}$ or $v_{CH4,t,db,j}$:**

As an alternative monitoring approach, the determination of flow of methane to the project's biogas destruction/utilization devices (i.e flares and/or engine-generator sets) for a specific time interval within the 2nd 7-year crediting period may, as an alternative monitoring approach, be performed by addressing eventually missing data of flow of collected LFG (monitoring parameter $V_{t,db,j}$, $V_{t,wb,j}$, $V_{t,wb,j}$ or $M_{t,db,j}$) and/or methane content in collected LFG (monitoring parameter $v_{CH4,t,wb,j}$ or $v_{CH4,t,db,j}$) through data substitution. Under such circumstances, additional monitoring requirements as described in Section B.7.3 under *"Data substitution for methane content or biogas flow"* are to be considered as a condition for accounting of related achieved GHG emission reductions.

Also as an alternative monitoring approach, single or reduced number of LFG flow meters may be utilized (instead of applying an individual LFG flow meter for each LFG consuming element of the electricity generation infrastructure (each engine generator set) and/or each flare) in case monitoring approach as per Item *2.* "*Use of a single flow meter for multi-use of recovered biogas"* from "*Appendix. - Additional data handling and monitoring guidance for determining the mass flow of methane in biogas*" of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is selected. Under such circumstances, additional monitoring requirements as described in Section B.7.3 under *"Use of a single flow meter for multi-use of recovered biogas*" are to be considered as a condition for accounting of related achieved GHG emission reductions.

Measurement methods and procedures	Volumetric flow measurement of collected LFG should always refer to the actual LFG absolute pressure and LFG temperature. Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events for the LFG flow meter(s) will be performed by using a reference primary device provided by a third party independent accredited calibration laboratory. Calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. The currently installed flow meters (which were used for monitoring flow of collected LFG during the monitoring periods encompassed by the 1st 7-year crediting period) are calibrated every 18 months (as per the recommendations of the equipment/instrument manufacturers).
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter will be monitored only in case option C of the Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0) is applied for the determination of $F_{CH4,flared,y}$ and $F_{CH4,EL,y}$.

Data / Parameter	$V_{t,db}$
Unit	m³ dry gas/h
Description	Volumetric flow of LFG stream in time interval *t* on a dry basis
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG flow meter(s). One individual volumetric LFG flow meter may be used for measuring the flow of LFG sent to each high temperature enclosed flare and/or each engine-generator set, with separated measurement data being recorded and reported for each flare and each engine-generator set of the electricity generation infrastructure). In case monitoring approach as per Item 2. "Use of a single flow meter for multi-use of recovered biogas" from "Appendix. - Additional data handling and monitoring guidance for determining the mass flow of methane in biogas" of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied as a monitoring alternative; a single or reduced number of LFG flow meters may be utilized instead.

Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Volumetric flow measurement of collected LFG should always refer to the actual LFG absolute pressure and LFG temperature. Calculated based on the wet basis LFG flow measurement plus water concentration measurement. Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events for the LFG flow meter(s) will be performed by using a reference primary device provided by a third party independent accredited calibration laboratory. Calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. The currently installed flow meters (which were used for monitoring flow of collected LFG during the monitoring periods encompassed by the 1st 7-year crediting period) are calibrated every 18 months (as per the recommendations of the equipment/instrument manufacturers).
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter will be monitored only in case option A of the Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0) is applied for the determination of $F_{CH4,flared,y}$ and $F_{CH4,EL,y}$.

Data / Parameter	$\mathbf{v_{CH4,t,db}}$
Unit	m^3CH_4/m^3 dry gas
Description	Volumetric fraction of CH_4 in the collected LFG in time interval *t* on a dry basis

Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying an appropriate continuous CH_4 content gas analyzer.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool “Emissions from solid waste disposal sites” (version 06.0.1) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measurements to be performed by appropriate continuous gas analyzer operating in dry-basis. Volumetric flow measurement should always refer to the actual pressure and temperature. Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events in the continuous CH_4 content gas analyzer will be performed by utilization of calibration span gas with certified CH_4 content (for span checking/adjustment). Utilization of an inert calibration gas (e.g. N_2) will also occur (for span checking/adjustment). All calibration gases (span gases) must have a certificate provided by the gas supplier and must be under their validity period. Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer’s recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. The currently installed $CH_4/O_2/CO_2$ content gas analyzer unit (which was used for monitoring CH_4 content in collected LFG during the monitoring periods encompassed by the 1st 7-year crediting period) is calibrated yearly (as established by the internal calibration procedure which is in accordance with calibration frequency recommendation from the equipment manufacturer).
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter may be monitored only in case option A or D of the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0) and it is applied for the determination of $F_{CH4,flared,y}$ and $F_{CH4,EL,y}$.

Data / Parameter	**$v_{CH4,t,wb}$**
Unit	m^3 CH_4/m^3 wet gas
Description	Volumetric fraction of CH_4 in the collected LFG in time interval *t* on a wet basis
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate continuous CH_4 content gas analyzer.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool “Emissions from solid waste disposal sites” (version 06.0.1) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measurements to be continuously performed by appropriate gas analyzer operating in wet-basis. Volumetric flow measurement should always refer to the actual pressure and temperature. (calculated based on the dry basis analysis plus water concentration measurement or continuous in-situ analyzers). Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.

QA/QC procedures	Periodic calibration events in the continuous CH_4 content gas analyzer will be performed by utilization of calibration span gas with certified CH_4 content (for span checking/adjustment). Utilization of an inert calibration gas (e.g. N_2) will also occur (for span checking/adjustment). All calibration gases (span gases) must have a certificate provided by the gas supplier and must be under their validity period. Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. The currently installed CH_4/O_2/CO_2 content gas analyzer unit (which was used for monitoring CH_4 content in collected LFG during the monitoring periods encompassed by the 1st 7-year crediting period) is calibrated yearly (as established by the internal calibration procedure which is in accordance with calibration frequency recommendation from the equipment manufacturer).
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter will be monitored only in case option C of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0) is applied for the determination of $F_{CH4,flared,y.}$ and $F_{CH4,EL,y}$. The parameter may be monitored in case option A or D of the methodological tool is applied instead.

Data / Parameter	**$M_{t,db}$**
Unit	kg/h
Description	Mass flow of the LFG stream in time interval *t* on dry basis
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG flow meter(s). One individual mass LFG flow meter may be used for measuring the flow of LFG sent to each high temperature enclosed flare and/or each engine-generator set, with separated measurement data being recorded and reported for each flare and each engine-generator set of the electricity generation infrastructure). In case monitoring approach as per Item 2. "Use of a single flow meter for multi-use of recovered biogas" from "Appendix. - Additional data handling and monitoring guidance for determining the mass flow of methane in biogas" of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied as a monitoring alternative; a single or reduced number of LFG flow meters may be utilized instead.

Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool “Emissions from solid waste disposal sites” (version 06.0.1) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Continuous measurements to be performed by applying appropriate flow meter operating in dry-basis. Mass flow measurement should always refer to the actual pressure and temperature (calculated based on the wet basis flow measurement plus water concentration measurement). Instruments with recordable electronic signal (analogical or digital) are required.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events for the LFG flow meter(s) will be performed by using a reference primary device provided by a third party independent accredited calibration laboratory. Calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer’s recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. The currently installed flow meters (which were used for monitoring flow of collected LFG during the monitoring periods encompassed by the 1st 7-year crediting period) are calibrated every 18 months (as per the recommendations of the equipment/instrument manufacturers).
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter will be monitored only in case option D of the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0) is applied for the determination of $F_{CH4,flared,y}$ and $F_{CH4,EL,y}$.

Data / Parameter	**T_t**
Unit	K[60]
Description	Temperature of the LFG stream in time interval *t*
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG temperature sensor.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measured to determine the density of methane ρ_{CH4}. No separate monitoring of LFG temperature is necessary when using LFG flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters (by considering standard temperature and pressure (STP) conditions). Instruments with recordable electronic signal (analogical or digital) are required.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events will be performed in the LFG temperature sensor by a third party independent accredited calibration laboratory in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions.

[60] Measurements for T_t will be recorded and reported in °C. Recorded/reported data will be converted to Kelvin in order to also being recorded/reported in K.

Additional comment	In case of measurements for the applicable LFG flow parameter are automatically converted and recorded in normalized cubic meters (by considering standard temperature and pressure (STP) conditions), monitoring of this parameter may not be required (except if the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted. Under this circumstance, this parameter shall be monitored continuously to assure the applicability condition is indeed met).

Data / Parameter	$\mathbf{P_t}$
Unit	Pa[61]
Description	Pressure of the LFG stream in time interval *t*
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG pressure sensor.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measured to determine the density of methane ρ_{CH4}. No separate monitoring of LFG pressure is necessary when using LFG flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters (by considering standard temperature and pressure (STP) conditions). Instruments with recordable electronic signal (analogical or digital) are required.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.

[61] Depending on installed measurement instrument, measurements for P_t will be recorded and reported in mbar. Recorded/reported data will be converted into Pascal in order to be also recorded and reported in Pa.

QA/QC procedures	Periodic calibration events will be performed in the LFG pressure sensor by a third party independent accredited calibration laboratory in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	$\mathbf{p_{H20,t,Sat}}$
Unit	Pa (depending on measurement instrument, measurement records in mbar will be converted and also reported in Pa)
Description	Saturation pressure of H_2O at temperature T_t in time interval *t*
Source of data	Data as per the literature "*Fundamentals of Classical Thermodynamics*"; Authors: Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4º Edition 1994. Published by John Wiley & Sons, Inc.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	This parameter is solely a function of the LFG stream temperature T_t and can be found at above-referenced literature for a total pressure equal to 101,325 Pa.
Monitoring frequency	-
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	Status of biogas destruction device[62]
Unit	
Description	Operational status of biogas destruction devices
Source of data	
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Records of electricity generation and/or operation of the flare(s) (by means of a flame detector(s)) are to be used in order to demonstrate/confirm occurrence of destruction/utilization of methane by the biogas destruction/utilization device(s) in question (operational flare(s) and/or engine generator set(s)). Emission reductions will be not accrued for periods in which the LFG destruction/utilization device/equipment is not demonstrated/confirmed to be under operational status.
Monitoring frequency	Continuous
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions.

[62]As established by the applied methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0), the monitoring parameter "Status of biogas destruction device" is applicable for both the project's high temperature enclosed flares (hereby regarded as "*biogas destruction devices*") and for the engine-generator sets of the project's electricity generation infrastructure (hereby regarded as "*biogas utilization devices*"). Thus, despite of its name/description, monitoring details for this particular monitoring parameter includes both the terms "*biogas destruction device(s)*" and "*biogas utilization device(s)*" for sake of completeness and transparency and are thus applicable for both types of devices.

Additional comment	Measurement methods and procedures, QA/QC procedures for the following monitoring parameters may be applicable: $V_{t,wb}$, $V_{t,db}$, $v_{CH4,t,db}$, $v_{CH4,t,wb}$, $M_{t,db}$, T_t, P_t, $Flame_m$, and $Op_{j,h}$ In the case of the high temperature enclosed flares, monitoring and documenting will be performed on the basis of monitoring records for the monitoring parameter "Flame detection of flare in the minute *m*" ($Flame_m$)[63].

Data / Parameter	**$EC_{PJ,grid,y}$**
Unit	MWh
Description	Amount of grid electricity consumed by the project activity during the year *y*
Source of data	Measured as part of the operation of the project activity by applying appropriate electricity meter(s).
Value(s) applied	It is estimated that the project activity will consume 1,647 MWh of grid sourced electricity per year during the 2nd 7-year crediting period.
Measurement methods and procedures	Authorized electricity meters. Measurement records will be cross-checked against available electricity consumption receipts/invoices issued by the local electricity distribution company. The parameter $EC_{PJ,y}$ is equivalent to the parameter $EG_{EC,y}$ as indicated in ACM0001 (version 15.0).
Monitoring frequency	Continuous measurements will be aggregated automatically. Accumulated measurement records will be reported at least once a week.
QA/QC procedures	Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. The currently installed electricity meters (which were used for monitoring electricity generated by the project activity and also electricity consumed by the project activity (electricity generated by the installed captive off-grid electricity generators (fuelled by Diesel) and electricity imported from the SIC grid) during the monitoring periods encompassed by the 1st 7-year crediting period) are calibrated every 2 years.

[63] In the particular case of the engine-generator sets of the project's electricity generation infrastructure, monitoring and documenting related to such devices may be performed inter alia on the basis of applicable monitoring requirements for the monitoring parameter "Operation of the equipment that consumes LFG (engine-generator sets of the project's electricity generation facility" ($Op_{j,h}$).

Purpose of data	Calculation of project emissions.
Additional comment	The values considered in the context of the ex-ante estimation of emission reductions were selected based on the nameplate power output for the installed centrifugal blowers (as per the project configuration in December 2013). The installed centrifugal blowers are the most electricity intensive equipment of the project activity). Additional 20 kW in the estimated value for electricity consumption is considered in order to address the potential electricity consumption of other less electricity intensive equipment. Also as an assumption, it is considered that the project activity will operate 24 hours a day during the 2nd 7-year renewable crediting period.

Data / Parameter	$EC_{BL,y}$
Unit	MWh
Description	Amount of electricity generated using LFG by the project activity in year *y*
Source of data	Measured as part of the operation of the project activity by applying appropriate electricity meter(s).
Value(s) applied	see table below
Measurement methods and procedures	Authorized electricity meters. The parameter $EC_{Bl,y}$ is equivalent to the parameter $EG_{PJ,y}$ as indicated in ACM0001 (version 15.0).
Monitoring frequency	Continuous measurements will be aggregated automatically. Accumulated measurement records will be reported at least one a week.

Year	Values applied (MWh)
2014	109,240
2015	146,658
2016	146,658
2017	155,824
2018	164,990
2019	174,156
2020	174,156
2021	37,803

Values within years 2014 and 2021 are applicable for the periods from 17 Mar 2014 to 31 Dec 2014 and from 1 Jan 2021 to 16 Mar 2021 respectively.

QA/QC procedures	Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. The currently installed electricity meters (which were used for monitoring electricity generated by the project activity and also electricity consumed by the project activity (electricity generated by the installed captive off-grid electricity generators (fuelled by Diesel) and electricity imported from the SIC grid) during the monitoring periods encompassed by the 1st 7-year crediting period) are calibrated every 2 years.
Purpose of data	Calculation of baseline emissions.
Additional comment	The estimated values considered in the context of the ex-ante estimation of emission reductions are based on the technical electricity generation capacity (by considering the amount of LFG generated annually and the recovery rate of the project activity) and by also considering the total nameplate power generation installed (as per the planned implementation/expansion of the electricity generation facilities).

Data / Parameter	$Op_{j,h}$
Unit	-
Description	Operation of the equipment that consumes LFG (engine-generator sets of the electricity generation facility).
Source of data	Measured as part of the operation of the project activity.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 1st 7-year crediting period.

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. $Op_{j,h}$ = 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, $Op_{j,h}$ = 1
Monitoring frequency	Hourly
QA/QC procedures	Calculation of baseline emissions.
Purpose of data	In the particular case of the project activity the only equipment that consumes LFG are the engine-generator sets of the electricity generation facility.
Additional comment	-

Data / Parameter	$\mathbf{F_{CH4,EG,t}}$
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	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2^{nd} 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) and considering aspects/characteristics of the landfill.

Measurement methods and procedures	Measure the mass flow of methane in the exhaust gas according to an appropriate national or international standard (such as the UK's Technical Guidance LFTGN05 or a similar standard). 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.
Monitoring frequency	Biannual
QA/QC procedures	QA/QC procedures are to be applied by the entity responsible for performing the related measurements as per requirements of the applied standard. Periodic calibration events in the applied instruments will be performed by a third party independent accredited calibration laboratory (in a frequency as per instrument specifications and/or instrument manufacturer's recommendations). Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice.
Purpose of data	Calculation of baseline emissions.[64].
Additional comment	Monitoring of this parameter is required in the case of enclosed flares and if the project participants select Option B.1 to determine flare efficiency

Data / Parameter	$\mathbf{T_{EG,m}}$
Unit	ºC
Description	Temperature in the exhaust gas of the enclosed flare in minute *m*
Source of data	Measurements performed by the project participants

[64] It is relevant to note that, as shown in Section B.6.1, as per the applied methodological approach, monitoring records of $F_{CH4,EG,t}$ are used for the determination of project emissions from flaring ($PE_{flare,y}$), of which are accounted for the determination of baseline emissions (and not used for the determination of project emissions despite of being termed as "*project emissions*" from flaring).

Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measure the temperature of the exhaust gas of each installed high temperature enclosed flare by appropriate temperature measurement equipment (e.g. thermocouples). Measurements outside the operational temperature specified/recommended by the manufacturer may indicate that the flare is not functioning correctly and may require maintenance. Flare manufacturers must provide suitable monitoring ports for the monitoring of the temperature of the exhaust gas of the flare. These would normally be expected to be in the middle third of the flare. Where more than one measurement port for temperature of the exhaust gas of the flare is fitted to the flare, the flare manufacturer must provide written instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the operation of the flare according to manufacturer's specifications for temperature[65].
Monitoring frequency	Continuous measurements will be recorded and reported with a least every minute frequency.

[65] In the particular case of the currently installed high temperature enclosed flares as part of the project activity, there is only one individual thermocouple located in the upper section of each flare. Anyway, in case additional flares with more than one measurement port (for temperature of the exhaust gas of the flare) are installed within the 2nd 7-year crediting period, the requirement will thus be considered.

QA/QC procedures	Temperature measurement equipment should be replaced or calibrated in accordance with their maintenance schedule. Instruments will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept. The currently installed thermocouples (which were used for monitoring temperature in the exhaust gas of the flare during the monitoring periods encompassed by the 1st 7-year crediting period) are not calibrated. Instead, project participants exchange the thermocouples every 12 months, according to the manufacturer's recommendation.
Purpose of data	Calculation of baseline emissions.[66].
Additional comment	Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. As part of the monitoring procedure, these events will be noted in the site records along with any corrective action that was implemented to correct the issue. Measurements are required to determine if manufacturer's flare specifications for operating temperature are met.

Data / Parameter	**$Flame_m$**
Unit	Flame status "*on*" or flame status "*off*"
Description	Flame detection of flare in the minute *m*
Source of data	Measurements/monitoring performed by the project participants. Whenever, flame is detected in the flare, flame status "*on*" is attributed. Whenever, flame is not detected in the flare, flame status "*off*" is attributed.

[66] It is relevant to note that, as shown in Section B.6.1, as per the applied methodological approach, monitoring records of $T_{EG,m}$ are used for the determination of project emissions from flaring ($PE_{flare,y}$), of which are accounted for the determination of baseline emissions (and not used for the determination of project emissions despite of being termed as "*project emissions*" from flaring).

Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measure using a fixed installation optical flame detector: Ultra Violet detector or Infra-red or both.
Monitoring frequency	Once per minute.
QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations. Periodic calibration events will be performed in the instruments by a third party independent accredited calibration laboratory in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instruments will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions.
Additional comment	Applicable to all flares. The condition will be regularly monitored for each individual high temperature enclosed flare.

Data / Parameter	**$Maintenance_y$**
Unit	Calendar dates
Description	Maintenance events completed in year *y* as monitored by the project participants.
Source of data	Measurements/monitoring performed by the project participants.

Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane in the LFG which is sent to the flares and/or to the electricity generation facilities as part of the operation of the project activity in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y ($BE_{CH4,SWDS,y}$) by using applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) and considering aspects/characteristics of the landfill.
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	Annual
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 emissions.
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	**$FC_{LPG,y}$**
Unit	Ton
Description	Quantity of LPG consumed by the project activity in year *y*
Source of data	Monitoring based on measurements performed by applying weight scale
Value(s) applied	It is estimated that 200 kg (0.2 ton) of LPG will be consumed by the project activity per year during the 2nd 7-year crediting period[67].
Measurement methods and procedures	Recording of measurements of LPG consumed by project activity in year *y*.
Monitoring frequency	Continuous measurements of quantity of LPG by the project activity will be monitored with frequency not lower than once a month.
QA/QC procedures	Periodic calibration events will be performed in the mass meters by a third party independent accredited calibration laboratory in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instruments will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept. The currently installed weight scale (which was used for monitoring the amount of LPG consumed by the project activity during the 1st 7-year crediting period) is calibrated every year (as per the recommendations of the equipment/instrument manufacturers).
Purpose of data	Calculation of project emissions.
Additional comment	LPG purchasing receipts may be used for crosschecking of valid measurement records.

[67] The estimated value is determined by taking into account the previously reported values of LPG consumed by the project activity during the monitoring periods so far encompassed by the 1st 7-year crediting period for the project activity.

Data / Parameter	**$NCV_{LPG,y}$**
Unit	GJ/ton LPG
Description	Net calorific value of the fuel LPG in year y
Source of data	Value provided by the fuel supplier in invoices, regional or national default values or IPCC default values (at upper limit of uncertainty at 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories[68]). Source of value applied in the context of ex-ante estimation of emission reductions during the 2nd 7-year crediting period: IPCC default value. (applicable value at upper limit of uncertainty at 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy)).
Value(s) applied	52.2
Measurement methods and procedures	-
Monitoring frequency	In case values are provided by the fuel supplier in invoices, the applied weighted average annual value will be determined based on provided related information in the context of each individual fuel delivery event. In case regional or national default values or IPCC default values are considered an every year monitoring frequency is applied.
QA/QC procedures	Both values provided by the fuel supplier in invoices as well as regional or national default values will be confirmed to be within the uncertainty range of the IPCC default values (as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines). If the considered values fall below this range, additional information and/or justification will be collected and will be used to justify the outcome. The laboratory(ies) sourcing related measurements or analysis will be confirmed to have ISO17025 accreditation (or it will be justified that it/they can comply with similar quality standards).
Purpose of data	Calculation of project emissions.
Additional comment	If the LPG supplier does provide related NCV values and CO_2 emission factor for the delivered fuel on the invoice and these two values are based on measurements for this specific fuel, this source will be used for the determination of values for the monitoring parameter $NCV_{LPG,y}$.. In case, another source(s) for the values is/are applied, regional or national default values or IPCC default values will thus be considered.

[68] Any future revision of the IPCC Guidelines will be taken into account

Data / Parameter	**$EF_{CO2,LPG,y}$**
Unit	tCO_2/GJ LPG
Description	CO_2 emission factor of fuel LPG in year *y*
Source of data	Value provided by the fuel supplier in invoices, regional or national default values or IPCC default values (at upper limit of uncertainty at 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories)[69]. Appropriate net calorific value (NCV) for LPG may be used for converting energy basis data into mass basis data. For the ex-ante estimation of emission reductions to be achieved by the project activity during the 2nd 7-year crediting period, the value is selected as per 2006 IPCC Guidelines on National GHG Inventories (applicable value at upper limit of uncertainty at 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy)).
Value(s) applied	0.0656
Measurement methods and procedures	-
Monitoring frequency	In case values are provided by the fuel supplier in invoices, the applied weighted average annual value will be determined based on provided related information in the context of each individual fuel delivery event. In case regional or national default values or IPCC default values are considered an every year monitoring frequency is applied.
QA/QC procedures	Both values provided by the fuel supplier in invoices as well as regional or national default values will be confirmed to be within the uncertainty range of the IPCC default values (as per 2006 IPCC Guidelines on National GHG Inventories - applicable value at upper limit of uncertainty at 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy).). If the considered values fall below this range, additional information and/or justification will be collected and will be used to justify the outcome.
Purpose of data	Calculation of project emissions.
Additional comment	If the LPG supplier does provide related NCV values and CO_2 emission factor for the delivered fuel on the invoice and these two values are based on measurements for this specific fuel, this source will be used for the determination of values for the monitoring parameter $NCV_{LPG,y}$.. In case, another source(s) for the values is/are applied, regional or national default values or IPCC default values will thus be considered.

[69] Any future revision of the IPCC Guidelines will be taken into account.

Data / Parameter	$EC_{PJ,captive,y}$
Unit	MWh
Description	Quantity of electricity generated in captive diesel backup generator during the year *y*
Source of data	Measurements by the project participants.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period.
Measurement methods and procedures	Use authorized electricity meters.
Monitoring frequency	Measurements will be aggregated manually or automatically. Accumulated measurement records will be reported at with at least every-month frequency.
QA/QC procedures	Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. The currently installed electricity meters (which were used for monitoring electricity generated by the project activity and also electricity consumed by the project activity (electricity generated by the installed captive off-grid electricity generators (fuelled by Diesel) and electricity imported from the SIC grid) during the monitoring periods encompassed by the 1st 7-year crediting period) are calibrated every 2 years.
Purpose of data	Calculation of project emissions.
Additional comment	The captive off-grid backup electricity generators (fuelled by diesel) are used only for emergency purposes. Thus, in the context of ex-ante estimates of emission reductions to be achieved by the project activity, there is no estimated amount of electricity to be generated this generator and/or amount of fossil fuel diesel to be consumed by the generators either. Project emissions due to the consumption of electricity sourced by these generators are thus estimated as zero (null) in the context of ex-ante estimates of emission reductions to be achieved by the project activity. However, such project emissions will be determined ex-post along the crediting period (based on applicable monitoring and calculation requirements as presented in Section B.6.1) and will be accounted for the determination of emission reductions.

Data / Parameter	$FC_{Diesel,y}$
Unit	Liters
Description	Quantity of fuel Diesel combusted by the captive off-grid electricity generator
Source of data	Measurements by the project participants.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period.

Measurement methods and procedures	Measurements using flow meters or volume meters. As an alternative measurements will be based on records of an integrated electronic system of the generator, which shows the percentage of stored fuel Monitoring will be made weekly, recording the operating hours and the percentage of fuel load of equipment, considering the consumption specified by the manufacturer.
Monitoring frequency	Measurements will be aggregated manually or automatically. Accumulated measurement records will be reported at with at least once a week.
QA/QC procedures	Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice.
Purpose of data	Calculation of project emissions.
Additional comment	The captive off-grid backup electricity generators (fuelled by diesel) are used only for emergency purposes. Thus, in the context of ex-ante estimates of emission reductions to be achieved by the project activity, there is no estimated amount of electricity to be generated this generator and/or amount of fossil fuel diesel to be consumed by the generators either. Project emissions due to the consumption of electricity sourced by these generators are thus estimated as zero (null) in the context of ex-ante estimates of emission reductions to be achieved by the project activity. However, such project emissions will be determined ex-post along the crediting period (based on applicable monitoring and calculation requirements as presented in Section B.6.1) and will be accounted for the determination of emission reductions. This parameter will be monitored only if alternative approaches 1 or 3 of the applicable Tool to calculate baseline, project and/or leakage emissions from electricity consumption are selected for determining project emissions consumption of electricity sourced by the captive off-grid electricity generator ($PE_{EC,captive,y}$). Measurements will be cross-checked against receipts of fuel purchasing and/or internal orders of fuel transfering.

Data / Parameter	$\mathbf{NCV_{Diesel,y}}$
Unit	GJ/liters
Description	Net calorific value of the fuel Diesel in year y
Source of data	Value provided by the fuel supplier in invoices, regional or national default values or IPCC default values (at upper limit of uncertainty at 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories[70]).

[70] Any future revision of the IPCC Guidelines will be taken into account

Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period.
Measurement methods and procedures	-
Monitoring frequency	In case values are provided by the fuel supplier in invoices, the applied weighted average annual value will be determined based on provided related information in the context of each individual fuel delivery event. In case regional or national default values or IPCC default values are considered an every year monitoring frequency is applied.
QA/QC procedures	Both values provided by the fuel supplier in invoices as well as regional or national default values will be confirmed to be within the uncertainty range of the IPCC default values (as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines). If the considered values fall below this range, additional information and/or justification will be collected and will be used to justify the outcome. The laboratory(ies) sourcing related measurements or analysis will be confirmed to have ISO17025 accreditation (or it will be justified that it/they can comply with similar quality standards).
Purpose of data	Calculation of project emissions.
Additional comment	This parameter will be monitored only if alternative approaches 1 or 3 of the applicable Tool to calculate baseline, project and/or leakage emissions from electricity consumption are selected for determining project emissions consumption of electricity sourced by the captive off-grid electricity generator ($PE_{EC,captive,}$y).

Data / Parameter	$\mathbf{EF_{CO2,Diesel,y}}$
Unit	tCO_2/GJ
Description	CO_2 emission factor of fuel Diesel in year *y*
Source of data	Value provided by the fuel supplier in invoices, regional or national default values or IPCC default values (at upper limit of uncertainty at 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories)[71]. Appropriate net calorific value (NCV) for LPG may be used for converting energy basis data into mass basis data.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period.
Measurement methods and procedures	-

[71] Any future revision of the IPCC Guidelines will be taken into account.

Monitoring frequency	In case values are provided by the fuel supplier in invoices, the applied weighted average annual value will be determined based on provided related information in the context of each individual fuel delivery event. In case regional or national default values or IPCC default values are considered an every year monitoring frequency is applied.
QA/QC procedures	Both values provided by the fuel supplier in invoices as well as regional or national default values will be confirmed to be within the uncertainty range of the IPCC default values (as per 2006 IPCC Guidelines on National GHG Inventories - applicable value at upper limit of uncertainty at 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy).). If the considered values fall below this range, additional information and/or justification will be collected and will be used to justify the outcome.
Purpose of data	Calculation of project emissions.
Additional comment	This parameter will be monitored only if alternative approaches 1 or 3 of the applicable Tool to calculate baseline, project and/or leakage emissions from electricity consumption are selected for determining project emissions consumption of electricity sourced by the captive off-grid electricity generator ($PE_{EC,captive,}$y).

Data / Parameter	**$EG_{Diesel-Generator,y}$**
Unit	MWh
Description	Quantity of electricity generated in captive diesel backup generator during the year *y*
Source of data	Measurements by the project participants.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 2nd 7-year crediting period.
Measurement methods and procedures	Use authorized electricity meters.
Monitoring frequency	Measurements will be aggregated manually or automatically. Accumulated measurement records will be reported at with at least every-month frequency.
QA/QC procedures	Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer’s recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice.
Purpose of data	Calculation of project emissions.

Additional comment	The captive off-grid backup electricity generators (fuelled by diesel) are used only for emergency purposes. Thus, in the context of ex-ante estimates of emission reductions to be achieved by the project activity, there is no estimated amount of electricity to be generated this generator and/or amount of fossil fuel diesel to be consumed by the generators either. Project emissions due to the consumption of electricity sourced by these generators are thus estimated as zero (null) in the context of ex-ante estimates of emission reductions to be achieved by the project activity. However, such project emissions will be determined ex-post along the crediting period (based on applicable monitoring and calculation requirements as presented in Section B.6.1) and will be accounted for the determination of emission reductions. It is important to note that, if all electricity generated by the backup captive off-grid electricity generators (fuelled by Diesel) are consumed by the project activity, $EG_{Diesel\text{-}Generator,y} = EC_{PJ,captive,y}$.

By referring to a later (the latest) version of the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0), this revised version of the PDD includes a revised monitoring plan that fully meets all monitoring requirements of such later version of the methodology tool. Eventual application of any one of the alternative monitoring approaches named *“data substitution for methane content or biogas flow”* and *“use of a single flow meter for multi-use of recovered biogas*” as per the *”Appendix “Additional data handling and monitoring guidance for determining the mass flow of methane in biogas”* from the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0) along the 2nd 7-year crediting period of the project activity will be performed on the basis of the same monitoring equipment/instruments previously considered at the time of the initial design of the monitoring plan. Furthermore, both alternative monitoring approaches includes methodological monitoring requirements that will have to be fully met as a requisite for accounting of achieved emission reductions due to methane destructions, thus ensuring the required conservativeness of the monitoring and verification processes by not leading to a reduction in the accuracy of calculation of emission reductions to be achieved by the project activity along its 2nd 7-year crediting period. In summary, the revised monitoring plan does not negatively affect the level of accuracy in overall monitoring of the project activity (when compared to related monitoring requirements valid and available prior to the revision of the monitoring plan). The conservativeness of the monitoring and verification process is not negatively impacted either. Furthermore, the performed revision of the monitoring plan is not likely to lead to a reduction in the accuracy of calculation of emission reductions to be achieved by the project activity along its 2nd 7-year crediting period either.

The performed revision of the monitoring plan is summarized in Appendix 6.

B.7.2. Sampling plan

>>
Not applicable

B.7.3. Other elements of monitoring plan

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General monitoring:

The following instruments/equipment will be used to monitor required data along the 2nd 7-year renewable crediting period (depending on the applied measurement options and calculation approaches - to be chosen ex-post)[72]:

Instrument or Source of data	Measurement option		Data monitored	
Appropriate volumetric or mass flow meters (one individual LFG flow meter for each high temperature enclosed flare and/or engine-generator set, with separated measurement data being recorded and reported for each flare and each engine-generator set of the electricity generation infrastructure)[73] [74].	A	Volume flow – dry basis; Volumetric fraction dry or wet basis	$\mathbf{V_{t,db,j}}$	Volumetric flow of LFG stream *j* in time interval *t* on a dry basis (in m^3 dry gas/h).
	C	Volume flow – wet basis; Volumetric fraction wet basis	$\mathbf{V_{t,wb,j}}$	Volumetric flow of LFG stream *j* in time interval *t* on a wet basis (in m^3 wet gas/h).
	D	Mass flow – dry basis; Volumetric fraction dry or wet basis	$\mathbf{M_{t,db,j}}$	Mass flow of LFG stream *j* in time interval *t* on a dry basis (in kg/h).
Continuous CH_4 content gas analyser unit	-		$\mathbf{v_{CH4,t,db/wb,j}}$	Volumetric fraction of methane on the LFG stream in a time interval *t* on a dry or wet basis (in m^3 CH_4/m^3 dry or wet gas)
LFG pressure sensor	**-**		$\mathbf{P_t}$	Pressure of the LFG stream in time interval *t* (in Pa or mbar) Note: $\mathbf{P_t}$ may not be monitored when using LFG flow meters that automatically consider and measures LFG temperature and LFG pressure, thus expressing LFG volumetric or mass flows in normalised units.
LFG temperature sensor	**-**		$\mathbf{T_t}$	Temperature of the LFG stream in time interval *t* (in K or ºC)

[72] Measurement options defined in the Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0.0) when referring to "Adequate volumetric or mass flow meter (s)" and defined in the methodological tool Project emissions from flaring" (Version 02.0.0) in other cases.)

[73] As an alternative monitoring approach, the determination of flow of methane to the project's biogas destruction/utilization devices (i.e flares and/or engine-generator sets) for a specific time interval within the 2nd 7-year crediting period may, as an alternative monitoring approach, be performed by addressing eventually missing data of flow of collected LFG (monitoring parameter $V_{t,db,j}$, $V_{t,wb,j}$, $V_{t,wb,j}$ or $M_{t,db,j}$) and/or methane content in collected LFG (monitoring parameter $v_{CH4,t,wb,j}$ or $v_{CH4,t,db,j}$) through data substitution. Under such circumstances, additional monitoring requirements as described below in this Section under *"Data substitution for methane content or biogas flow"* are to be considered as a condition for accounting of related achieved GHG emission reductions.

[74] As an alternative monitoring approach, single or reduced number of LFG flow meters may be utilized (instead of applying an individual LFG flow meter for each LFG consuming element of the electricity generation infrastructure (each engine generator set) and/or each flare) in case monitoring approach as per Item *2.* "*Use of a single flow meter for multi-use of recovered biogas"* from "*Appendix. - Additional data handling and monitoring guidance for determining the mass flow of methane in biogas*" of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is selected. Under such circumstances, additional monitoring requirements as described below in this Section under *"Use of a single flow meter for multi-use of recovered biogas*" are to be considered as a condition for accounting of related achieved GHG emission reductions.

Instrument or Source of data	Measurement option	Data monitored	
			Note: T_t may not be monitored when using LFG flow meters that automatically consider and measures LFG temperature and LFG pressure, thus expressing LFG volumetric or mass flows in normalised units.
Electricity meter	-	$EC_{PJ,y} = EC_{grid,y}$	Amount of grid electricity consumed by the project activity in year *y* (in MWh)
		$EC_{PJ,captive,y}$	Quantity of electricity generated in captive diesel backup generator during the year *y* (in MWh)
		$EC_{BL,y} = EG_{PJ,y}$	Amount of electricity generated using LFG by the project activity in year *y* (in MWh)
Mass/weight scale		$FC_{LPG,y}$	Amount of LPG consumed by the project activity in year *y* (in ton)
	Approach 1 or 3	$FC_{Diesel,y}$	Quantity of fuel Diesel combusted by the captive off-grid electricity generator (in liters)
Not based on measurements performed in the context of operation and monitoring for the project activity	-	$p_{H20,t,Sat}$	Saturation pressure of H_2O at temperature T_t in time interval *t* This parameter is solely a function of the LFG stream temperature T_t and can be found at referenced literature.
Not based on measurements performed in the context of operation/monitoring for the project activity	-	**Management of SWDS**	Management of SWDS The design and operational conditions of the landfill will be annually monitored on the basis of different sources, including *inter alia*: - Original design of the landfill; - Technical specifications for the management of the landfill; - Applicable local or national regulations
Meter or equipment electronics	-	$Op_{j,h}$	Operation of the equipment that consumes LFG (engine-generator sets of the electricity generation facility). For each engine-generator set *j* using LFG, it will be continuously monitored whether the equipment is operating in hour *h* by monitoring any one the following sub-parameter/condition: - Amount of electricity generated in hour h - Status of the engine-generator set during each hour *h*.
Not based on measurements Monitoring performed in the context of operation/monitoring for the project activity (based on		$NCV_{LPG,y}$	Net calorific value of the fuel LPG in year y (in GJ/ton LPG). Data will be determined as per applicable guidance of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.

Instrument or Source of data	Measurement option	Data monitored	
calculations)			
Not based on measurements Monitoring performed in the context of operation/monitoring for the project activity (based on calculations)	**Approach 1 or 3**	**$NCV_{Diesel,y}$**	Net calorific value of the fuel Diesel in year y (in GJ/ton LPG). Data will be determined as per applicable guidance of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.
Not based on measurements Monitoring performed in the context of operation/monitoring for the project activity (based on calculations)		**$EF_{CO2,LPG,y}$**	CO_2 emission factor of fuel LPG in year *y* (in tCO_2/GJ). Data will be determined as per applicable guidance of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.
Not based on measurements Monitoring performed in the context of operation/monitoring for the project activity (based on calculations)	**Approach 1 or 3**	**$EF_{CO2,Diesel,y}$**	CO_2 emission factor of fuel Diesel in year *y* (in tCO_2/GJ). Data will be determined as per applicable guidance of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.
Measurements undertaken by a third party accredited entity	**B.1**	**$F_{CH4,EG,t}$**	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period *t* (kg) For each one of the installed high temperature enclosed flare, it will be measured the mass flow of methane in the exhaust gas according to an appropriate national or international standard (e.g. UKs Technical Guidance LFTGN05). 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 Monitoring of this parameter is only required in the case the project participants select Option B.1 to determine the efficiency values for the high temperature enclosed flares.
Thermocouples	**A or B.1**	**$T_{EG,m}$**	Temperature in the exhaust gas of the enclosed flare in minute *m* (ºC) For each one of the installed high temperature enclosed flare, it will be continuously measured the temperature of the exhaust gas through use of appropriate temperature measurement instrument (e.g. thermocouples). Measurements outside the operational temperature specified by the flare manufacturer may indicate that the flare is not functioning correctly and may

Instrument or Source of data	Measurement option	Data monitored	
			require maintenance or repair work. For each flare, the temperature of the exhaust gas in each flare have to be measured in a suitable monitoring port. In high temperature enclosed flares, monitoring ports are normally expected to be located within the middle third of the flare. In case more than one temperature port is fitted to the high temperature enclosed flare, the flare manufacturer must provide written instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the operation of the flare according to manufacturer's specifications for temperature of exhaust gas. The four high temperature enclosed flares currently installed as part of the project activity only have one monitoring port for temperature of the exhaust gas. Measurements are required to determine if manufacturer's flare specifications for operating temperature are met.
Project participants	**A or B.1**	**$Flame_m$**	Flame detection of flare in the minute *m* (Flame "*on*" or Flame "*off*") For each installed high temperature enclosed flare, continuous monitoring of flame detection through use of appropriate installation (e.g. optical flame detector (using ultra violet or infra red technology or both).
Project participants	**B.1**	**$Maintenance_y$**	Maintenance events completed in year *y* (Calendar dates) for each one of the high temperature enclosed flare combusting LFG. For each installed high temperature enclosed flare, record the date when maintenance events are performed in year *y*. Records of maintenance logs will include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced/repaired, or needing to be replaced, source of replacement parts, serial numbers and related calibration certificates.
Project participants	**-**	**Status of biogas**	Records of electricity generation and/or operation of the flare(s) (by means of a

Instrument or Source of data	Measurement option	Data monitored	
		destruction device[75]	flame detector(s)) are to be used in order to demonstrate/confirm the occurrence of destruction/utilization of methane by the biogas destruction/utilization device(s) in question (engine generator set and/or flare) Emission reductions will be not accrued for periods in which the LFG destruction/utilization device(s) is/are not demonstrated/confirmed to be under operational status [76].

During the 2nd 7-year crediting period, all continuously measured LFG related parameters as well as measurements related to the exhaust gas of the flares (temperature in the exhaust gas of the flares and eventually other parameters related to flare operational conditions) will all be recorded electronically via an appropriate data logger / data acquisition system (to be located within the site boundary). The data logger / data acquisition system will have the capability to record all data in a safe and reliable manner (thus ensuring the required data reliability and validity). Data recording and reporting frequency for these parameters will be at least every one minute.

Records of electricity consumed and generated by the project activity will also be recorded electronically via an appropriate data logger / data acquisition system (to be located within the site boundary). Data from related electricity purchase invoices (issued by local electricity distribution company) will also be used as cross-checking.

During the 2nd 7-year crediting period, records of quantity of LPG consumed by the project activity will remain being aggregated manually or automatically (depending on the specifications of related measurement instrument to be applied). Accumulated related measurement records will be reported at with an at least every-month frequency. Data from related LPG purchasing receipts or invoices (to be issued by local LPG distribution company) will also be used as cross-checking.

By the use of appropriate software application, recorded monitoring data will be regularly retrieved, aggregated and reported in order to be considered in the context of calculations of emission reduction achieved by the project activity.

Monitoring records available in the data logger / data acquisition system might be regularly retrieved remotely by modem or directly on site. If automatic data logging by the logger / data acquisition system fails, measurement data might be recorded manually (whenever it is possible). If data is not properly recorded or cannot be retrieved, no emissions reductions will be claimed for the period encompassing such data recording/reporting failure.

During the 2nd 7-year crediting period, all monitoring data will remain being recorded and backed-up in a central database. As per the applicable monitoring procedure, data records will be summarized into emission reduction calculations prior to each periodic CDM verification during the 2nd crediting period. All data recorded by the data logger / data acquisition system will be made

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[75] As established by the applied methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0), the monitoring parameter “Status of biogas destruction device” is applicable for both the project’s high temperature enclosed flares (hereby regarded as “*biogas destruction devices*”) and for the engine-generator sets of the project’s electricity generation infrastructure (hereby regarded as “*biogas utilization devices*”). Thus, despite of its name/description, monitoring details for this particular monitoring parameter includes both the terms “*biogas destruction device(s)*” and “*biogas utilization device(s)*” for sake of completeness and transparency and are thus applicable for both types of devices.

[76] In the particular case of the engine-generator sets of the project’s electricity generation infrastructure, monitoring and documenting related to such biogas utilization devices may be performed inter alia on the basis of applicable monitoring requirements for the monitoring parameter “Operation of the equipment that consumes LFG (engine-generator sets of the project’s electricity generation facility)” ($Op_{j,h}$).

available to the Designated Operational Entities (DOEs) responsible for each periodic verification. This will ensure that data integrity and reliability for related monitoring data.

As per the monitoring procedure adopted by KDM S.A., access to monitoring data will be restricted and controlled. All monitoring records will be kept archived until at least two years after the end of the crediting period or at least two years after the last issuance of CER's for the project activity, whichever occurs later.

It will be the responsibility of the appointed monitoring team manager to ensure that all monitoring data is properly measured and recorded as part of operation of the project activity.

Technical specifications for monitoring instruments/equipment (e.g. manufacturer, model, serial numbers, accuracy, etc.) will be detailed in the Monitoring Reports for each periodic verification.

Maintenance and calibration for monitoring instruments/equipment and project's equipment/components in general:

During the 2nd 7-year crediting period, all maintenance service and routines will include all preventive and corrective actions necessary for ensuring good functioning of all project related equipment, such as:

- Visual control of the equipment state and real-time check of displayed parameters,
- Cleaning up the equipment and the sensors,
- Lubrication and greasing,
- Replacement or overhauling of defective parts (including regular welding service in the HDPE pipelines and manifolds).

Calibration events in monitoring instruments/equipment will be periodically and appropriately performed as per applicable frequency, procedures and methods established or recommended by instrument/ equipment manufacturer, applicable national/international standards and/or best practice, as available.

General malfunction of equipment: if monitoring instruments/equipment or project's equipment/components present failure or malfunction, applicable repair or replacement actions will be carried out. Spare units for some of the monitoring instruments/equipment may be kept on site.

Project's operational and management structure:

An appropriate project's operational and management structure will be made available as part of the operation of the project activity during the 2nd 7-year crediting period.

The project's operational and management structure will rely on trained staff with responsibilities clearly defined. All collaborators and employees involved with operation of project and/or monitoring will be trained internally and/or externally. Training efforts may include *inter alia*:

a) General competence development about LFG generation and collection;
b) Review of equipment operational principles and captors;
c) Maintenance and calibration requirements for project's related equipment;
d) Procedures for monitoring data gathering and handling;
e) Emergency and safety procedures;

The monitoring plan will be implemented during the 2nd 7-year crediting period by reflecting the best practice in terms of monitoring efforts for LFG collection and destruction project based initiatives under de CDM.

Selection of alternative monitoring approaches as per provisions of the Appendix "Additional data handling and monitoring guidance for determining the mass flow of methane in biogas" from the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0):

Data substitution for methane content or biogas flow: if required, the determination of flow of methane to the project's biogas destruction/utilization devices (i.e. flares and/or engine-generator sets) for a specific time interval within the 2nd 7-year crediting period may, as an alternative monitoring approach, be performed by addressing eventually missing data of flow of collected LFG (monitoring parameter $V_{t,db,j}$, $V_{t,wb,j}$, $V_{t,wb,j}$ or $M_{t,db,j}$) and/or methane content in collected LFG (monitoring parameter $v_{CH4,t,wb,j}$ or $v_{CH4,t,db,j}$) through data substitution as per provisions of *Item 1. "Data substitution for methane content or biogas flow"* of *"Appendix - Additional data handling and monitoring guidance for determining the mass flow of methane in biogas*" of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)[77].

[77] Item *1. "Data substitution for methane content or biogas flow"* of *"Appendix. Additional data handling and monitoring guidance for determining the mass flow of methane in biogas"* of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) establishes the following:

> *(…) If missing data are encountered in the course of determining the methane mass flow, it may be substituted with conservative data sets (see below) from specific periods. However, data substitution shall only be applied to either the methane concentration or the biogas volumetric flow readings, but not to both simultaneously. If data is missing for both parameters during a given period of time, no data substitution shall be allowed for that period.*
>
> *Substitution as outlined in Table 1 below may be undertaken only if the following conditions are met:*
>
> *(a) For methane concentration, biogas flow rates during the period where data gap occurred (data gap period) shall be consistent with normal operation (i.e. the average flow rates during the gap period shall not deviate from the average flow rates of the period taken for data substitution (data substitution period)1 by more than +/- 20%); and*
>
> *(b) For biogas flow rate, methane concentration during the data gap period shall be consistent with the methane concentration observed during normal operations (i.e. the average methane concentration during the data gap period shall not deviate from the average methane concentration of the data substitution period by more than +/- 20%); and*
>
> *(c) Project participants shall demonstrate that the methane is being destroyed during the period of the data gap. If corroborating parameters fail to demonstrate any of these requirements, no substitution shall be allowed.*

Table 1. Data substitution procedure

Duration of missing data	*Data Substitution procedure*
Less than six hours	*Use the weighted average of the four hours period immediately before and four hours period immediately after the outage*
Six to 24 hours	*Use the upper bound or lower bound of 95% confidence interval of the data spanning 24 hours prior to and 24 hours after the outage, whichever results in more conservative estimate of emission reductions*
One to seven days	*Use the upper bound or lower bound of 95% confidence interval of the data spanning 72 hours prior to and 72 hours after the outage, whichever results in more conservative estimate of emission reductions*
Greater than one week	*No data may be substituted*

(…)"

"Use of a single flow meter for multi-use of recovered biogas": measurements of collected LFG supplied to a set of available/operational biogas destruction/utilization devices (i.e flares and/or engine-generator sets) may, as an alternative monitoring approach, be performed by a single or reduced number of LFG flow meters (instead of applying an individual LFG flow meter for each particular biogas destruction/utilization device) (with related measurements from such single or reduced number of LFG flow meters being performed as per monitoring requirements valid for the monitoring parameters $V_{t,db,j}$, $V_{t,wb,j}$, $V_{t,wb,j}$ or $M_{t,db,j}$). In case this alternative monitoring approach is selected during any time interval within the 2nd 7-year crediting period, applicable monitoring requirements valid/applicable specifically for the use of a single or reduced number of LFG flow meters[78] are required to be met as follows as a requisite for accounting of related emission reductions:

As part of the application of the project's monitoring system, the following requirements should be met:

(i) It has to be ensured that within each section of the project's LFG supply pipeline that directs LFG towards each individual flare and to each individual engine-generator, there will always be an individual safety valve installed/located within such pipeline section and prior to the device in question (that automatically closes whenever the biogas destruction/utilization device to which LFG is directed to becomes under non-operational status) and/or

(ii) It has to be ensured that the biogas destruction/utilization device(s) (for which collected LFG is measured by the single or reduced number of flow meters) is/are designed in such a manner that it is physically impossible for the gas to pass through and into the atmosphere while the device remains non-operational.

Thus, as part of the project monitoring system, it is a requisite ensure and make demonstrable that due to requirement (i) or (ii) it is not possible having collected LFG being

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[78] Appendix "*Additional data handling and monitoring guidance for determining the mass flow of methane in biogas*" from the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) (under the sub-section "*Use of a single flow meter for multi-use of recovered biogas*") includes the following monitoring requirements:

> *"(…) If the recovered biogas (e.g. landfill gas) 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, emission reductions from methane destruction for these periods may be claimed provided that verification confirms the fulfilment of all the following conditions indicated below. In such a case, the destruction efficiency of the least efficient destruction device in operation shall be used as the destruction efficiency for all destruction devices monitored by this single flow meter:*
>
> > *(a) All destruction devices are either equipped with valves on the input gas line that close automatically (e.g., normally closed valves) if the device becomes nonoperational (i.e., requiring no manual intervention), or designed in such a manner that it is physically impossible for the gas to pass through and into the atmosphere while the device remains non-operational; and*
> >
> > *(b) For any period where one or more destruction devices within this arrangement are not operational, it shall be demonstrated that the remaining operational devices have the capacity to destroy the actual gas flow recorded during the period. For devices other than flares, it shall be shown that the output corresponds to the flow of gas (e.g., through mass and/or energy balance).*
>
> *Measurement of methane content shall be conducted immediately downstream of the flow meter, while respecting the installation requirements of the flow meter. (…)"*

passed through (vented through) any one of the project's biogas destruction/utilization devices whenever they are under non-operational status. In such way, for each future monitoring period within the 2nd 7-year crediting period, it should be made confirmable that no collected LFG has been able to be eventually directly emitted into (vented through) the atmosphere through a non-operational project's flare and/or engine-generator set.

Furthermore, also a part of the project monitoring system, it should also be made confirmable/demonstrable that whenever any biogas destruction/utilization device or set of devices is/are under operational status (destroying/utilizing LFG), all collected LFG directed towards such device(s) is indeed be combusted/destroyed.

Such confirmation/demonstration is required to be done through the following approaches:

- Records of electricity generation and/or operation of the flare(s) (by means of a flame detector(s)). In the particular case of the engine-generator sets, it will be demonstrated that electricity generation (as the output from operation of such devices) is correspondent to the flow of LFG actually consumed by the devices.
- For any minute *m* where one or more biogas destruction/utilization devices connected downstream to such single or reduced number of LFG flow meter(s) (i.e. engine-generator set(s) and/or flare(s)) is/are not operational, it is to be demonstrated that the set of remaining device(s) under operational status (destroying/utilizing LFG) do has/have the quantitative capacity to combust the amount of LFG flow being sent to such device(s) during such minute *m* (as measured by the single or reduced number of flow meters).

Finally, it will also be required to make confirmable/demonstrable that measurement of methane content of collected LFG (monitoring parameter $v_{CH4,t,wb,j}$ or $v_{CH4,t,db,j}$) is conducted immediately downstream of the applied single or reduced number of LFG flow meters, while respecting the installation requirements of such LFG flow meter(s).

By referring to a later (the latest) version of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0), this revised version of the PDD includes a revised monitoring plan that fully meets all monitoring requirements of such later version of the methodology tool. Eventual application of any one of the alternative monitoring approaches named *"data substitution for methane content or biogas flow"* and *"use of a single flow meter for multi-use of recovered biogas*" as per the *"Appendix "Additional data handling and monitoring guidance for determining the mass flow of methane in biogas"* from the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) along the 2nd 7-year crediting period of the project activity will be performed on the basis of the same monitoring equipment/instruments previously considered at the time of the initial design of the monitoring plan. Furthermore, both alternative monitoring approaches include methodological monitoring requirements that will have to be fully met as a requisite for accounting of achieved emission reductions due to methane destructions, thus ensuring the required conservativeness of the monitoring and verification processes by not leading to a reduction in the accuracy of calculation of emission reductions to be achieved by the project activity along its 2nd 7-year crediting period. In summary, the revised monitoring plan does not negatively affect the level of accuracy in overall monitoring of the project activity (when compared to related monitoring requirements valid and available prior to the revision of the monitoring plan). The conservativeness of the monitoring and verification process is not negatively impacted either. Furthermore, the performed revision of the monitoring plan is not likely to lead to a reduction in the accuracy of calculation of emission reductions to be achieved by the project activity along its 2nd 7-year crediting period either.

The performed revision of the monitoring plan is summarized in Appendix 6.

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

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Completion date for the application of ACM0001 (version 15.0) for the renewal of crediting period: 30/07/2014.
Responsible entity / person:
Nuno Barbosa
nuno@unicarbo.com.br
UniCarbo Energia e Biogás Ltda.
São Paulo, Brazil

Revised version of the PDD (version 1.5.1, dated 14/03/2017) addressing the following as post-registration changes:

- Consideration/utilization of alternative monitoring approaches as per "Appendix - Additional data handling and monitoring guidance for determining the mass flow of methane in biogas" of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) (as revision of the monitoring plan from the registered PDD).
- Corrections in information (that do not affect the project design).

Further details are included in Appendix 6

Responsible entity / person:
Nuno Barbosa
nuno@unicarbo.com.br
UniCarbo Energia e Biogás Ltda.
São Paulo, Brazil

This revised version of the PDD (version 1.6, dated 24/06/2017) addressing as the following post-registration changes:

Corrections (in information that do not affect the project design):

- Missing default value (applicable for generated electricity exported through the electricity grid the project activity is connected to) is added in details for the ex-ante determined (fixed) parameter "Average technical transmission and distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the project activity" ($TDL_{grid,y}$) in Section B.6.2. Furthermore, while the previously selected 20% default value became applicable only for grid-sourced electricity imported by the project activity and is termed as $TDL_{grid,import,y}$, the added 3% missing default value is termed as $TDL_{grid,export,y}$. Texts in Sections B.6.1 and B.6.3 are adjusted accordingly.

- Calculations of ex-ante estimates of emission reductions to be achieved by the project activity during the 2nd 7-year crediting period are corrected in both Section B.6.3 and in a revised version of the emission reduction calculation spreadsheet (that is enclosed to the PDD) by taking into account the missing 3% default value for the ex-ante determined (fixed) parameter $TDL_{grid,y}$ (value applicable for generated electricity exported through the electricity grid the project activity is connected to).

- Details for the project participants of project activity are updated (as per the latest version of the completed Modalities of Communication (MoC) form for the project activity).

- The estimated annual values for the monitoring parameter "Amount of electricity generated using LFG by the project activity in year *y*" ($EC_{BL,y}$) (applicable for years 2014 – 2021) are correctly reported in Section B.7.1.

Further details are included in Appendix 6

Responsible entity / person:
Nuno Barbosa
nuno@unicarbo.com.br
UniCarbo Energia e Biogás Ltda.
São Paulo, Brazil

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
The project is expected to be operational on January 31st, 2007.[79]

C.1.2. Expected operational lifetime of project activity

>>
21 years. While the project activity started to operate in March 2007, the currently expected remaining operational lifetime for the project activity is about 14 years.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>
While the project activity applies 7-year renewable crediting period option, this PDD is thus valid for the 2nd 7-year renewable crediting period.

C.2.2. Start date of crediting period

>>
The 2nd 7-year renewable crediting period starts on 17/03/2014 or the assumed renewal date of the crediting period renewal (as per the procedures applied by UNFCCC), whichever is earlier.

C.2.3. Length of crediting period

7-year renewable.

[79] The project starting date as per its definition in the UNFCCC's "Glossary of CDM Terms" is 07 February 2006 (date when purchase order of the first enclosed flare was issued and approved by KDM S.A.)

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

Landfill gas collection, treatment and flaring are measures to improve the environmental management of solid wastes in landfills. The detailed design and engineering of the proposed project will be conducted by KDM and a leading consulting company on landfill gas management.

The project implementation would provide a number of local environmental benefits in addition to climate change mitigation:

- Destruction of non-methane hydrocarbons (NMOC) that contribute to photochemical smog in the local area. Moreover, volatile organic compounds are burnt in high-temperature flare, specially designed for this purpose.
- Destruction of air pollutants, such as hydrogen sulphide, that are sometimes present in landfill gas in trace quantities in LFG.
- Reduced fire and explosion risk through improved management of landfill gas.
- Reduced odour as landfill gas is captured and flared.
- Avoidance of methane leaking through the landfill cover. LFG displaces oxygen in the soil, thereby harming the roots of plants. Plants on the landfill surface protect the cover soil from erosion. Erosion can lead to rainwater intrusion into the landfill and a consequent increase in leachate quantities. Erosion of the surface soil makes it more difficult for plants to grow. Plants promote transpiration of water, thereby minimizing both leachate and rainwater runoff.

Note that LFG combustion generates small amounts of nitrogen oxides (NO_x), particulate matter and carbon monoxide (CO), as would be the case in the kitchen stove or any other combustion device burning natural gas. The emissions of such gases are regulated in order to maintain air quality and the project would meet the relevant regulations. Regarding project emissions, the recently approved environmental license, "Resolución de Calificación Ambiental - RCA Nº 391", established that KDM S.A. will have a compensation plan for all the emissions involved. To this end, the project would use enclosed flares specially designed to reduce these emissions to levels below that of an open flame. Note, however, that since the main fuel is methane, the emissions of particulate matter (e.g. PM10) would be minimal. On the other hand a LFG flare is especially designed to operate at high temperature in order to burn the volatile organic compounds.

Note that the Environmental License (RCA 391/2006) issued on 29 June 2006 to the landfill operator (project sponsor) allows for power generation but with a maximum power output of 3 MW (valid/applicable for the CLLC-1 electricity generation facility). In mid 2006, it was assumed that when at the time of increase of installed electricity generation capacity, the corresponding permits are to be requested to the Ministry of the Environment (former CONAMA)[80].

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[80] In June 2012, the project activity had the following status related to compliance with environmental permits and regulations:

- The project was granted with the Environmental license registered under Resolution N°344/2010, enabling power generation up to 28MW (valid/applicable for CLLC-2 electricity generation facility). This environmental permit was issued by CONAMA in May 2010.
- The environmental license for the CLLC-2 electricity generation facility (Resolution N°344/2010) refers to a max. electricity generation capacity of up to 28 MW since it was issued on 17/05/2010 by taking into consideration the maximum nameplate installed capacity to be encompassed by such facility as per preliminary design information made available at the time of the conduction of such environmental licencing process (within years 2009 and 2010). Since the CLLC-2 facility is expected to have its total nameplate installed capacity exceeding 28 MW limit established in its environmental licencing by year 2022 (upon the forecasted installation of its 20th engine-generator set of nameplate installed capacity of 1.413 MW), whenever it is applicable/required, a process for an eventual review/correction of the previously granted environmental permit document may be opportunely conducted through applicable procedures and rules with the competent environmental authorities in Chile. Despite of the incorrect/non-updated reference to the maximum allowed nameplate installed capacity for the CLLC-2 facility included in its environmental licensing document (Resolution N°344/2010), the CLLC-2

D.2. Environmental impact assessment

>>

The Environmental License (RCA 391) establishes that the project has environmental impact through the following components: air (atmospheric emissions, odors, and noise), water, soil and adjacent roadways.

It is KDM's responsibility to monitor and/or take into account relevant environmental impacts, by implementing a series of measures to meet complying of environmental standards applicable to the project. In broad terms, these measures cover:

- Minimize atmospheric emissions associated with project construction and operation, through the use of wet processes, irrigation, covered transport, washing vehicles, and in general, following the indications of the national legislation applicable to processes of this nature.
- Monitor emissions of particulate matter, nitrogen oxides (NO_x) and carbon monoxide, as indicated in the RCA 391, with respect to frequency of measurement and measurement procedures. To this end, the company must design a plan for the compensation of environmental emissions, i.e. generate an effective reduction in emissions that are quantifiable and additional, valid for the project and registered with the environmental authorities once the plan has been approved by the authorities. This plan for compensations should include a comprehensive monitoring program that has been submitted to the authorities. ***Note that this emissions compensation program is analogous to the CDM, but applicable to local air pollutants. Chile is the only developing country in the world with such a program in operation.***
- LFG capture efficiency should be subject to the safety of landfill operation and landfill stability. Periodic analysis of the latter must be undertaken. Note that the Environmental Authority has stated in the RCA that "*currently landfill gas is extracted mainly to control the internal pressure within the landfill and reduce risks of local accumulations that could lead to undesirable surface fires. These objectives have been satisfactorily met with the quantity of LFG historically and currently captured and flared.*"

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

Stakeholder comments for the Loma Los Colorados Landfill Gas Project are sought in two ways:

1) Through a questionnaire/survey sent to all potential stakeholders (see list below).
2) During two special public events that were held in August 2005 in an hotel in Santiago and at the landfill (Montenegro). Stakeholders invited in step 1 were invited to the event, which were also open to the public in general, permitting an opportunity of all persons and institutions who feel affected by the project to provide their input to the proposed project activity.

The following set of questions was presented to stakeholders, during this event:

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facility is currently operating under full compliance with all valid and applicable environmental requirements defined by the competent environmental authority in Chile.

1) With reference to climate change, the Kyoto Protocol and the Clean Development Mechanism, briefly express your opinion on the "Loma Los Colorados Landfill Gas Project".
2) Would you recommend private companies, government authorities and other organizations to develop projects of this nature: the capture and flaring and/or use of landfill gas?
3) Do you believe "Loma Los Colorados Landfill Gas Project" will contribute to the social, economic and environmental development (Sustainable Development) of Chile?
4) Do you believe that the project would contribute to the sustainable development of Til-Til "Comuna"?
5) Are there any additional comments you would like to make?

The invitation process to participate in the stakeholder consultation was as follows:

At the end of July 2005, an e-mail was sent to the persons listed in the table below inviting them to participate at an event in Santiago on August 2, 2005. Invitees were requested to extend the invitation to anyone else that might be interested.

The August 2 meeting, held at a hotel en Santiago, was attended by about 40 persons from public and private institutions, universities, NGOs, companies interested in the energy use of landfill gas, companies related to the CDM, equipment suppliers, independent consultants, etc. The presentation included a brief description of CDM and a more detailed description of the proposed project. A brochure on the project was also distributed. Following the presentation, the audience was given the option of asking questions and providing opinion verbally; later the questionnaire with the questions mentioned above were also distributed. Some responses were received on the spot, while others sent them in by fax.

On August 5, 2005 an e-mail was sent to everyone originally invited and others that participated, and a web link was provided where they could download additional information on the project. They were give two weeks (until August 17) to provide additional comments. This constituted the first consultation process.

With respect to the consultation with the local community, landfill operator (KDM) staff contacted the head of the Community Association of Montenegro and invited participation at an event on August 12, at a meeting room located at the landfill site.

Twelve persons from the community participated at the event, which was conducted in a manner similar to that in Santiago, with the difference that e-mail was not used to send additional material, unless this was requested.

The following persons were invited to attend the meetings and to submit comments:

Name	Position	Company/Institution	Events Attendants
Marcela Main	Coordinadora Cambio Climático, Dirección Ejecutiva (Climate change affairs, coordinator Executive Directory)	CONAMA – Comisión Nacional de Medio Ambiente	
Javier García	Ingeniero Civil Industrial, Depto. Control de la Contaminación (Industrial civil engineer, department of contamination control)	CONAMA	Yes
Genaro Rodríguez	Area Residuos (Area of waste)	CONAMA	

Joost Meijer	Area Residuos (Area of waste)	CONAMA	
Pablo Badenier	Director CONAMA RM	CONAMA RM – Comisión Nacional de Medio Ambiente para Región Metropolitana (CONAMA RM – National environmental comission for the metropolitan región)	
Ivo Kovacic	Jefe de Area Evaluación de Impacto Ambiental (Chief of area of environmental impact evaluations)	CONAMA RM	
Cristián Araneda	Area Evaluación de Impacto Ambiental (Area of environmental impact evaluations)	CONAMA RM	
Gonzalo Velásquez	Jefe de Area Residuos Sólidos (Chief of area of solid waste)	CONAMA RM	
Marcelo Fernández	Jefe de Area Calidad del Aire (Chief of area for air quality)	CONAMA RM	Yes
		CONAMA RM	Yes
Juan Antonio Muñoz	Jefe de SEREMI Obras Públicas (Chief of SEREMI public infrastructure development)	MOP – Ministerio de Obras Públicas (MOP – Ministry of public infrastructure development)	Yes
Mirza Lemus	-	MOP	Yes
Benjamín Araneda	-	SAG - Servicio Agrícola Ganadero (SAG – Service for agriculture and cattle ranching)	-
Cristián Calderón	Jefe Unidad de Residuos Sólidos (Chief of solid waste unit)	SEREMI Salud (SEREMI Healthcare)	-
Marta Zamudio	Jefe (Subrogante) Depto. Acción Sanitaria (Chief, department of sanitary action)	SEREMI Salud (SEREMI Healthcare)	-
Yorka Retamal	Jefe Depto. Gestión Ambiental Chief, department of environmental management)	SEREMI Salud (SEREMI Healthcare)	-
Omar Cáceres	Jefe (Subrogante) Subdepto. Entorno Saludable (Chief, sub-department of healthy suroundings)	SEREMI Salud (SEREMI Healthcare)	-
José Miguel Arriaza	Depto. Gestión Ambiental (Department of Environmental management)	SEREMI Salud (SEREMI Healthcare)	Yes

Rodrigo Rivera	-	SEREMI Salud (SEREMI Healthcare)	Yes
Alejandra Hernández	-	SEREMI Salud (SEREMI Healthcare)	
Magdalena Arancibia	-	SEREMI Salud (SEREMI Healthcare)	
Soledad Ubilla	Jefe División Políticas Públicas (Chief Division of Public Policies)	MINSAL – Ministerio de Salud (MINSAL – Ministry of Healthcare)	
Jaime Bravo	Jefe del Area Medio Ambiente y Eficiencia Energética (Chief of area of environmental affairs and energy efficiency)	CNE - Comisión Nacional de Energía (CNE – Energy National Commision)	
Luis Cifuentes	Jefe Centro Medio Ambiente, Escuela Ingeniería (Chief of the environmental studies center, Engineering School)	PUC - Pontificia Universidad Católica de Chile	
César Saez	Profesor Centro de Medio Ambiente, Escuela Ingeniería (Lecturer of the environmental studies center, Engineering School)	PUC	
Enzo Sauma	Profesor Centro de Medio Ambiente, Escuela Ingeniería (Lecturer of the environmental studies center, Engineering School)	PUC	
Juan de Dios Rivera	Profesor del Departamento de Ingeniería Mecánica y Metalúrgica (Lecturer within the department of Mechanical and metalurgic engineering)	PUC	
Orelvis González	Jefe Sector Energía Sustentable (Chief, Sector for sustainable energy)	PUC	
Raúl O'Ryan	-	Universidad de Chile	
Leandro Herrera	-	Universidad de Chile	
José Hernández	-	Universidad de Chile	
Marcel Szantó	Ingeniería en Contrucción (Construction engineer)	UCV - Pontificia Universidad Católica de Valparaíso	
Juan Palma	Ingeniería en Contrucción (Construction engineer)	UCV	
Paola Conca	Gerente de Medio Ambiente (Environmental manager)	ProChile	Yes
Ana María Ruz	Director Programa Energía Sustentable	Fundación Chile	Yes

	(Director for the programme in sustainable energy)		
Javier Obach	-	Fundación Chile	Yes
Marcela Angulo	Director General (General director)	Fundación Chile	Yes
Jaime Dinamarca	Gerente de Medio Ambiente (Environmental manager)	SOFOFA – Sociedad de Fomento Fabril	
Manlio Coviello	Expert Natural Resources Division	CEPAL – Comisión Económica para América Latina	
Ignacio Vergara		Consultor Independiente	Yes
Andrés Gómez Lobo		Consultor Independiente	
Orlando Jiménez		CORFO – Corporación de Fomento	Yes
Francisco Albornoz		CORFO	Yes
Arturo Brandt		Poch Ambiental	
Ian Nelson	Gerente Area Grandes Clientes (Manager for area of key clients)	Metrogas S.A.	Yes
Oscar Uribe	Subgerente de Estudios (Sub-manager for studies and evaluations)	Metrogas S.A.	
Gerardo Muñoz	Subgerente Area GNC y Climatización (Sub-manager for area of CNG and climatization)	Metrogas S.A.	Yes
Francisco Richards	Area Grandes Clientes (Key client area)	Metrogas S.A.	Yes
Sebastián Bernstein	Ingeniero de Estudios (Engineer for studies and evaluations)	Metrogas S.A.	
Matías del Río	Jefe Comunidades y Centrales Térmicas (Chief, Communities and termal power plants)	Metrogas S.A.	Yes
Alejandro Sáez	-	Gas Atacama	Yes
Fernando Urrutia	-	Gas Atacama	Yes
Nicole Porcile	-	Cementos Polpaico	
Patricia Grüebler	-	SGS Chile	Yes
Mónica Aedo	Gerente de Sector Servicios Ambientales (Manager, Environmental Services sector)	SGS Chile	
Edgardo Devoto	-	DNV	
Manuel Antonio Pérez	Representante en Chile (Representative in Chile)	LFG Specialties	Yes
Fernando Azofeifa	-	Banco Santander Santiago	
José Vargas	Ingeniero Proyectos (Project engineer)	Pyros	Yes

Mario Solís	Area Negocios y Ventas (Area for business and sales)	Pyros	Yes
Patricio Ossandón	Ingeniero de Proyectos (Project engineer)	Pyros	Yes
Carlos Gebert	-	Sumitomo	
Alvaro Acevedo	Gerente General (General manager)	Queulat	Yes
César Contreras	-	Gasco	
Alfredo Becerra	Gerente General (General manager)	Geoandina	Yes
Jean Francois Bradfer	Gerente General (General manager)	AS&D Consultores	Yes
Matías Errázuriz	-	Wetland	
Claudia Parra Q.	-	Montenegro	Yes
Eliana Ayala G.	-	Montenegro	Yes
María Elisa Tobar F.	-	Montenegro	Yes
Miriam Toro G.	-	Montenegro	Yes
Liliana González A.	-	Montenegro	Yes
Olga Berríos A.	-	Montenegro	Yes
Name unknown	-	Montenegro	Yes
Name unknown	-	Montenegro	Yes
Name unknown	-	Montenegro	Yes
Name unknown	-	Montenegro	Yes

E.2. Summary of comments received

>>

All of the comments were made in Spanish. Following is a summary of translated comments.

Question 1: With few exceptions, the commenters expressed the opinion that the project should be implemented and that the project would be a positive development. A few commenters expressed the opinion that energy recovery should be emphasized in implementing a LFG recovery project. One expressed a preference for cogeneration.
One stakeholder expressed the following opinion: KDM's proposed activities are too limited. Landfill gas should not be burned in a flare. Instead the gas should be used to replace other fuels as a source of useful energy. The Kyoto Protocol does not provide proper incentives for energy recovery.

Question 2: Almost all commenters expressed support for the development of LFG recovery projects, such as the one proposed at the Loma Los Colorados Landfill. Several commenters included the condition that LFG recovery projects should be developed only if they are economically feasible or cost-effective. Several commenters expressed a preference that LFG recovery projects include energy recovery.

One commenter expressed unequivocal opposition to LFG recovery projects that do not include energy recovery.

Question 3: Most commenters agreed that the project would support the sustainable development of Chile in economic and environmental aspects. Several commenters expressed doubt or uncertainty that the project would promote social development. Other commenters specifically mentioned the social benefits of the project to the nearby community of Montenegro. They mentioned employment and reduction of odors as benefits the project would bring to the nearby community.

Some commenters said that including energy recovery as part of the project would increase the projects support for sustainable development. Electricity generation was supported by several commenters.

One commenter stated that the project would not contribute to sustainable development because the project would not properly use the energy in the LFG.

Question 4: Most commenters agreed that the project would support the sustainable development of the comuna of Til-Til. Several commenters said that there should be focus on the benefits to the village of Montenegro. Montengro lies within Til-Til.

One commenter expressed preference for a new industrial park that could use the LFG as fuel. One commenter said that the social aspects should be evaluated further. One commenter said that the landfill is already required to reduce emissions, so emission reductions from the project would not be additional. One commenter expressed a preference for using the best available technology. Some commenters said that electricity generation would improve the project's contribution to sustainable development, with one commenter suggesting that the provision of electricity to the local community would be a benefit.

One commenter said that burning LFG in a flare would not contribute to sustainable development of the local community but that energy recovery and the consequent generation of wealth would contribute to sustainable development.

Question 5: Some comments were complementary or supportive regarding the project, CDM, and the presentation at the stakeholders' meeting.

One commenter expressed regret that the project a) does not use the energy from the LFG in a more productive way; b) wastes energy and receives money for doing so; and c) illustrates how governmental incentives allow the waste of resources.

Several commenters expressed hope that the project would promote the development of the village of Montenegro. One commenter specified that some of the project profits should be used for schools, public transportation, sports, and cultural activities. One commenter mentioned job creation as a desirable benefit. Other commenters expressed the general sentiment that Montenegro, being very close to the landfill, should be given some favorable treatment.

E.3. Report on consideration of comments received

>>

In this section, comments are categorized according to subject. For each category, a description of how the project proponents have taken account of the comments is given.

Favorable Comments

Favorable comments are acknowledged. The project developer intends to proceed with the project as quickly as reasonably possible so that the benefits of the project will be realized.

Energy Recovery. Many comments relate to energy recovery. KDM intends to use some or all of the collected LFG to generate electricity, and possibly to supply landfill gas to industrial users off-site. Note that off-site use of LFG is not allowed by the CDM methodology ACM0001, so that the most appropriate option is power generation, as analyzed in this PDD.

The project proponents recognize that a LFG energy recovery project generally requires a much larger investment than does the gas collection system associated with the energy recovery project and that certainty of fuel supply is generally a crucial prerequisite for justifying the investment in

energy recovery. By moving forward with a gas collection and flaring system, the CDM project developer hopes to make certain of the supply of fuel.

The project proponents believe that the project, even without any energy recovery, promotes the objectives of the CDM by decreasing emissions of greenhouse gases and by destroying minor components of LFG that cause local air pollution. The mitigation of global warming and local air pollution is part of sustainable development. Recovering useful energy from LFG is often a worthwhile activity. However, the objective of recovering energy should not be used as a reason to delay the development of a pollution-control project based on the flaring of LFG.

Social Benefits

Several commenters expressed concern that social benefits were not as clear as environmental and economic benefits. Ironically, several commenters from Montenegro specifically noted the social benefits of the project that they expected would impact on their community; such as the destruction of odorous gas, employment, and general improvement of landfill operations.

About ten to twelve people will be directly hired to work full time on the project. Several people may be hired during construction. Money spent on supplies and services will indirectly contribute to the development of the local economy.

Benefits to the Village of Montenegro

Many of the landfill employees live in Montenegro. The project owner will make special efforts to find qualified people from Montenegro to work on the project. However, if qualified people are not found in Montenegro, they will be hired from wherever they may be found.

Following discussions with Mr. Juan Andrés Rivera, the Project Sponsor (KDM) has agreed to provide the following services to the village of Montenegro:

1. Fix the electrical system of the Montenegro rural school.
2. Expand the classroom in order to make room for a library.
3. Build bathrooms for pre-school children and for teachers of the Montenegro rural school.
4. Improve the water treatment system of the Montenegro rural school.
5. Provide eight 8 fire extinguishers to the Montenegro rural school.
6. Organize a Course on Risk Management for officials and teachers of the Montenegro rural school.
7. Provide two new computers for the Montenegro rural school.

In order not to limit the benefits to a single village, project proponent expects to provide improved services to a total of 14 rural schools all over the country.

Cost-Effectiveness

A few comments related to the cost-effectiveness of the project. The project proponent intends to develop the project because its analysis indicates that the value of the CERs exceeds the costs of producing the CERs. Similarly, if energy production for sale is cost effective in the sense that the cost of thermal energy production or electricity generation is less than the market price for thermal energy or electricity, then the project developers would pursue such options.

Additionality

The comment regarding additionality (see Question 4) is addressed in Section B of this PDD.

Best Available Technology

The project will use up-to-date technology, which in some cases will be the best that is available.

SECTION F. Approval and authorization

>>

The registered CDM project activity has been granted with Letter of Acceptance (LoA) by the Designated National Authority (DNA) of the host party Chile. Copy of such LoA and related assessment details are made available at the project page at UNFCCC's CDM website and in the Validation Report for the project activity (dated 21/03/2006).

Host Country Approval from Chile confirmed the voluntary participation of KDM S.A. as project participant in the CDM project activity. It is clearly stated in LoA issued by the DNA of Chile that the project activity is considered to contribute towards Sustainable Development in Chile. This is also assessed and reported in the Validation Report for the project activity (dated 21/03/2006).

Japan is also a Party for the project activity. LoA from this Annex I Party was issued by the DNA of Japan. This LoA authorizes and approves The Kansai Electric Power Co., Inc. as project participant.

Finally, Spain is also a Party for the project activity. LoA from this Annex I Party was issued by the DNA of Spain. This LoA authorizes and approves URBASER, S.A. as project participant.

Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	KDM S.A.
Street/P.O. Box	Alcalde Guzmán 0180, Quilicura
Building	
City	Santiago
State/Region	
Postcode	
Country	Chile
Telephone	
Fax	
E-mail	fleon@guk.cl
Website	www.kdm.cl
Contact person	
Title	General Manager
Salutation	Mr.
Last name	Leon
Middle name	
First name	Fernando
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	fleon@guk.cl

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	The Kansai Electric Power Co., Inc.
Street/P.O. Box	3-6-16, Nakanoshima, Kita-ku
Building	
City	Osaka
State/Region	
Postcode	
Country	Japan
Telephone	+ 81 6 6441 8821
Fax	
E-mail	kadono.naoyoshi@b3.kepco.co.jp
Website	
Contact person	
Title	
Salutation	Mr.
Last name	Toyama
Middle name	
First name	Koji
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	koji.toyama@kepco.co.jp

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	URBASER, S.A.
Street/P.O. Box	Avda. Tenerife 4-6, 28703 San Sebastian de los Reyes
Building	
City	Madrid
State/Region	
Postcode	
Country	Spain
Telephone	+ 56 2 248 28 600
Fax	
E-mail	sinostroza@gud.cl
Website	
Contact person	
Title	
Salutation	Mr.
Last name	Inostroza
Middle name	Cáceres
First name	Sergio
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	sinostroza@gud.cl

Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
Organization name	ALLCOT AG
Street/P.O. Box	Steinhauserstrasse, 74.
Building	
City	Zug
State/region	
Postcode	
Country	Switzerland
Telephone	+ 41 79 129 49 60
Fax	
E-mail	all@allcot.com
Website	
Contact person	
Title	
Salutation	Mr.
Last name	Leroy
Middle name	
First name	Alexis
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	all@allcot.com

Project participant and/or responsible person/ entity	☐ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	UniCarbo Energia e Biogás Ltda.
Street/P.O. Box	Avenida Eng. Luis Carlos Berrini, 1140 - 72
Building	
City	São Paulo
State/Region	São Paulo, SP
Postcode	04571-000
Country	Brazil
Telephone	+ 55 11 9 8596 0950
Fax	+ 55 11 9 8596 0950
E-mail	nuno@unicarbo.com.br
Website	www.unicarbo.com.br
Contact person	
Title	Mr.
Salutation	
Last name	Barbosa
Middle name	
First name	Nuno
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Appendix 2. Affirmation regarding public funding

Not applicable. The implementation and operation of the project do not involve any kind of public funding from Parties included in Annex I.

Appendix 3. Applicability of methodology and standardized baseline

Information about the applicability of selected methodology is presented in Section B.2.

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

All information about the ex-ante calculation of emission reductions are summarized in Section B.6.3. An emission reduction calculation spreadsheet includes all calculations of figures which are indicated in Section B.6.3. This spreadsheet is enclosed to this PDD.

Appendix 5. Further background information on monitoring plan

All information about the design and operation of the monitoring plan are presented in Section B.7.1.

Appendix 6. Summary of post registration changes

The revised version of the PDD (version 1.6, dated 24/06/2017) includes the following permanent post-registration change:

Corrections (in information that do not affect the project design):

- Missing default value (applicable for generated electricity exported through the electricity grid the project activity is connected to) is added in details for the ex-ante determined (fixed) parameter "Average technical transmission and distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the project activity" ($TDL_{grid,y}$) in Section B.6.2. Furthermore, while the previously selected 20% default value became applicable only for grid-sourced electricity imported by the project activity and is termed as $TDL_{grid,import,y}$, the added 3% missing default value is termed as $TDL_{grid,export,y}$. Texts in Sections B.6.1 and B.6.3 are adjusted accordingly.

- Calculations of ex-ante estimates of emission reductions to be achieved by the project activity during the 2nd 7-year crediting period are corrected in both Section B.6.3 and in a revised version of the emission reduction calculation spreadsheet (that is enclosed to the PDD) by taking into account the missing 3% default value for the ex-ante determined (fixed) parameter $TDL_{grid,y}$ (value applicable for generated electricity exported through the electricity grid the project activity is connected to).

- Details for the project participants of project activity are updated (as per the latest version of the completed Modalities of Communication (MoC) form for the project activity).

- The estimated annual values for the monitoring parameter "Amount of electricity generated using LFG by the project activity in year *y*" ($EC_{BL,y}$) (applicable for years 2014 – 2021) are correctly reported in Section B.7.1.

The revised version of the PDD (version 1.5.1, dated 14/03/2017) includes the following permanent post-registration change:

Revision of the monitoring plan from the registered PDD:

- Consideration/utilization of alternative monitoring approaches as per "Appendix - Additional data handling and monitoring guidance for determining the mass flow of methane in biogas" of the latest version of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) as follows:
  - Depending on operational conditions, monitoring approach as per Item *1. "Data substitution for methane content or biogas flow"* may be applied (in case missing data are encountered in the course of determining the methane mass flow as part of the determination of $F_{CH4,sent\_flare,y}$ *and* $F_{CH4,EL,y}$ along the 2nd 7-year crediting period).

- Depending inter alia on availability of monitoring equipment, monitoring approach as per Item *2.* "*Use of a single flow meter for multi-use of recovered biogas"* may be applied.

- Inclusion of the monitoring details for the new/additional monitoring parameter "Operational status of biogas destruction devices" (Status of the biogas destruction device)" as required by the later version of the applied methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0).

Corrections (in information that do not affect the project design):

- Missing monitoring details for the monitoring parameter "Maintenance events completed in year *y* as monitored by the project participants ($Maintenance_y$)" are added in Section B.7.3.
- Figure 2 – "*Schematic flow diagram: delineation of the project boundary for the project activity during the 2nd 7-year crediting period*" is corrected in terms of the number of engine-generator sets for the project's CLLC-2 electricity generation facility and location of LFG flow meters
- The formula for the determination of baseline emissions of methane ($BE_{CH4,y}$) in the context of ex-ante estimates of emission reductions to be achieved by the project activity is corrected in Section B.6.3. Related calculations of ex-ante estimates of emission reductions to be achieved by the project activity during the 2nd 7-year crediting period are also corrected in both Section B.6.3 and in a revised version of the emission reduction calculation spreadsheet (that is enclosed to the PDD).
- Reporting in Section B.6.2 of the previously determined value for the ex-ante determined parameter "Historical amount of methane in the LFG which is captured and destroyed in the year prior to the implementation of the project activity (2006)" ($F_{CH4,BL,x-1}$) is corrected from 41,122 tCH_4/yr to 516.16 tCH_4/yr.
- A clarification disclaimer referring to both the issuance of the environmental license for the CLLC-2 electricity generation facility + current compliance of the implementation and operation of the facility with all valid and applicable environmental requirements (as defined by the competent environmental authority in Chile) was added in Section D.2.
- Minor previously existent typo mistakes were corrected in different sections of the PDD.

Document information

Version	*Date*	*Description*
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).

Version	*Date*	*Description*
06.0	9 March 2015	Revisions 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; Editorial improvement.
05.0	25 June 2014	Revisions 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;* • 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.

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