Project design document form for CDM project activities

(Version 08.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)
Version number of the PDD	9.2
Completion date of the PDD	16/06/2017
Project participant(s)	Companhia Riograndense de Valorização de Resíduos S/A Biogas Riograndense Ltda. Belektron d.o.o.
Host Party	Brazil
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
Estimated amount of annual average GHG emission reductions	489,799 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

Summarized description of the project activity:

The CDM project activity “Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)” encompasses collection and destruction/utilization of landfill gas (LFG) at the landfill named Central de Resíduos do Recreio (CR do Recreio landfill) which at that time was owned and operated by the solid waste management company and host-country project participant SIL Soluções Ambientais Ltda[1]. The CR do Recreio landfill is located in the city of Minas do Leão – Rio Grande do Sul State, which is a Federal State located in the Southern region of Brazil. At the time of the project design initial conceptualization[2] and its registration as a CDM project activity, the main objective of the project activity was merely avoiding greenhouse gas (GHG) emissions of methane (CH_4) into the atmosphere through efficient collection and destruction of LFG by flaring in high temperature enclosed flare(s), thus promoting GHG emission reductions. Since July 2015, as a result of an occurred permanent change in the project design, share of collected LFG has been utilized as fuel for electricity generation in an electricity generation facility with nameplate power generation capacity of 8.556 MW. Continuous operations of this power plant was initiated on 21/07/2015.

The CR do Recreio landfill started its operations in October 2001 and at that time it was designed to be the most complete available structure for treatment and disposal of municipal solid waste (MSW) in the Rio Grande do Sul State. The landfill was implemented in the valley of a not any longer under operation coalmine. The CR do Recreio landfill has an area of 730,000 m^2 and capacity to receive 90,000 ton of MSW per month (as established in the valid Operating License 4268/2012-DL). The CR do Recreio landfill currently receives solid waste from more than one hundred municipalities in Rio Grande do Sul, including the State capital Porto Alegre.

Since the time of the project design initial conceptualization, the CR do Recreio landfill applies modern technologies for disposal of solid waste. Through the application of the Brazilian Standard NBR 8419/92 – “*Apresentação de projetos de aterros sanitários de resíduos sólidos urbanos*”[3] (a Brazilian best practice and technical standard adopted to develop and operate landfills while respecting environmental, health and engineering concerns), the landfill obeys to the following requirements:

- Proofing of the landfill basis with both compacted clay barriers and with a polyethylene geo-membrane;
- Compacting of the disposed solid waste with specific equipment;
- Covering of the compacted solid waste with clay in order to avoid the dispersion of odor and the appearance of rats, cockroaches, buzzards and bugs;
- Controlling of the amount of solid waste disposed at the landfill;
- Collection and treatment of leachate;
- Release of landfill gas into the atmosphere in order to avoid internal increase of pressure;
- Monitoring of the ground water quality.

---

[1] Since12/09/2012, as a result of a corporate merger process between the waste management companies SIL Soluções Ambientais Ltda. and Solvi Group S.A., the CR do Recreio landfill is owned and operated by the established enterprise Companhia Riograndense de Valorização de Resíduos S.A. (CRVR). Despite the new ownership of the CR do Recreio landfill, in July 2015, the host country project participant for the project activity remains being SIL Soluções Ambientais Ltda.

[2] The time period encompassing years 2005 and 2006 is when the initial conceptualization of the general design of the project activity was undertaken. All information and details applicable in the context of the initial project design (as earlier indicated in the registered version of the PDD valid for the currently expired 1st 7-year crediting period for the project activity) are referred in this version of the PDD as "*at the time of the project design initial conceptualization*" and refers to information dated/valid at the period encompassing years 2005 and 2006.

[3] The title of the Brazilian Standard NBR 8419/92 is translated into English language as – “Proposal of projects of landfills for municipal solid waste”.

As a result of the implementation of the project activity, the operation and management of the CR do Recreio landfill has not changed when compared to the situation prior to the implementation of the project activity and it is not expected to change during the time period to be encompassed by the 2nd 7-year renewable crediting period of the project activity either (from 01/12/2014 to 30/11/2021).

As per the project design, whenever the project's electricity generation component is completely not under operation (with all engine-generator sets not under operation), all collected LFG will be flared at the enclosed high temperature flare(s). Moreover, when the project's electricity generation component is under full operation (with all the engine-generator sets under operation) or under partial operation (with some of the engine-generator sets under operation), any surplus or fraction of collected LFG (which is beyond the LFG consumption level for the project's electricity generation component) will be sent to the high temperature enclosed flare(s) for destruction through combustion under controlled conditions, thus assuring combustion of collected methane under high efficiency as well as destruction of air pollutants present in collected LFG even when LFG cannot be combusted in the engine-generator sets.

Regarding applicable environmental regulations and good practices for landfill projects, construction and operation, the CR do Recreio landfill was initially granted in 2001 with an operation license (permit) issued by the local environmental authority *Fundação Estadual de Proteção Ambiental - FEPAM* (Rio Grande do Sul State's Environmental Agency). This operation license was later renewed in 2012 with validity for additional 4 years. At the time of the project design initial conceptualization, the CR do Recreio was one of the few landfills located in Rio Grande do Sul that complied with all applicable environmental requirements.

Phase 1 of the project activity (2007 – 20 July 2015): LFG collection and destruction by flaring:

Prior to the implementation of the project activity, the practice at the CR do Recreio landfill was to collect and burn LFG only through a passive LFG venting/combustion system in a non-efficient and continuous basis, with no active (forced) system to collect LFG nor systematic and monitored flaring system implemented. By then, LFG (which is rich in methane (CH_4)) was emitted naturally into the atmosphere through the surface of the landfill and through pre-project existing passive conventional LFG venting/combustion drains; and with a minor share of generated LFG being combusted in such conventional LFG venting/combustion drains in order to address safety and odor concerns.

At the time of the project design initial conceptualization, an extra-incentive was required for having SIL – Soluções Ambientais Ltda. making additional capital investments in order to promote LFG collection and destruction in a systematic and efficient manner. As part of the initial phase of the project activity, a LFG collection system (including LFG collection wells and a LFG pipeline network) + a complete LFG flaring and monitoring system (encompassing high temperature enclosed flare(s)[4] + ancillary and monitoring equipment and instruments) were implemented. The LFG collection system was built mostly by converting the previously existing passive conventional LFG venting/combustion drains into appropriate, more efficient and better-designed LFG collection wells. All project's LFG collection wells are covered and are connected to a main LFG pipeline in order to have collected LFG being directed to the high temperature enclosed flare(s) for destruction through combustion. Centrifugal blowers and LFG moisture traps are also installed as part of the project activity[5].

[4] In July 2015, one high temperature enclosed flare (with declared nameplante LFG flaring capacity of 8,100 Nm^3/h) was under operation as part of the project activity. Additional flare(s) may be installed in the future as a result of the expected increase of the amount of LFG collected by the project activity. Further details about the installed flare is included in Section A.3.

[5] As part of the operation of the project activity since year 2007, additional LFG collecting wells have been built and put into operations along the years. By July 2015, there were about 268 LFG collection wells implemented at the CR do Recreio landfill as part of the project activity, of which 183 LFG wells were under regular and continuous operation.

Phase 2 of the project activity (21 July 2015 onwards): use of collected LFG as renewable energy source fuel for electricity generation (with a share of collected LFG being destroyed by flaring):

As per the project design, a share of collected LFG is used as fuel for electricity generation in an electricity generation facility which was built in the CR do Recreio landfill and with nameplate power generation capacity of 8.556 MW. The implementation of project's Phase 2 will promotes GHG emissions reductions due to generation of electricity from renewable energy source in addition to GHG emission reductions due to destruction of methane (in the high temperature enclosed flare(s) and in the engine-generator sets of the electricity generation facility).

In summary, after the implementation of project's phase 2, the project activity encompasses the following possible uses for collected LFG:

(i) Destruction of collected LFG through combustion in high temperature enclosed flare(s) (flaring);
(ii) Utilization of collected LFG as fuel for electricity generation with generated electricity being used for meeting electricity demand for the own project activity[6] and being exported through the National Electricity Grid of Brazil.

The implementation of a new electricity generation facility as part of the project activity is promoting an environmentally friendlier and more rational use of LFG collected by the project activity. Since the implementation of the new electricity generation facility, in addition to previously existent CDM revenues, the project activity also have revenues from the commercialization of most of generated electricity as an additional and important revenue source. Moreover, the project activity will also be able to become self-sufficient for meeting its electricity demand [7].

The decision making process for the implementation of the new electricity generation facility as a post-registration change to the project design is dated of 2013 (thus more than 5 years after the registration of the project as a CDM project activity). After successfully and continuously operating the project activity as a LFG collection and destruction initiative for more than 5 years, the project participant SIL Soluções Ambientais Ltda. and CRVR S.A. (current operator and owner of the CR do Recreio landfill) were able to confirm from a technical perspective that collected LFG at the CR do Recreio landfill indeed has all qualitative and quantitative requisites and required specifications (under a satisfactory level) to be used as gaseous fuel for electricity generation, thus promoting an environmentally friendlier and more rational use of LFG.

.

The implementation of the project's new electricity generation component was concluded on 02/06/ 2015 and its continuous operations started on 21/07/2015, and its commissioning was performed during the period from 22/06/2015 to 21/07/2015.

The figure below represents an schematic diagram for the new electricity generation facility:

---

[6] As per the project design, grid-sourced electricity is alternatively used for meeting the electricity demand for the project activity.

[7] After the implementation of project's new electricity generation facility, the project's electricity demand started to be met by one of the following sources:

1. small fraction of electricity that is generated by the project activity (with most of generated electricity being exported through the National Electricity Grid of Brazil);
2. imports of grid-sourced electricity
3. electricity sourced by an installed backup captive off-grid electricity generator (fuelled by diesel) (only during temporary planned or unplanned circumstances where (a) project's electricity generation facility is temporarily not under operation or (b) supply of grid-sourced electricity is temporarily interrupted).

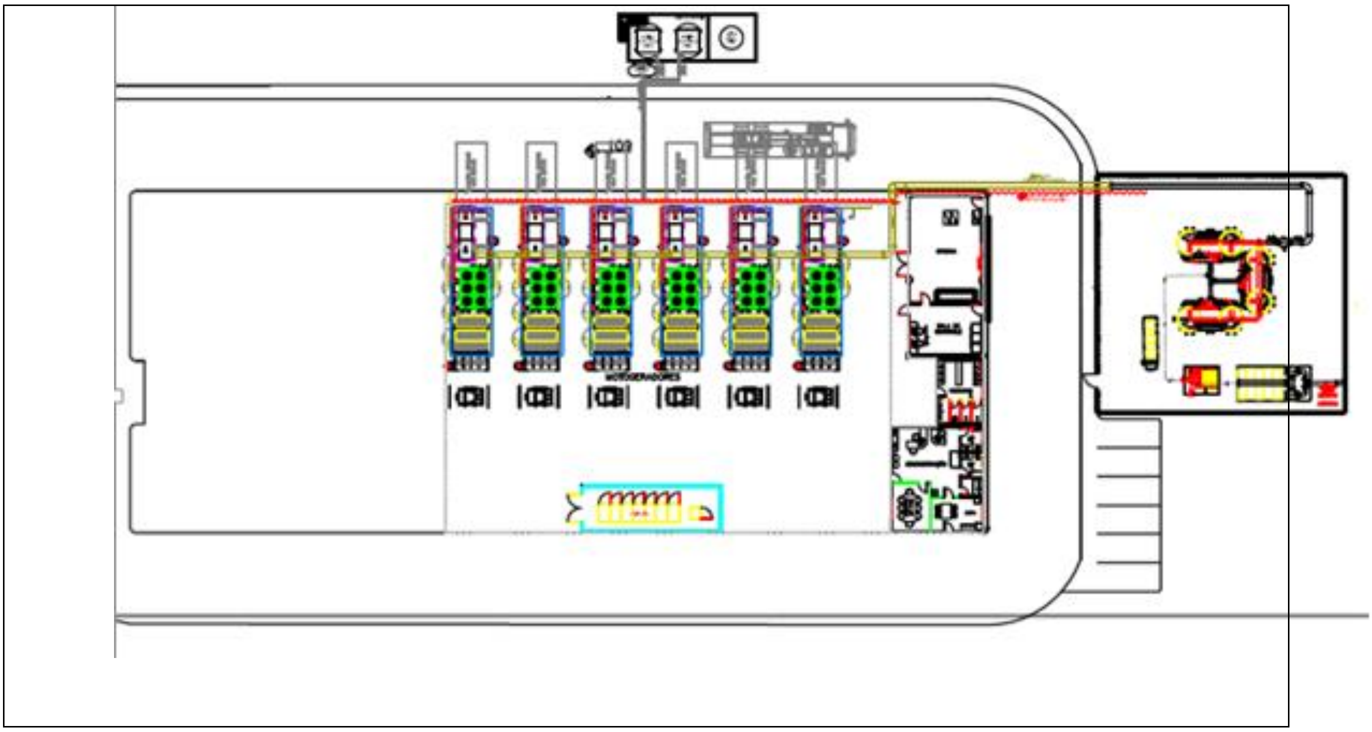

Figure 1 – Schematic diagram of the lay-out of new electricity generation facility (which started continuous operations on 21/07/2015)

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 CR do Recreio landfill remains being the same as the scenario existing prior to the implementation of the project activity:

- LFG generated at the CR do Recreio landfill (with high content of methane) being freely emitted into the atmosphere without any treatment, collection, combustion or control through the surfaces of the landfill with small fraction being destroyed in passive and conventional LFG venting/combustion drains in order to address safety and/or odour concerns[8].
- 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 passive and conventional venting/combustion drains.
- Electricity (in an amount equivalent to the amount of electricity generated by the project activity) being generated in existing fossil-fuel power generation sources connected to the National Electricity Grid of Brazil and/or new additions of fossil-fuel power generation sources

Environmental aspects and other contribution of the project activity towards Sustainable Development locally and in the whole host-country Brazil:

The project activity promotes a significant positive impact towards sustainable development in Brazil. First, while reducing methane emissions, it also minimizes the risk of explosions in the landfill site (although the CR do Recreio's engineering and design specifically aims to avoid these types of accidents). Secondly, given the fact that at the time of the project design initial conceptualization, initiatives of this type were relatively new in Brazil, at that time it was assumed that the implementation and operation of the project activity would represent a significant technology

[8] The baseline condition/situation involving destruction of small share of LFG in the pre-project conventional and passive LFG venting/combustion drains (including its continuation along the 2nd 7-year crediting period) in order to address safety and odour concerns is further explained in Section B.6.1 under Step A.2.

transfer[9]. Thirdly, while specialized operators are needed for the project operation, that represents positive impact in terms of employment and capacity-building in the region. The aforementioned elements concur in making the project extremely vital in the context of sustainable development.

While the project activity also encompasses generation of electricity from a non-conventional renewable energy source, the installation and operation of the project's electricity generation facility also represents promotion of additional local job opportunities (for building and operating the project's electricity generation facility). The project's electricity generation facility fuelled by LFG is expected to be used as a relevant technological demonstration initiative in the Southern region of Brazil for the promotion of electricity generation using non-conventional renewable energy source. The use of LFG as fuel for electricity generation is still not common practice in Brazil. It is the intention of the project participant to establish cooperation agreements with local NGOs, academia and community in order to demonstrate and promote this type of initiative.

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 3,428,594 tCO_2e during the 2nd 7-year renewable crediting period. This value is equivalent to an average annual GHG emission reduction of 489,799 tCO_2e/year.

A.2. Location of project activity

A.2.1. Host Party

>>
Federal Republic of Brazil

A.2.2. Region/State/Province etc.

>>
Rio Grande do Sul State

A.2.3. City/Town/Community etc.

>>
Municipality of Minas do Leão

A.2.4. Physical/Geographical location

>>
The CR do Recreio landfill is located in the Municipality of Minas do Leão, Rio Grande do Sul State, approximately 80 km Western from Porto Alegre city, in the Southern Region of Brazil. The exact geographic coordinates of the project site (in decimal and in Degree, Minute, Second (DMS) formats) are as follows:

Format	Latitude	Longitude
DMS	30° 8' 49" S	52° 1' 33" W
Decimal	-30.1469	-52.0258

The following images show the location of the project activity.
.

[9] In July 2015 there were 45 LFG project based initiatives encompassing collection and destruction and/or utilization implemented or under implementation or yet to be implemented in Brazil. All these initiatives were/are to be implemented as CDM project activities.

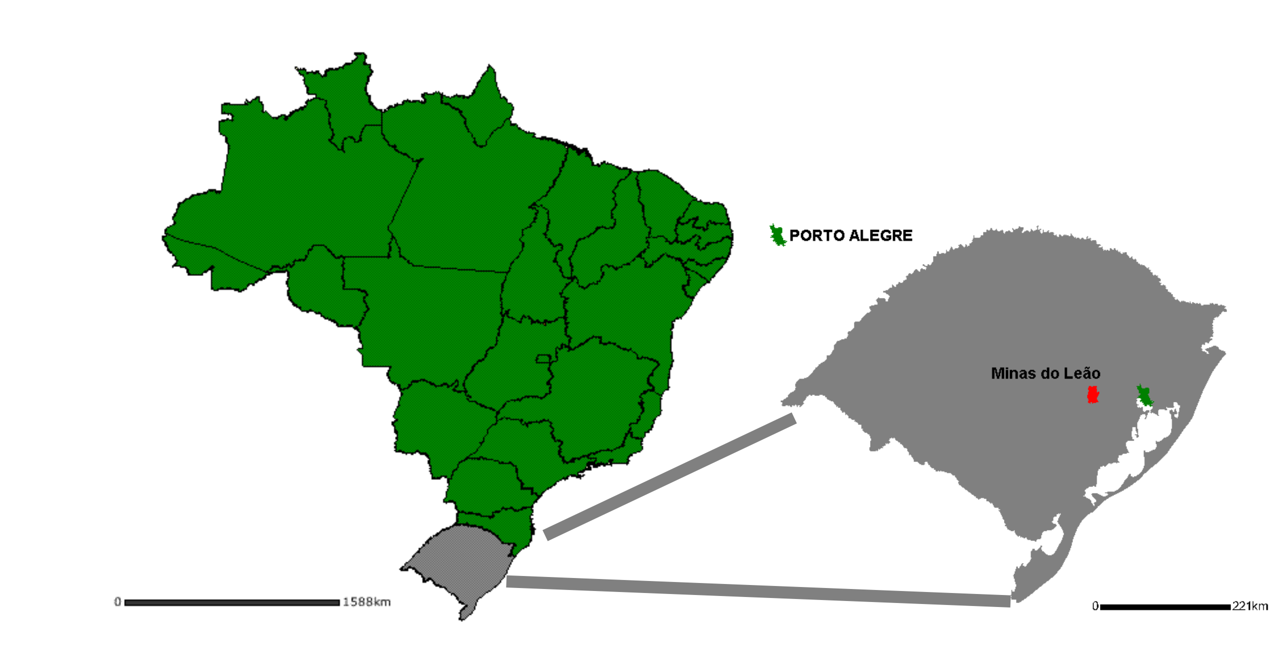

Figure 2 - Location of the project activity in Rio Grande do Sul State

Figure 3 - Aerial view of the location of the CR do Recreio landfill
(as visible in July 2015 by using Google Earth PC application)
(The black arrow highlights the location of the project's LFG destruction station (high temperature enclosed flare). The project's new electricity generation facility is implemented in the same location within the CR do Recreio landfill)

A.3. Technologies and/or measures

>>

Pre-project situation at the CR do Recreio landfill:

The pre-project situation (situation prior to the implementation of the project activity) represents the non-existence of deemed appropriate and environmentally friendly equipment and practice dedicated to promote LFG management at the CR do Recreio landfill. The pre-project situation also represents no generation of electricity at the project site.

As part of the performed CDM validation for the project in year 2006, it was demonstrated and confirmed that the pre-project situation represents the baseline scenario for the project activity where LFG management at the landfill encompasses use of rudimentary passive and conventional LFG venting/combustion drains being in the landfill's MSW disposal area to allow sporadic passive combustion of LFG[10] (in order to avoid significant accumulation of LFG in the inner section of the landfill and thus reducing the risk of fire and explosions (safety concerns) and also address odour concerns).

For the time period encompassing the 2nd 7-year crediting period of the currently registered CDM project activity, it is assumed that in the baseline scenario (absence of the proposed project activity), proper infrastructure for promoting effective and more efficient LFG collection and destruction would still be inexistent at the CR do Recreio landfill site during the whole 7-year crediting period.

Currently there are still no legal municipal, state or national requirements in the municipality of Minas do Leão, Rio Grande do Sul State nor in Brazil (respectively) that establish any requirement or guidance in terms of LFG management in new or existing landfills or waste dump sites[11].

Thus, the baseline scenario for methane remains being the continuation of the pre-project practice (only a minor share of generated LFG being collected and destroyed by pre-project conventional and passive venting/combustion drains at the CR do Recreio landfill (and additional drains that would

---

[10] As further explained and justified in Section B.6.1 under Step A.2, the pre-project conventional LFG venting/combustion drains (which are assumed to be the only LFG management infrastructure to be used along the baseline scenario) are of somehow rudimentary design and, in most of the cases, such drains do not allow continuous combustion of LFG as these rudimentary LFG management solutions are not conceived/designed for ensuring continuous or efficient combustion of LFG. LFG has never been continuously combusted in the pre-project passive LFG venting/combustion drains available prior to the implementation of the project activity due to the following reasons/aspects:

- Design aspects and operational conditions of the conventional LFG venting/combustion drains (such as the diameter of the LFG venting drains, average pressure of LFG in the drains, influence of wind and other climate aspects (e.g. rain)),
- Typical operational conditions at the CR do Recreio landfill prior to the implementation of the project activity (where no working staff has ever been required to attempt ensuring continuous combustion of LFG in the drains and/or monitor the conditions/status of such drains (e.g. regular checking whether the drains are alight));
- In July 2015, there were still no applicable legal/regulatory requirements to collected and destroy methane in the CR do Recreio landfill.
- In the absence of the project activity (baseline scenario) and without CDM carbon revenues incentives, as the operator of CR do Recreio landfill, SIL – Soluções Ambientais Ltda. and more recently CRVR S.A. would not have any real incentive or obligation to convert the otherwise existing LFG venting/combustion drains into more appropriate LFG flaring system/solution as such conversion would represent additional and unjustifiable costs.

Thus, in the absence of the proposed CDM project activity, it is assumed that continuous combustion of LFG in the pre-project/baseline drains (including additional drains that would be otherwise installed instead of the project's LFG collection wells) would not be a practice under the baseline scenario (including during the time period encompassed by the 2nd 7-year crediting period of the currently registered CDM project activity). The practice in the baseline scenario is assumed as being both venting and combustion of LFG under uncontrolled and non-systematic manner in the existent conventional LFG venting/combustion drains. The practice in the baseline scenario is also assumed as no electricity being generated at the CR do Recreio landfill.

[11] Further explanations regarding the expected continuation of the non-obligation of destroying LFG (in order to meet legal or regulatory requirements) (also during the time period to be covered by the 2nd 7-year crediting period) are included in Section B.6.1 under Step A.2.

otherwise be installed along the years in the baseline scenario)). The baseline scenario for the project's electricity generation component (phase 2) is demonstrated to be 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.

As required by ACM0001 (version 15.0), the previously conceived overall design, operation and management plan of the CR do Recreio landfill has not compromised or changed as a result of the implementation of the project activity encompassing the implementation of an active (forced) LFG collection and destruction/utilization solution at the landfill. The previously conceived overall design, operation and management plan of the CR do Recreio landfill is not expected to change during the time period to be encompassed by the 2nd 7-year renewable crediting period of the project activity either.

While no practice to increase methane generation has ever occurred prior to the implementation of the project activity, none of such practice (to increase methane generation) has ever occurred after the implementation of the project activity either. Furthermore, none of such practices are expected to occur during the time period to be encompassed by the 2nd 7-year renewable crediting period of the project activity either. As required by the applied baseline and monitoring methodology ACM0001 (version 15.0), the occurrence or planning of any change in the management of the CR do Recreio landfill during the time period to be encompassed by the 2nd 7-year renewable crediting period will be reported and will be justified by referring to applicable technical or regulatory specifications.

Technology and measures encompassed by the project design:
The employed technology encompasses deep improvements of LFG management at the CR do Recreio landfill through the installation and operation of an active LFG collection system composed by a LFG collection and transportation pipeline network + the installation and operation of a LFG flaring station (project implementation phase 1) and the installation and operation of an electricity generation facility fuelled by collected LFG (project implementation phase 2).

LFG collection system:
In order to maximize LFG collection efficiency, the pre-project passive conventional LFG venting/combustion drains were replaced by appropriate and efficient active (forced) LFG collection wells. The project's 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 high temperature enclosed flare(s)[12] and to the project's new electricity generation facility. The conversion of some of the pre-project existing passive conventional LFG venting/combustion drains into appropriate LFG collection wells represents a distinct advantage since such conventional drains were already installed in locations where most of the gas flows into the atmosphere. However, some physical barriers could interrupt the gas flow from the generation point to the well, so new wells needed to be drilled. Also as part of the designed project's LFG collection system, collected LFG is sent to the project's LFG destruction facility (flare(s)) and/or to the yet to be implemented project's new electricity generation facility through a LFG High Density Polyethylene (HDPE) pipes and manifolds.

[12] In July 2015, the project activity was operating with one enclosed high temperature flare installed. Additional flares might be installed in the future depending on the amount of LFG generated at the landfill (there is a forecast of increase of the amount of LFG generated at the landfill).

Figure 4 – View of a LFG collection well of the project activity

Figure 5 – Partial view of the project's LFG pipeline

Figure 6 – Partial view of the project's centrifugal blowers installed as part of the project activity[13]

High temperature enclosed flare:
The main operational characteristics and specifications of the currently installed high temperature enclosed flare (as per the project's configuration in July 2015) are as follows:

Installed LFG flaring equipment[14]	Characteristics/specifications
High temperature enclosed flare	Manufacturer: Arquipélago Engenharia Ambiental Ltda. Height: 13.7 m Diameter: 3.0 m Max. LFG flaring capacity (for continuous operation): 8,100 Nm^3/h 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): 1,000 ^oC Required frequency for inspection service (incl. inspection in the conditions of the flare's isolation ceramics revetment material): every 10 (ten) years

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

New electricity generation facility with combined nameplate installed capacity of 8.556 MW:
As part of the revised project design, a new electricity generation facility (using LFG as fuel) was implemented at the project site in July 2015 and started its continuous operations on 21/07/2015, with 6 engine-generator sets manufactured by GE Jenbacher, type 4 model G-420 (or similar) with

[13] Additional centrifugal blowers may be installed in the future in order to accommodate the forecasted increase in the amount of LFG collected and destroyed/utilized by the project activity.

[14] Additional flare may be installed in order to address the forecasted increase in the amount of LFG collected and destroyed/utilized by the project activity.

nameplate installed capacity of 1.426 MW each are to be implemented. The planned change in the project design also encompassed installation of ancillary equipment required for electricity generation using LFG as fuel (control system, power transformers, transmission line, measuring system, LFG treatment and cooling equipment, etc.).

Figure 7 – Partial view of the project's electricity generation facility[15]

Expected operational lifetime for the project activity:
The expected operational lifetime for the project's LFG collection and destruction system (using high temperature enclosed flare(s)) and also for the electricity generation facility (using LFG as fuel) is at least 20 years. However, project lifetime may even exceed 20 years if required service and maintenance is performed correctly and in case the project activity is always operated as per recommendation and requirements set by manufacturers of related equipment/instruments.

While the project activity started its continuous operations (as part of its 1st crediting period) in December 2007 (implementation of the project's phase 1), thus the remaining operational lifetime for project equipment encompassed by phase 1 potentially exceeds 13 years. For the project's new electricity generation component, an operational lifetime of at least 20 year is expected.

Project monitoring system:
The project activity also includes all needed monitoring system (instruments, equipment and procedures) required to ensure that all applicable monitoring activities are performed as established in the monitoring plan and under conformity with ACM0001 (version 15.0) and applicable methodological tools. Such measurements and monitoring include continuous measurements of LFG flow to the flare and to the electricity generation facility, continuous measurements of methane content in collected LFG, etc. ACM0001 (version 15.0) requires ex-post monitoring whether equipment destroying LFG through flaring operates under compliance with operational requirements and/or recommendations as set by flaring equipment manufacturer. Moreover, consumption of electricity and fossil fuel by the project activity (+ related emission factors) are also monitored in order to have project emissions being determined.

Consumption of electricity by the project activity:
During the period since the start of operation of the project activity in December 2007 to September 2010, all electricity demand for the project activity has been entirely met by consumption of grid-sourced electricity. During this period, during events of temporary interruption of supply of grid-sourced electricity to the project activity, the operation of the project activity was completely interrupted. In September 2010, in order to address frequent failures and/or interruptions of supply

[15] Additional centrifugal blowers may be installed in the future in order to accommodate the forecasted increase in the amount of LFG collected and destroyed/utilized by the project activity.

of grid-sourced electricity to the project activity, a backup captive off-grid electricity generator (fuelled by diesel and with 180 kVA of nameplate installed capacity) was installed as part of the project activity in order to meet the project's electricity demand during unexpected or planned interruptions on supply of grid-sourced electricity to the project activity. The installed backup captive off-grid electricity generator is manufactured by STEMAC Grupos Geradores S.A. During events of interruption of supply of grid-sourced electricity to the project activity, the installed backup captive off-grid electricity generator supplies electricity to 2 of the 4 currently installed centrifugal blowers and to the project's control/monitoring system, thus allowing the project activity to operate. The backup unit automatically normally enters into operation whenever interruption of supply of grid-sourced electricity to the project activity occurs.

After the implementation of the project's new electricity generation facility in July 2015, the project's electricity demand started to be met by one of the following sources:

1. small fraction of electricity generated by the project activity (with most of generated electricity being exported through the National Electricity Grid of Brazil);
2. imports of grid-sourced electricity
3. installed backup captive off-grid electricity generator (fuelled by diesel) (only during temporary planned or unplanned circumstances where (a) project's electricity generation facility is temporarily not under operation or (b) supply of grid-sourced electricity is temporarily interrupted).

Consumption of Liquefied Petroleum Gas (LPG) by the project activity:
In accordance to the project design, since the start of operation of the project activity, LPG has been used as a start-up fuel to ignite the high temperature enclosed flare whenever it is required to re-start the operation of the flare(s) (e.g. after maintenance/repair events, after temporary planned or unplanned interruptions in grid electricity supply to the project activity, etc.)[16].

Technology transfer due to the implementation and operation of the project activity:
By the time of the initial design conceptualization for project phase 1 (collection and destruction of LFG by flaring), the technology applied by the project activity was not widely utilized in Brazil. By that time, very few landfills had already installed equipment for improving the amount of landfill gas collected (with all these initiatives being implemented as CDM project activities). For implementing the project activity, SIL Soluções Ambientais Ltda. relied on engineers and other specialists with experience in area to advise the company while implementing and operating the project activity. These professionals also trained local operators and engineers for operation and maintenance of the project facilities.

For the project phase 2 (utilization of collected LFG as fuel for electricity generation), the technology applied is currently still not widely applied in Brazil either. The project's electricity generation facility was fully built and commissioned by authorized representatives of the manufacturer of the engine-generator sets.

Despite the fact that LFG collection and destruction/utilization initiatives are of great potential in Brazil, at the time of the project's design initial conceptualization, no reliable suppliers of high temperature enclosed flares and other ancillary equipment were available. Thus, for the implementation of project phase 1, technology transfer thus occurred from countries with more strict environmental legislative requirements and environmentally sound technologies. The same applies for the project implementation phase 2: engine-generator sets and ancillary equipment/instruments.

[16] LPG has been supplied to the project activity during the 1st 7-year crediting period in 45 kg standard cylinders by an authorized LPG distributor. The mass of consumed LPG by the project activity has been regularly monitored. It is currently expected that LPG will remain being supplied to the project activity in standard cylinders with net capacity of 45 kg of LPG during the 2nd 7-year crediting period.

Temporary research initiative: technical field investigations for the potential of producing "bio-methane fuel" through purification of collected LFG and its utilization as gaseous fuel for light and heavy vehicles during year 2012:

As further explained in the information box below, on 29/11/2010, SIL – Soluções Ambientais Ltda. signed a 18-month technical cooperation agreement with the local natural gas distribution company Companhia de Gás do Estado do Rio Grande do Sul (Sulgás) and with the waste management department of the Administration of the Municipality of Porto Alegre city (*Departamento Municipal de Limpeza Urbana da Cidade de Porto Alegre – DMLU*) with the purpose/scope of promoting technical field investigations for the potential of producing "*bio-methane fuel"* through purification of collected LFG and its utilization as gaseous fuel for light and heavy vehicles. In the framework of such technical cooperation agreement for field investigations, a pilot small-scale LFG purification, compression and bottling plant/station was implemented at the CR do Recreio landfill and temporarily operated during year 2012 by collecting, purifying, compressing and bottling very small amount of LFG which was collected by the project activity in a non-continuous basis. Although on 28/05/2012, SIL - Soluções Ambientais Ltda. has signed with Sulgás the extension of the agreement for additional 12 months, no further investigation or operation of the pilot small-scale LFG purification, compression and bottling plant/station has occurred after year 2012. Although the edification of the pilot small-scale LFG purification, compression and bottling station still available in the CR do Recreio landfill in august 2014, all of its equipment were disassembled and removed from the project site. Moreover, the LFG pipeline connecting the pilot station to the project's LFG main pipeline was also disassembled on 31/10/2013. The box below includes, for sake of completeness and transparency, further details about such pilot and non-commercial small-scale LFG purification, compression and bottling station.

Box 1 - Pilot and non-commercial small-scale LFG purification, compression and bottling station (using LFG collected by the project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)"

On 29/11/2010, SIL – Soluções Ambientais Ltda. signed a technical and non-commercial cooperation agreement with the state owned Companhia de Gás do Estado do Rio Grande do Sul (Sulgás) (local natural gas distribution company) and with the waste management department of the Administration of the Municipality of Porto Alegre city (*Departamento Municipal de Limpeza Urbana da Cidade de Porto Alegre – DMLU*) with the purpose/scope of investigating the potential for production of *bio-methane fuel* from purification of collected LFG and its utilization as gaseous fuel for light and heavy vehicles for scientific investigation purpose only.

During the period from August 2011 to November 2012, a pilot small-scale LFG purification, compression and bottling station (under a non-continuous and non-regular basis) has operated by collecting, purifying, compressing and bottling (in cylinders) very small amount of LFG. Such reduced amount of LFG was collected by the project activity.

The following aspects are relevant in the context of the operation of the pilot and non-commercial small-scale LFG purification, compression and bottling facility (with LFG purification capacity of 30 Nm^3/h and bottling capacity of 10 Nm^3/h).

The installed small scale LFG purification, compression and bottling station is equipped with the following main components:

- system to remove Hydrogen Sulfide Gas (H_2S), Siloxanes, Carbon Doxide (CO_2), Oxigen (O_2), Nitrogen (N_2) and water from LFG. The system is designed and supplied by Janus & Pergher Ltda. and it has LFG purification capacity of 30 Nm^3/h (or 720 Nm^3 per day)
- system to compress (up to 220 bar (22,000 kPa)) and bottle LFG with compression/bottling capacity of 10 Nm^3/h (or 240 Nm^3 per day)

The two following pictures show the small-scale pilot LFG purification and bottling plant, and the point in the project's LFG collection pipeline where LFG is collected to be processed in the facility (prior to the LFG flow meter of the project activity):

External view of the small-scale pilot LFG purification and bottling plant (first picture) and the point within the project's LFG collection pipeline where LFG was collected to be processed in the facility (termed as "*Entrada GNVerde*")

- The non-commercial cooperation agreement became effective on the 23/12/2010 (publication of notification about the cooperation agreement date in the official press of the municipality of Porto Alegre (*Diario Oficial*).
- Under the cooperation agreement, it was responsibility of both Sulgás and SIL the installation of the small scale LFG purification, compression and bottling station.
- The small-scale station initiated operations on 8 August 2011 under a non-continuous basis[17].
- While the operation of the station envisaged research, the station operated under a temporary and not constant operation during a limited time period, and no operation of the plant occurred after November 2012.
- As there are no commercial transactions in the context of the technical cooperation agreement, SIL – Soluções Ambientais Ltda. does not have any financial benefit (no supplied LFG was sold). Due to that, no LFG flow meter was installed (to precisely measure the amount of collected LFG purified and bottled by the small-scale station).
- Although very low amount of collected LFG was directed to the pilot small-scale LFG purification, compression and bottling station, this station is not regarded as part of the project activity. Thus the occurred limited production and bottling of *bio-methane fuel*, and the utilization of such *bio-methane* as fuel for vehicles as part of the performed experiments are not included in the boundary of the project activity.
- Supply of collected LFG to the small-scale pilot LFG purification and compression plant occurred through a T-junction which is located in a section of the main LFG pipeline prior the project's LFG flow meter (which is used to measure the amount of LFG sent to the flare). Therefore, no LFG used at the small-scale pilot LFG purification and compression plant was ever accounted as LFG collected by project activity and sent to the flare.
- By considering the temporarily validity of the cooperation agreement (18 months), the implementation of the small-scale pilot LFG purification and compression plant does not represent any permanent change in the design of the project activity.

It is crucial to note that although the edification of the pilot small-scale LFG purification, compression and bottling station is still made available in the CR do Recreio landfill, all equipment were disassembled and removed from the project site. Moreover, the LFG pipeline connecting the pilot station to the project's LFG main pipeline was also disassembled on 31/10/2013.

Thus, in accordance with applicable rules and regulations of the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (*Agência Nacional do Petróleo, Gás Natural e Biocombustíveis - ANP*), no purified LFG was ever consumed as fuel internally or externally by vehicles with purpose other than research and testing.

As established in the terms of the signed technical and non-commercial cooperation agreement, the installed pilot small scale LFG purification, compression and bottling station was planned to be demobilized after 18 months of operation, however on 29/05/2012 the parties signed an extension of the agreement for additional 12 months, that ended on 29/05/2013. The plant is currently completely demobilized. However, the edification for the pilot plants remains in the project site.

SIL – Soluções Ambientais Ltda. highlights that the installation of the pilot station and the occurred research / testing events in the project site do not represent any temporary or permanent post-registration change in the design and/or operation of the project activity that would need to be addressed as per applicable procedures for addressing post-registration changes (as defined in the latest version of the Clean Development Mechanism Project Standard) or even by any other mean/procedure due to the following aspects:

- The temporary and not actually continuous (less than 2 hours per day on average) operational aspect of the initiative involving a small-scale pilot station for research purpose

[17] As demonstrated to the verifying DOE in previous verification assessments of the 1st 7-year crediting period (on-site assessment observation, documents, etc.), all LFG supplied to the pilot small-scale LFG purification, compression and bottling station has been diverted from the LFG pipeline which transport LFG collected in the project's LFG wells to the LFG flaring facility. No LFG sourced to this pilot small-scale LFG purification, compression and bottling station was ever accounted for the determination of emission reductions achieved by the project activity in the context of verification assessments.

only (under the framework of the signed technical and non-commercial cooperation agreement) has consumed very small amount of LFG (and under a non-continuous basis) when compared to the typical flow of LFG which has been continuously collected by the project activity.

- It is important to mention that LFG utilized by the small-scale pilot station during its operational phase was not measured and was not accounted in the context of the monitoring of quantity of LFG collected and combusted by the project activity in the context of previous verification assessments. Thus, no emission reductions were ever claimed due to any amount of LFG used by the pilot station that would otherwise be emitted into the atmosphere in the absence of the project (baseline scenario).

- The project participant SIL – Soluções Ambientais Ltda. never had any economic benefit by allowing Sulgás to use a very small fraction of collected LFG for generation of bio-methane under the established technical cooperation and research agreement: no sale of LFG occurred, no use of the vehicles being fuelled with purified LFG occurred by SIL – Soluções Ambientais Ltda. (the test vehicle fuelled with purified LFG was under test cycle operation by the research staff for testing and evaluation purposes only), no renting of space occurred.

- The whole concept and goal of the temporary and not continuous operation of the small-scale pilot LFG purification, compression and bottling station served as a platform for technical research only (with no commercial or economic focus). The interest of Sulgás and waste management department of the Administration of the Municipality of Porto Alegre city in the issue of utilization of LFG as a vehicle fuel was actually trigged by the CDM. Awareness about potential energetic utilization of LFG from landfills can be regarded as one of the positive externalities of the CDM in Brazil.

No change in the design and operational conditions of the CR do Recreio landfill:

As required by ACM0001 (version 15.0), the design and operational conditions of the CR do Recreio landfill has not changed after the implementation of the project activity and no change is expected to occur within the 2^{nd} 7-year renewable crediting period. While the volume covered with disposed MSW at the CR do Recreio landfill has increased as part of the normal operational dynamics of such large landfill, the landfill design and operational requirements in place are still being the same since the start to operations of the landfill in year 2001 regardless of the implementation (in year 2007) and constant operation of the project activity (since December 2007).

The CR do Recreio landfill is thus expected to remain being operated with the application of the same and previously applied MSW landfilling technics and procedures. SIL – Soluções Ambientais Ltda. (and more recently CRVR S.A.) has designed and has managed and operated the CR do Recreio landfill in accordance with its design, construction, operational and management requirements as required and established in the environmental permits and licenses applicable for the CR do Recreio landfill and best practices for landfill construction and operations in Brazil.

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)
Brazil (host)	Companhia Riograndense de Valorização de Resíduos S/A	No
Brazil (host)	Biogás Riograndense Ltda.	No
United Kingdom of Great Britain and Northern Ireland	Belektron d.o.o.	No

A.5. Public funding of project activity

>>

No public funding is involved for the implementation and operation of this project activity.

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

B.1. Reference of methodology and standardized baseline

>>

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 also applied:

- Emissions from solid waste disposal sites (version 07.0, EB83) (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v6.0.1.pdf/history_view);

- 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);

- Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 02.0.0, EB 61) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v2.0.0.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);

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

B.2. Applicability of methodology and standardized baseline

>>

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*[18] *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*	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 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 3). Nonetheless, in order to comply with the currently applicable requirements for landfill gas projects, the PDD was updated (in the context of a Post registration changes request in the context of the 1st 7-year.crditing period) by applying the latest valid version of ACM0001 (version 15.0) baseline and monitoring methodology. While ACM0001 (version 15.0) remains being 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. The project design encompasses the installation of an active (forced) LFG capture system in an existing SWDS partially replacing a previously existent passive LFG combustion system (using conventional passive LFG venting/combustion drains)[19]with collected LFG

[18] SWDS = Solid Waste Disposal Site. In the particular case of the project activity, the considered SWDS is the CR do Recreio landfill.

[19] While the installed active (forced) LFG capture system as part of the project activity encompasses entirely new equipment (centrifugal blowers, flares, etc.), by assuming that the project activity completely replaces the previously existent pre-project passive LFG venting and combustion system (using conventional passive LFG venting/combustion drains), in the particular context of the demonstration of meeting of applicability criteria for ACM0001 (version 15.0), it is assumed that condition (a) is not applicable and condition (b – i) is applicable. As

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 15.0)	**Justification**
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* *(iii) Supplying the LFG to consumers through a natural gas distribution network.* *(iv) Supplying compressed/liquefied LFG to consumers using trucks* (d) *Do not reduce the amount of organic waste that would be recycled in the absence of the project activity."*	being flared and utilized as gaseous fuel for electricity generation. The project was implemented in year 2007. In this sense, condition (b) – (i) of the quoted applicability criteria is met. The pre-project practice for LFG management is outlined in Section A.3. The project design encompasses collection of LFG and its destruction by flaring and/or its utilization as gaseous fuel for electricity generation. The project design does not encompass any other type of utilization of collected LFG. Thus, the project activity meets condition (c) - (i). *The implementation and operation of the project activity does not reduce the amount of organic waste that would be recycled in the absence of the project activity:* As a result of the previously occurred implementation of the project activity, there were no quantitative, qualitative, procedural or regulatory change occurred or triggered in terms of MSW management activities and policies valid for the CR do Recreio landfill and/or valid for any other existing solid waste treatment or solid waste 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 Brazil, both the implementation and operation of the project activity *per se* are not expected to promote any quantitative or qualitative change in terms of waste disposal activities historically undertaken at the CR do Recreio landfill. Furthermore, no quantitative or qualitative changes in terms of waste management practices are expected to occur in any other existent or potential solid waste disposal site (SWDS) or solid waste treatment facility (located or to be located in the region under influence

previously assessed as part of the validation assessment for the currently registered CDM project activity, prior to the implementation of the project activity, while a share of generated LFG was captured and vented through existent conventional venting/combustion drains, a minor share of collected LFG was combusted in a non-systematic or controlled manner. Such pre-project existent conventional LFG venting/combustion drains operated without any forced negative pressure gradient. No collected LFG were used for electricity or heat generation in the pre-project scenario. No collected LFG were supplied to consumers through a natural gas distribution network either. As a conclusion, no systematic or continuous monitoring of LFG (under a quantitative or qualitative perspective) has occurred prior to the implementation of the project activity at the CR do Recreio landfill. Under the initial project implementation phase, capital investments were made in new equipment (as part of the implementation of the project activity) in order to replace the pre-project conventional and inefficient LFG management solution, thus increasing the LFG recovery rate at the landfill and allowing systematic and controlled combustion/flaring for captured LFG. Under the second and yet to occur project implementation phase, collected LFG is utilized as gaseous fuel for electricity generation in a yet to be built new electricity generation facility.

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 15.0)	Justification
	by the CR do Recreio landfill) as a direct outcome or consequence of the implementation and operation of the CDM project activity during the 2nd 7-year crediting period. Thus, the mere previously occurred implementation of the project and its continuous operation as a LFG collection and destruction/utilization initiative have not promoted and 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)). The implementation of the new electricity generation facility fuelled by collected LFG is 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 either. As demonstrated in applicable construction, design and operational documented requirements valid for the CR do Recreio landfill (as previously defined by SIL – Soluções Ambientais Ltda. and later confirmed in the environmental permits valid for the construction and operation of this landfill), the CR do Recreio landfill is not expected to include any activity or initiative promoting recycling or utilization of organic fraction of waste disposed in this landfill (such as implementation of a large scale waste sorting or waste composting facility for example). Thus, without any organic waste recycling activity being under operation within the limits of the CR do Recreio landfill, it is clearly not expected that the mere implementation of the project activity promoting collection and destruction/utilization of LFG could eventually promote any reduction in the amount of organic waste recycling activities in the CR do Recreio landfill and/or in any other site located in region under influence of the CR do Recreio landfill. The design, construction and operational aspects for the CR do Recreio Landfill were previously defined in accordance with the commercial agreements that the project participant SIL – Soluções Ambientais Ltda. (and more recently CRVR S.A.) holds and is expected to hold in the position of the owner of the CR do Recreio landfill and also in the position of a private regional waste management company (service provider) acting as a player in the market and providing MSW disposal services for the city of Porto Alegre and

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 15.0)	Justification
	other municipalities located within its Metropolitan Region (including the city of Minas do Leão). 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 CR do Recreio Landfill. As a matter of fact, recycling and utilization of organic fraction of MSW is not a common practice in the whole country of Brazil. In this sense, the implementation and operation of the project activity thus clearly does not represent any perverse incentive or driver for the promotion of any quantitative or qualitative reduction or even 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 CR do Recreio Landfill or in the region of influence of this landfill [20]. The same is actually also applicable for recycling of inert waste material.

[20] As per the Brazilian Federal Law 12.305/10, waste recycling is defined as a process of transformation of waste material and residues through promotion of changes in their physical, chemical or biological properties in order to allow and promote use of such materials as raw material or even as new products. Although waste recycling is being regarded in the national sector directives for waste management as a priority goal, solid waste recycling initiatives in Brazil are still being quite limited (especially in the case of organic fraction of MSW). As outlined in the publication "*Panorama dos Resíduos Sólidos no Brasil – 2014*" (tittle translated into English language as "*Outlook of Solid Waste Sector in Brazil – year 2014"* and available online at: http://www.abrelpe.org.br/panorama_apresentacao.cfm), solid waste recycling initiatives in Brazil have encompassed mainly the following by-products/waste types with higher economic value:

- aluminum (mainly beverage aluminum cans),
- pre-separated/sorted clean (not contaminated) paper,
- pre-separated/sorted (not contaminated) plastic material (mainly PET beverage bottles),
- glass material.

The "*Panorama dos Resíduos Sólidos no Brasil*" is a publication annually published by the Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais – ABRELPE (translated into English language as "Brazilian Association for Municipal Solid Waste and Special Waste") and represents one of the most credible annual outlook and statistics source for the solid waste management in Brazil. The most recent Greenhouse Gases Emissions National Inventory (published by the Brazilian Ministry of Technology and Science in 2010 and available online at: http://www.mct.gov.br/upd_blob/0213/213909.pdf) also confirms that non-conventional MSW treatment alternatives (such as composting of organic fraction of MSW and waste incineration) are not meaningful practices in Brazil (including the region where the project activity was implemented).
In fact, in year 2012 the Brazilian Ministry of City Infrastructure (through its National Secretary of Sanitation) has published the year 2010 edition of a very comprehensive and detailed sectoral analysis/diagnostic about the whole MSW sector in Brazil: the publication "*Diagnóstico do Manejo de Resíduos Sólidos Urbanos – 2010*" (tittle translated into English language as "Diagnostics of Urban Solid Waste Management - 2010" and available online at: http://www.snis.gov.br/PaginaCarrega.php?EWRErterterTERTer=93). Like the Report "*Panorama dos Resíduos Sólidos no Brasil – 2014*", this Government official publication also includes relevant and detailed statistics for MSW management for the main municipalities, States and regions in Brazil. Available statistics includes prevailing practices in terms of waste management practices (collection, disposal and re-use/recycle).
In the particular case of the region under potential influence of the CR do Recreio landfill (city of Porto Alegre and surrounding cities), all solid waste materials (organic or inert) to be eventually/potentially recycled (very small share of collected MSW) are normally previously sorted in the waste generation sources (prior to be mixed with other types

of MSW to be disposed in landfills or waste dump sites in the region). In the particular case of recycling of organic fraction of waste material to be disposed in landfills or dump sites, the current *status quo* is also expected to be the prevailing situation valid in the future: paper waste streams (mixed with other MSW types), food residues, textile, wood waste etc. when ready to be disposed in landfills/dump sites or already disposed in a particular landfill or dump site) are not even regarded as recyclable material (and thus not even accounted in the available statistics for recyclable material).

Under the category "organic MSW fraction" only clean (not contaminated) and previously sorted pulp/paper/cardboard waste materials has actually been considered as recyclable material (as per both available statistics and available recycling practices). Besides some particular inert waste materials with commercial value (e.g. aluminum, clean plastic material and glass), no other waste materials have been collected from stream of MSW to be disposed in landfills in order to be recycled in the region where the project activity is implemented or transported to be recycled in other region. This has also been the common recycling scenario in other regions of Brazil.

Thus, in the particular case of the CR do Recreio landfill, both under the baseline and project scenarios (with or without the implementation of the project activity), no organic fraction of solid waste stream that has been directed to this landfill would be expected to be collected and directed to any type of recycling facility (e.g. composting facility) after or prior its disposal in the landfill site. This situation is expected to remain being the practice in the future. In fact, as established by related construction and design documents for the CR do Recreio landfill, no waste pickers or waste sorting teams have ever operated in the landfill area. No composting plant for organic waste (or any other type of alternative management for MSW organic content) was ever implemented or is expected to be implemented in the area in the future either.

That confirms that no relevant sorting and collection of recyclable organic material from MSW already disposed in the CR do Recreio landfill are expected to occur regardless of the implementation of the project activity (under both baseline and project scenarios). Thus, recycling or alternative use from organic fraction of waste already disposed in the landfill are not expected to occur either (regardless of the implementation of the project activity).

In summary, based on information and data included in the "*Diagnóstico do Manejo de Resíduos Sólidos Urbanos – 2010*"; information and data available in the "*Panorama dos Resíduos Sólidos no Brasil – 2014*" and also based on common practice for waste collection, disposal e recycling in the region of the project activity and even in other regions in Brazil, and by also taking into account the local situation at the region of the project site, the following assertions are valid for potential of recycling of organic fraction of MSW in the region of influence of the CR do Recreio landfill:

- The current MSW management practice in Brazil (and its trend for the future) represents disposal of collected MSW in existing and new landfills (and still existing open dump sites). This practice currently represents almost all undertaken management for all stream of MSW which is actually collected (in mass basis); with very reduced share of collected MSW in Brazil being currently treated under non-conventional methods such as waste incineration (0.03%) and composting (0.11%) (in mass basis as per data of year 2010 (data organized and published in year 2012)).
- It is important to note that in all regions in Brazil with existing MSW disposal activities using landfilling techniques (in existing landfill or existing dump sites) significant quality improvements in terms of MSW disposal services and techniques are still required especially for cases where solid waste is disposed in existing dump sites and in existing not well designed/managed landfills. Such required improvements include construction of better designed landfills, use of more appropriated technics for waste compacting and covering, etc. In this sense, the CR do Recreio landfill represents a very well designed and managed landfill. The main barrier for improving MSW management in Brazil is still being lack of capital and investment capacity from municipalities to face high associated costs for implementing environmentally friendly MSW management operations. Under the region of influence of the CR do Recreio landfill, organic fraction of solid waste material which is collected as MSW has been historically disposed by applying landfilling techniques.
- In all geographical regions in Brazil, relative low share of previously sorted pulp/paper/cardboard (clean and not contaminated) waste materials have been used as recycling material in the region. Materials under such conditions are termed in the available statistics as "dry recyclable material" and are normally not mixed with MSW stream to be sent to landfills or dump sites. It is important to note that the initiatives and businesses involving recycling of previously sorted dry pulp/paper/cardboard materials (clean and not contaminated materials) have their particular dynamics and characteristics and with not so detailed statistics in some cases. However, under no circumstance such activities are to be affected or even influenced by change, improvements or aspects related to MSW disposal activities employing good landfilling technics (for example: in most of the well managed landfills in Brazil, the landfill is implemented in a closed and controlled area without waste pickers collecting waste from the landfill as a way or living). By taking into consideration the dynamics of initiatives promoting recycling of paper material, it is correct to assume that, differently than for MSW disposal activities; policies, planning and practices related to MSW collection and sorting could indeed under a certain limit play a role such initiatives.
- By merely promoting efficient collection and destruction/utilization of LFG in a landfill (where LFG is generated due to anaerobic degradation of organic fraction of MSW which is to be disposed in the landfill under the framework of contracts for MSW disposal signed with municipalities in the region), the implementation of the project activity and its continuous operation *per-se* clearly does not represent any driver or incentive for promoting any change in the MSW management situation in the region where it is

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 15.0)	Justification
	Furthermore, regardless of the non-existence of any MSW recycling or utilization facility with comparable capacity that could eventually somehow compete with the CR do Recreio Landfill in terms of processing of 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 Brazil (including policies, laws, regulations and programmes) and are to be defined/triggered by competent governmental authorities (under a regional and national level) and/or to be eventually implemented/operated by practitioners of waste recycling.

implemented (including waste recycling practices or initiatives for organic content of MSW to be disposed in landfills or dump sites).

By taking into account (i) the institutional and regulatory framework for the public service of MSW management; (ii) the dynamics of MSW sector in the region where the project activity is to be implemented and in Brazil, and (iii) magnitude of average costs for existing MSW management options (which could be regarded as alternatives to disposal of MSW in landfills (e.g employment of MSW composting techniques)), (iv) the available related statistics, the following aspects are to be noted:

- it is clear that promotion or even disincentive of recycling of organic fraction of MSW are not waste policy aspects that would be under any influence or willingness of the project participant SIL – Soluções Ambientais Ltda. or CRVR S.A. (owner and operator of the CR do Recreio landfill). Aspects and actions related to promotion of any increase or even reduction of recycling of organic fraction of waste (and/or recycling of any other type of solid waste material) in the region where the project activity is implemented, are to be seen as dependent in a last instance on public service policies (including policies, laws, regulations and programmes) to be set by competent governmental authorities (under a regional and national level) and by practitioners of recycling. In Brazil, the administrations of municipalities are responsible for addressing all MSW management services. Furthermore, there are federal directives and laws to be considered by Municipalities for the implementation and operation of their local waste management policies. This is the case in the geographical region of the project site. Waste collection and disposal services are normally performed by the municipality and/or are performed by private companies hired and paid by one or more municipalities (under contractual commercial agreements for provision of public service on behalf of such municipality (ies)) for the provision of MSW collection and/or MSW disposal services by completely following directives and requirements established by the municipalities in signed contracts. In this context, both under the baseline and project scenarios (with or without the implementation of the project activity), SIL – Soluções Ambientais Ltda. and CRVR S.A. are not under a position to design or plan the implementation of any initiative promoting recycling or use of organic waste (e.g. operation of a solid waste composting plant) at the CR do Recreio landfill or at other location in the region.
- The implementation of the project-based initiative promoting collection of LFG and its destruction in high temperature flare and utilization as fuel for electricity generation in the CR do Recreio landfill *per se* would not trigger any change in the regional policies and practices for MSW management in the region or outside its region of influence either. As further discussed in Section B.6.1, so far, there is still no legal restriction neither requirement for LFG gas collection and its destruction using high temperature enclosed flares in Brazil. Moreover, there is still no legal restriction neither requirement for passive venting of LFG or its combustion in conventional LFG destruction systems either. Actually, there is no applicable regulation that deals with LFG management in Brazil. Thus, the implementation (and operation) of more appropriate and environmentally safe management of LFG at the CR do Recreio landfill as part of the project activity does not represent a driver or incentive to promote incremental disposal of organic waste stream at this landfill thus displacing or preventing such waste stream from being treated under an existent or potential (hypothetical) MSW recycling/utilization facilities (e.g. a hypothetical waste composting plant) instead.

In summary, by taking into consideration the nature of project activity and all aspects and information above-presented, the project activity does not pose any risk or potential to promote any relative decrease of the amount of organic fraction of MSW that would be otherwise recycled or utilized or prevention of any mean of waste recycling or utilization.

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – “Flaring or use of landfill gas” (version 15.0)	Justification
	In Brazil, the administrations of municipalities are the entities responsible for all MSW management services. Waste management companies such SIL – Soluções Ambientais Ltda. and the more recently established CRVR S.A. normally acts as service providers, providing MSW collection and disposal services as per directives and contractual requirements which are 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, SIL – Soluções Ambientais Ltda. and more recently CRVR S.A. are 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 CR do Recreio Landfill. No change in this sense is expected to occur during the 2nd 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 Brazil. Actually, there is no applicable regulation that deals with LFG management in Brazil at all. Thus, the implementation of more appropriate and environmentally safe management of LFG at the CR do Recreio 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 CR do Recreio 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 CR do Recreio Landfill because of the implementation and continuous operation of the project activity. Therefore applicability condition (d) is also satisfied.

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 15.0)	**Justification**
"*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* *(ii) 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 baseline scenario for the project activity is directly identified as release of LFG from the SWDS into the atmosphere (with minor share of generated LFG being partially destroyed in conventional LFG passive venting/combustion drains)). Since the project activity (under its revised design configuration) also promotes generation of electricity (of which equivalent amount would otherwise be generated by existing grid connected power plants and new additions – including fossil fuel fired power plants), the application of the procedure to identify the baseline scenario falls into (b) (i). The quoted applicability condition is thus satisfactory met.
Non applicability conditions	**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;* (b) *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*	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 flare(s) and in the engine-generator sets + GHG emission reductions associated with electricity generation using LFG as fuel (which would otherwise be generated by existing grid connected power plants and new additions – including fossil fuel fired power plants). After the implementation of the phase 1 of the project activity in year 2007, the landfill operator has continued with MSW disposal activities at the CR do Recreio 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 CTR Caieiras landfill are not expected to change during the 2nd 7-year crediting period either.

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 15.0)	Justification
activity.	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* *o 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 "Tool to determine the mass flow of a greenhouse gas in a gaseous stream". The applicability conditions of this tool also apply."*	As part of the project activity, share of collected LFG (whose component with the highest concentration is methane) is combusted in the high temperature enclosed flare(s) with other share being used as gaseous fuel for electricity generation. LFG is a flammable gas generated from the anaerobic decomposition of organic waste material disposed in the CR do Recreio 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 flare(s)[21]. As demonstrated above, the applicability conditions for the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" are also sufficiently met.

[21] In accordance with the design of the currently installed high temperature enclosed flare, Liquefied Petroleum Gas (LPG) has been used during short time periods for igniting the flares. For starting the flare, LPG is directed to the fuel injectors of the flare and once the flame is sufficiently stable, collected LFG is thus directed to the flare and supply of LPG to the injectors is thus immediately interrupted. 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's flare). 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 the installed flare 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
			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 source of electricity consumption.* <u>*Scenario B:*</u> *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.* <u>*Scenario C:*</u> *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."*	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 imports of grid electricity and/or by electricity generated in the electricity generator facility as part of the normal operation of the project activity. In cases of interruption of the power plant, the electricity demand of the project is to be met by imports of electricity sourced by the National Electricity Grid of Brazil and/or by electricity generated by the backup captive off-grid electricity generator (fuelled by Diesel). Thus, Scenario C of the tool is applicable. It is also important to note that, as established by ACM0001 (version 15.0) and further explained in Section B.6.1, baseline emissions for the amount of electricity to be generated by the project activity is also determined by applying the "Tool to calculate baseline, project and/or leakage

Methodological tool	Version	Applicability conditions	Comments
			emissions from electricity consumption".
"Emissions from solid waste disposal sites"	07.0	*"This tool provides procedures to calculate baseline, project or leakage 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 as established by ACM0001 (version 15.0).
"Tool to calculate the emission factor for an electricity system"	04.0.0	*"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-sourced electricity by the project activity and baseline emissions for the amount of electricity generated by the project activity (which, in the baseline scenario would otherwise be generated by existing grid connected power plants and new additions – including fossil fuel power plants) 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 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 (and to which to the project's new electricity generation facility is connected) is determined as the combined margin

Methodological tool	Version	Applicability conditions	Comments
			CO_2 emission factor. The relevant applicability condition of the methodological tool is thus fully 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 installed flare (after events of planned or unplanned interruptions of operation of the flare). The applicability condition of the methodological tool is thus met.
"Tool to determine the mass flow of a greenhouse gas in a gaseous stream"	02.0.0	"*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 which is sent to the flare(s) or sent to the project's new electricity generation facility. The applicability condition of the methodological tool is thus met.
Methodological tool "Assessment of the validity of	03.0.1	"*This tool provides a stepwise procedure to assess the continued validity of the baseline and to update*	The application of this tool in the context of the renewal of the 7-year crediting

Methodological tool	Version	Applicability conditions	Comments
the original/current baseline and to update the baseline at the renewal of a crediting period”		*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.*”	period is required as per the CDM Project Standard. The applicability condition of the methodological tool is thus met.

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 flare(s) and where electricity is generated by using LFG as the only fuel. A backup captive off-grid electricity generator (fuelled by diesel) is included as part of the project design and it is expected to be used only for emergency purposes[22]. The electricity grid to which the project's electricity generation component is connected for exporting electricity as well as for eventually importing grid-sourced electricity[23] is the National Electricity Grid of Brazil. The table below provides a summary of the delineation of greenhouse gases (GHG) and sources included and excluded from the project boundary:

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 in grid-connected power plants	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.
		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.

[22] The captive off-grid backup electricity generator (fuelled by diesel) is 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)

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).

in the context of ex-ante estimates of emission reductions to be achieved by the project activity . However, such project emissions are correctly determined ex-post along the crediting period (based on applicable monitoring and calculation requirements as presented in Section B.6.1) and are accounted for the determination of emission reductions.

[23] After the implementation of project's new electricity generation facility, the project's electricity demand started to be met by one of the following sources:

- small fraction of electricity generated by the project activity (with most of generated electricity being exported through the National Electricity Grid of Brazil);
- imports of grid-sourced electricity.

installed backup captive off-grid electricity generator (fuelled by diesel) (only during temporary planned or unplanned circumstances where (a) project's electricity generation facility is temporarily not under operation or (b) supply of grid-sourced electricity is temporarily interrupted).

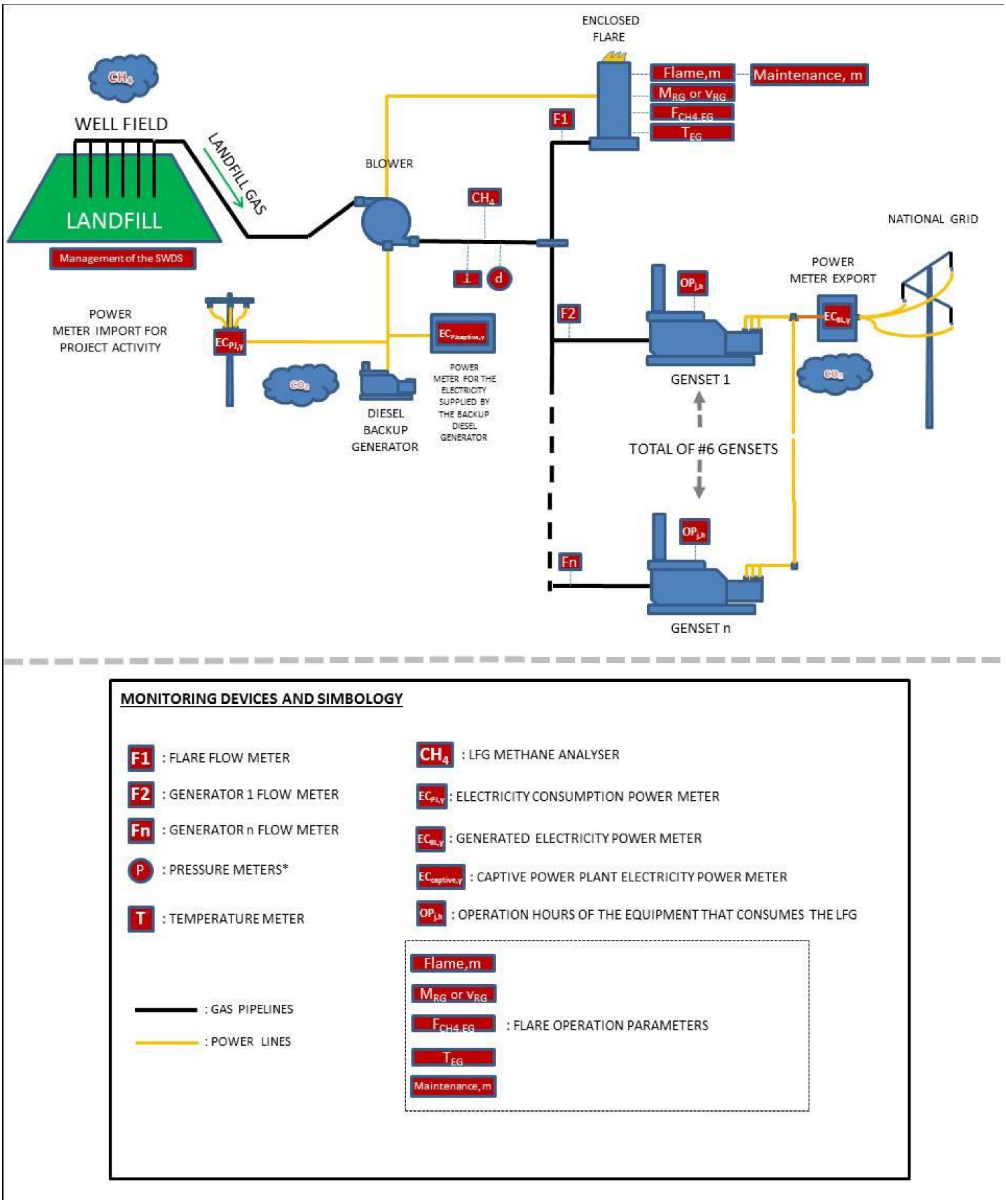

Figure 7 - Schematic flow diagram: delineation of the project boundary for the project activity

B.4. Establishment and description of baseline scenario

>>

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" (version 03.0.1) for demonstrating the validity of the previously derived baseline scenario for the project activity. This demonstration is performed by presenting the whole determination of the baseline scenario by following the 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 for the project activity, 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 previously derived baseline scenario for the project activity (which was previously determined and assessed at the time of the validation of the project activity in year 2006 and later updated in year 2014 as part of the inclusion of the project's new electricity generation component as a permanent change in the design of the project activity).

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

Continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0):

Identification of the baseline scenario: As per the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0), that is the approach applied in the latest version of the PDD valid for the expired 1st 7-year crediting period for determining the baseline scenario of the project activity, the baseline scenario is directly determined as follows:

> *"The baseline scenario for LFG is assumed to be the atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons. If all or part of the electricity generated by the project activity is exported to the grid, the baseline scenario for all or the part of the electricity exported to the grid is assumed to be electricity generation in existing and/or new grid-connected power plants. If all or part of the electricity is supplied to off-grid application, the baseline electricity generation equipment is assumed to correspond to the default emission factor from Option B2 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"; (…)"*

By also considering the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0) in the context of the renewal of the crediting period of the project activity as valid, the baseline scenario for the project activity along the 2nd 7-year crediting period remains being directly determined as follows:

> *In the particular case of the CR do Recreio landfill, it is assumed that in the absence of the project activity (baseline scenario), generated LFG would be directly emitted into the atmosphere through the surface of the landfill and through the existent pre-project conventional LFG venting/combustion drains. It is also assumed that under the baseline scenario (absence of the project activity) a minor share of LFG generated at the landfill would be combusted under uncontrolled and non-systematic manner in the existent pre-project conventional LFG venting/combustion drains. Under the baseline scenario, it is also assumed that no electricity generation would occur at CR do Recreio landfill and that electricity (in equivalent amount of electricity to be generated under the project scenario) would be generated by existing grid-connected power plants and addition of new power generation units, including fossil fuel fired power plants, within the National Electricity Grid of Brazil.*

In summary, by taking into account the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0) as a valid approach, there is no need to assess compliance of the current baseline with relevant mandatory

national and/or sectoral policies as such simplified procedure directly establish the baseline scenario. The demonstration of continuation of the baseline scenario for the project activity is thus directly assumed to be under full compliance with mandatory national, regional and/or sectorial policies and requirements.

Regardless of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0), it is to be noted that, as further explained in Section B.6.1, prior to the registration of the project as a CDM, there was no legal obligation to capture and destroy the LFG at the CR do Recreio landfill and in any other existing landfill in Brazil. This situation currently prevails[24]. Although there is still no regional or national legal requirement in Brazil establishing LFG to be collected and destroyed in landfills in Brazil, in the particular case of the CR do Recreio landfill, as per the design, construction and operational requirements applicable for this landfill and previously voluntarily defined by SIL – Soluções Ambientais Ltda., since the time of its construction and start of operations it has been required that a non-defined and small share of generated LFG are to be vented and/or destroyed by combustion in conventional passive LFG venting/combustion drains in order to address safety and odor concerns. Combustion of minor share of generated LFG in conventional passive LFG venting/combustion drains was indeed the normal practice and only existent LFG management measure in place (during the period from year 2001 to 2007) prior to the implementation of the project activity. A set of conventional LFG venting/combustion drains was installed in the landfill in order to address such safety and odor concerns since the initial operational phase of the landfill by year 2001 (prior to the implementation of the project activity).

Regardless of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0), 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

By taking into account the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0) as valid in the context of the renewal of the crediting period for the project activity, it is assumed that there is no need to assess the impact of circumstances (such availability of new fuels or raw materials and the impact of electricity or fuel prices in the identification of the current practice for the baseline emissions) and/or sectoral policies which have come into effect after the submission of the project activity for validation or the submission of the previous request for renewal of the crediting period and are applicable at the time of requesting renewal of the crediting period.

By also taking into account the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0), the demonstration of continuation of the baseline scenario for the project activity is thus assumed to be independent from the validity of conditions used to determine the baseline emissions in the previous crediting period. Assess the availability of new fuels or raw materials and the impact of electricity or fuel prices in the identification of the current practice for the baseline emissions is thus assumed as not required.

Regardless of the validity of the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0) for the renewal of the crediting period, the previously identified baseline scenario for the project activity is demonstrated as not changed at the time of requesting renewal of the crediting period. As demonstrated in the previous step, besides the Brazilian National Policy on Waste Management (Decree No. 7,404/10), there are no other relevant mandatory national and/or sectoral policies which have come into effect

after the submission of the project activity for validation or the submission of the previous request for renewal of the crediting period and are applicable at the time of requesting renewal of the crediting period. Details about the Brazilian National Policy on Waste Management (Decree No. 7,404/10) and its impacts over the baseline scenario for the project activity are also included in the previous step. Thus, the conditions used to determine the baseline emissions in the previous crediting period are still valid.

As an outcome of such analysis, it is confirmed the following:

- By taking into account the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0), the conditions and circumstances considered or taken into account to determine the baseline emissions in the previous 7-year crediting period are directly assumed as still being valid. It is directly assumed that LFG (rich in CH_4) generated at the CR do Recreio landfill would still being freely emitted into the atmosphere (with minor share of generated LFG being destroyed in conventional passive LFG venting/combustion drains in order to address safety and odor requirements) in the absence of the project activity. Generated LFG would still being freely emitted into the atmosphere through both the surface of the landfill and through the conventional passive LFG venting/combustion drains (whenever such drains are not alight). Furthermore, generation of electricity (in an amount equivalent to the amount of electricity generated by the project activity) would occur in existing fossil-fuel power generation sources connected to the National Electricity Grid of Brazil and/or new additions of fossil-fuel power generation sources under the baseline scenario.

- Regardless of the validity of the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0) in the context of the renewal of the crediting period of the project activity, 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.

By considering the validity of the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0) in the context of the renewal of the crediting period for the project activity, the baseline scenario for the project activity remains being directly determined as outlined under application of Step 1.1.

However, regardless of the validity of the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0) in the context of the renewal of the crediting period of the project activity, while the baseline scenarios previously identified at the validation of the project activity and later at the inclusion of the new project's electricity generation facility as a post-registration change in the project design were 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 thus not applicable.

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

While the latest version of the registered PDD valid for the previous 1st 7-year renewable crediting already applies the CDM baseline and monitoring methodology ACM0001 (version 15.0) + applicable methodological tools [25], most of the ex-ante selected data and parameters as per the latest version of the PDD for the 1st 7-year crediting period remain valid. The only ex-ante determined parameters to have value updated are the following ones:

- Build margin CO_2 emission factor in year *y* ($EF_{grid,BM,}$)
- Weighting of build margin emissions factor (w_{BM})
- Weighting of operating margin emissions factor (w_{OM})

The values for the above-listed ex-ante determined parameters are updated as per applicable guidance of the methodological tool “Tool to calculate the emission factor for an electricity system” (version 04.0, EB 75)

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

The application of Steps 1.1, 1.2, 1.3 and 1.4 confirmed that the current baseline as well as most of data and parameters are still valid for the 2nd 7-year renewable crediting period, this Step is thus regarded as not applicable.

The only ex-ante determined parameters to have value updated are the following ones:

- Build margin CO_2 emission factor in year *y* ($EF_{grid,BM,}$)
- Weighting of build margin emissions factor (w_{BM})
- Weighting of operating margin emissions factor (w_{OM})

The values for the above-listed ex-ante determined parameters are updated as per applicable guidance of the methodological tool “Tool to calculate the emission factor for an electricity system” (version 04.0, EB 75)

B.5. Demonstration of additionality

>>

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[26]. Anyway, it is crucial to consider that the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0) remains being considered for the 2nd 7-year crediting period for the project activity. As per such simplified procedure, the additionality of the project activity is demonstrated as follows:

> *“The following types of project activities are deemed automatically additional, if prior to the implementation of the project activity the LFG was only vented and/or flared but not utilized for energy generation:*
> *(a) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW;*

[25] PDD version 8.2, dated 04/08/2014 and approved/registered by the UNFCCC on 16/04/2015.

[26] The assessment and demonstration of additionality for the registered CDM project activity “Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)” is also presented in the latest version of the PDD valid for the 1st 7-year renewable crediting period (version 8.2, dated 04/08/2014).

(b) The LFG is used to generate heat for internal or external consumption;

(c) The LFG is flared."

In summary, regardless the demonstration of additionality is not applicable/required for the renewal of the crediting period of a registered CDM project activity, just by taking into account the continuation of the simplified procedure to identify the baseline scenario and demonstrate additionality of ACM0001 (version 15.0) in the context of the demonstration of the validity of the previously derived baseline scenario, the project activity is thus automatically/directly assumed as additional.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

>>

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)

<u>Determination of Baseline Emissions (BE_y):</u>

As per ACM0001 (version 15.0), baseline emissions (BE_y) for the 2nd 7-year renewable crediting period are determined according to equation (1) and comprises the following emission sources:

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

b) Baseline emissions for electricity generation using fossil fuels or supplied by the grid in the absence of the project activity;

c) Baseline emission for heat generation using fossil fuels in the absence of the project activity; and

d) Baseline emissions for natural gas use from existing 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)

For 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 for the project activity during its 2nd 7-year renewable crediting period and are thus regarded as null.

Thus, the determination approach for baseline emissions is summarized as follows:

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

In accordance with ACM0001 (version 15.0), 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)[27]:

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

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). $F_{CH4,BL,y}$ is determined under "*Determination of $F_{CH4,BL,y}$*" in Section B.6.1.
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 ($F_{CH4,PJ,y}$) 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:

[27] 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 (CR do Recreio 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.

$F_{CH4,PJ,y}$	=	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 "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", 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* ($Op_{j,h,y}$).

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:

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

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 ($F_{CH4,flared,y}$)

$F_{CH4,flared,y}$ 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:

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

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)

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 "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 flare(s);
- 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); an
- The mass flow should be calculated on 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 ($F_{CH4,EL,y}$)

$F_{CH4,EL,y}$ is determined directly 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):

- 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 "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" will be applied to determine $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$ [28] by using the options A, B, C or D. The selection of the determination option will depend on project conditions and equipment to be installed.

[28] In the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" 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 flare(s) ($F_{CH4,sent\_flare,y}$) and the amount of methane sent to the project's electricity generation component ($F_{CH4,EL,y}$)) is actually represented as $F_{i,t}$.

Use of Option A, B, C or D:

Depending on the project conditions, one of the following measurement options will be chosen and the following formulas applied for the determination of as $F_{i,t}$[29]:

Option	Flow of gaseous stream	Volumetric fraction
A	Volume flow dry basis	Dry or wet basis[30]
B	Volume flow wet basis	Dry basis
C	Volume flow wet basis	Wet basis
D	Mass flow dry basis	Dry or wet basis

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:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t} \quad \textbf{(7)}$$

with

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \quad \textbf{(8)}$$

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)

[29] The selection of option A, B, C or D will be done on an ex-post basis.

[30] While flow measurement on a dry basis may not be 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 B:

The mass flow of greenhouse gas *I* ($F_{i,t}$) is determined using equations (7) and (8). The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis as follows:

$$V_{t,db} = V_{t,wb} / (1 + v_{H2O,t,db}) \quad \textbf{(9)}$$

Where:

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

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

$$v_{H2O,t,db} = \frac{m_{H2O,t,db} * MM_{t,db}}{MM_{H2O}} \quad \textbf{(10)}$$

Where:

$v_{H2O,t,db}$	=	Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (in m^3 H_2O/m^3 dry gas)
$m_{H2O,t,db}$	=	Absolute humidity in the gaseous stream in time interval *t* on a dry basis (in kg H_2O/kg dry gas)
$MM_{t,db}$	=	Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)
MM_{H2O}	=	Molecular mass of H_2O (in kg H_2O/kmol H_2O)

In case this Option is selected, the absolute humidity of the gaseous stream ($m_{H2O,t,db}$) will be determined using Option 2 specified below under "*Determination of the absolute humidity of the gaseous stream"* and the molecular mass of the gaseous stream ($MM_{t,db}$) will be determined using the following equation:

$$MM_{t,db} = \sum_k (v_{k,t,db} * MM_k) \quad \textbf{(11)}$$

Where:

$v_{k,t,db}$	=	Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis (in m^3 gas k/m^3 dry gas) MM_k = Molecular mass of gas *k* (kg/kmol)
K	=	All gases, except H_2O contained in the gaseous stream (e.g. N_2, CO_2, O_2, CO, H_2, CH_4, N_2O, NO, NO_2, SO_2, SF_6 and PFCs). See simplification below. The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (*k*) in the gaseous stream. However as a simplification, the volumetric fraction of only the 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.

Option C:

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

$$F_{i,t} = V_{t,wb,n} * v_{i,t,wb} * \rho_{i,n} \quad \textbf{(12)}$$

with

$$\rho_{i,n} = \frac{P_n * MM_i}{R_u * T_n} \quad \textbf{(13)}$$

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 m^3 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 m^3 gas *i*/m^3 wet gas)
$\rho_{i,n}$	=	Density of greenhouse gas *i* in the gaseous stream at normal conditions (in kg gas *i*/m^3 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.m^3/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:

$$V_{t,wb,n} = V_{t,wb} * (T_n/T_t) * (P_t/P_n) \quad \textbf{(14)}$$

Where:

$V_{t,wb,n}$	=	Volumetric flow of the gaseous stream in a time interval *t* on a wet basis at normal conditions (in m^3 wet gas/h)
$V_{t,wb}$	=	Volumetric flow of the gaseous stream in time interval *t* on a wet basis (in m^3 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/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 above table should be applied instead.

The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using equations (7) and (8). 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:

$$V_{t,db} = M_{t,db} / \rho_{t,db} \quad \textbf{(15)}$$

Where:

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

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

$$\rho_{t,db} = \frac{P_t * MM_{t,db}}{R_u * T_t} \quad \textbf{(16)}$$

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)

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)

$MM_{t,db}$ = Molecular mass of the gaseous stream in a time interval *t* on a dry basis (in kg dry gas/kmol dry gas). The molecular mass of the gaseous stream ($MM_{t,db}$) is estimated by using equation (11).

<u>Determination of the absolute humidity of the gaseous stream</u>

The absolute humidity is as parameter required for Options B and E only, thus it will be used only in case Option B is adopted (as Option E is not selected as a measurement option for the project activity). Option 2 of the tool is selected for the project activity:

<u>Option 2: Simplified calculation without measurement of the moisture content</u>

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).

$$m_{H_2O,t,db,SAT} = \frac{p_{H2O,t,Sat} * MM_{H2O}}{(P_t - p_{H2O,t,Sat}) * MM_{t,db}} \quad \textbf{(17)}$$

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)
$MM_{t,db}$ = Molecular mass of the gaseous stream in a time interval *t* on a dry basis (in kg dry gas/kmol dry gas). $MM_{t,db}$ is estimated by using equation (11).

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".

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 ($F_{CH4,RG,m}$)[31]. 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 "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" 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 "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" 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.

[31] Although in July 2015 there was only one high temperature enclosed flare installed as part of the operation of the project activity, additional flare(s) might be installed in the future depending on forecasted increase of the amount of LFG generated at the CR do Recreio landfill.

Step 2: Determination of flare efficiency:

As required by ACM0001 (version 15.0), the flare efficiency values will be determined for the installed 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 the project's high temperature enclosed flare 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[32].

Option B: Measure the flare efficiency.

Option A: Application of 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 of 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

[32] 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 July 2015, 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 7-year renewable crediting period. The enclosed flare which is currently installed as part of the project activity is a high height flare.

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):

(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:

$$\eta_{flare,calc,y} = 1 - \frac{1}{2}\sum_{t=1}^{2}\left(\frac{F_{CH4,EG,t}}{F_{CH4,RG,t}}\right) \quad \textbf{(18)}$$

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[33], 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:

[33] 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*.

$$PE_{flare,y} = GWP_{CH4} * \sum_{m=1}^{525,600} F_{CH4,RG,m} * \left(1 - \eta_{flare,m}\right) * 10^{-3} \quad (19)$$

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 emissions from the CR do Recreio 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:

$$F_{CH4,PJ,y} = \eta_{PJ} * BE_{CH4,SWDS,y} / GWP_{CH4} \quad (20)$$

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:

$$BE_{CH4,SWDS,y} = \varphi_y * \left(1 - f_y\right) * GWP_{CH4} * \left(1 - OX\right) * \frac{16}{12} * F * DOC_{f,y} * MCF_y * \sum_{x=1}^{y} \sum_{j} W_{j,x} * DOC_j * e^{-k_j \cdot (y-x)} * \left(1 - e^{-k_j}\right) \quad (21)$$

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 CR do Recreio landfill (without promoting any change in the management and operation of the landfill), it does not prevent any solid waste from being deposited at the CR do Recreio 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 CR do Recreio 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:

Possible cases for determining methane captured and destroyed in the baseline as per ACM0001 (version 15.0)

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 under the situation valid at the time of the project design initial conceptualization (prior to the start of operation of the project activity), currently there is still being no legal obligation to capture and destroy the LFG at the CR do Recreio landfill[34].

[34] In July 2015, there was still no legal requirement for LFG gas collection and its destruction using active or passive high temperature enclosed flares in Brazil. Moreover, there was still no legal restriction neither requirement for passive venting of LFG or its combustion in conventional LFG destruction systems. Actually, there is still no applicable regulation that deals with LFG management in Brazil. The recently implemented National Policy on Waste Management does not deal with LFG management either.

Some facts about the Brazilian National Policy on Waste Management: After years of studies and negotiations, the Brazilian Regulation of the National Policy on Waste Management, established by Decree No. 7,404/10 (the Decree), was published on 02/08/2010 and entered into force on 23/12/2010. This decree regulates the National Policy on Waste Management (PNRS), established by Federal Law No. 12,305/10 (the LPNRS), and creates the Steering Committee for the Implementation of Reverse Logistics Systems (Steering Committee) and the PNRS Interministerial Committee. This new Brazilian Regulation of the National Policy on Waste Management does not establish any requirement, obligation or recommendation related to LFG management at landfills in Brazil. The following is outlined by the law firm “Tauil & Chequer Advogados“ in a recently published article:

Existence of non-regulatory and non-contractual requirements to destroy methane due to safety and odor concerns:

In the particular case of the CR do Recreio landfill, it is assumed that a requirement to destroy methane due to safety and odor concerns does exist due to following:

- Although there is no regional or national regulatory requirement in Brazil establishing or requiring LFG to be collected and destroyed in landfills (such as the CR do Recreio landfill) or waste dump sites, and although there is no contractual requirement to collected and destroy LFG either, in the particular case of the CR do Recreio landfill, as per the previously conceived design, construction and operational requirements (which were previously set by SIL – Soluções Ambientais Ltda. and which are still valid/applicable for the CR do Recreio landfill), in the absence of the project activity, it is acknowledged that a small and non-defined share of generated LFG would be expected to be collected and vented and/or destroyed through combustion in a set of conventional passive LFG venting/combustion drains in order to appropriately address safety and odor concerns under the baseline scenario (absence of the project activity)[35]. It is important to note that there has been no contractual requirement set by any official (governmental) or private party establishing/requiring collected LFG to be destroyed through combustion.

  While the methodological approach of ACM0001 (version 15.0) for determination of $F_{CH4,BL,y}$ explicitly determines that any required or existent destruction of LFG to address safety and/or odor concerns are to be regarded as "*an existing requirement to destroy methane*", by taking into

---

> *"(...) The Regulation of the National Policy on Waste Management, established by Decree No. 7,404/10 (the Decree), was published on December 23, 2010. In force since its publication, the Decree regulates the National Policy on Waste Management (PNRS), established by Federal Law No. 12,305/10 (the LPNRS), and creates the Steering Committee for the Implementation of Reverse Logistics Systems (Steering Committee) and the PNRS Interministerial Committee. The main purpose of the PNRS Interministerial Committee is to support the PNRS structuring and implementation, in order to enable the accomplishment of the provisions and goals set forth by the LPNRS. The Steering Committee has the basic function of guiding the implementation of reverse logistics. Among the instruments regulated by the Decree are the Reverse Logistics Systems, the Waste Management Plans (PGRS) and the National Registry for Hazardous Waste Operators. The Decree lists three specific instruments for the implementation and operation of the reverse logistic systems: (i) sectorial agreements, executed between public authorities and the industry; (ii) regulations, issued by the executive branch; and (iii) commitment agreements—which are to be adopted in the absence of sectorial agreements and regulations and when specific circumstances require more restrictive obligations—to be approved by the competent environmental agency. Regarding the obligation to prepare a PGRS, which should be required within environmental permitting proceedings, the Decree mentions the possibility of jointly submitting the PGRS under specific conditions and in cases where activities are conducted in the same condominium, municipality, micro-region or metropolitan/urban areas. Additionally, the Decree establishes that small companies that generate household waste, as provided for by article 30 of the LPNRS, are not required to submit a PGRS. Regarding the National Registry for Hazardous Waste Operators, which must be integrated to the already existing Federal Technical Registry of IBAMA, the Decree establishes a registration obligation for companies that manipulate or operate hazardous waste. The Decree also describes those who are considered generators or operators of hazardous waste, establishing several requirements for their authorization or permitting. These include the preparation of hazardous waste management plan, the demonstration of technical and economic capacity and the obtaining of civil liability insurance for environmental damages."*

Paper is available online: http://www.tauilchequer.com.br/publications/detailprint.aspx?publication=1179

[35] As also established by applicable design, construction and operational requirements for the CR do Recreio landfill (as defined by SIL – Soluções Ambientais Ltda. by taking into consideration the best practice for the construction and operation of landfills in Brazil), besides of the installation of the conventional passive LFG venting/combustion drains, practice of covering disposed waste + other best practices for waste landfilling were also implemented in the landfill in the pre-project scenario during the period from 2001 to December 2007 in order to address safety and odor concerns. Such operational requirements are still valid. It is important to note that the licensing and operational permits for the CR do Recreio landfill (as set by the competent environmental authority) do not require any management for generated LFG in the landfill.

account the related definition of “*requirement*” as per ACM0001 (version 15.0), it is thus assumed that there is indeed a requirement to destroy methane (in the absence of the project activity) in the particular case of the CR do Recreio landfill.

By taking such assumptions into account, the following is thus valid/applicable for the CR do Recreio landfill in the absence of the project activity (baseline scenario):

- Requirement to destroy methane: YES

By considering the requirement situation above summarized, Case 1 and Case 3 (which are options/cases associated to no requirement to destroy methane in the absence of the project activity) are thus regarded as not applicable cases for the determination of $F_{CH4,BL,y}$ in the context of the demonstration of the continuation of the previously derived baseline scenario and determination of baseline emissions for the 2nd 7-year renewable crediting period of the project activity.

Thus, the remaining possibly valid alternatives (cases) (after the analysis of existence of non-regulatory and non-contractual requirements to destroy methane due to safety and odor concerns) are thus Case 2 and Case 4.

Existence of LFG capture and destruction system at the CR do Recreio landfill:
Prior to the implementation of the project activity (pre-project scenario during the period from year 2001 until December 2007 – when the project activity initiated its operations), a very small fraction of methane generated at the CR do Recreio landfill was destroyed through combustion. In fact, a very reduced share of generated LFG was combusted through use of conventional LFG venting/combustion drains. Such conventional and rudimentary LFG management solution was at that time the only existent infrastructure for LFG management at the project site prior to the implementation of the project activity (which occurred in December 2007).

Under the baseline scenario (absence of the project activity), it is assumed that such practice would continue to exist.

Destruction of a very small and undefined share of generated methane would thus continue to occur in the absence of the project through the utilization of the previously existent conventional LFG venting/combustion drains (and through additional conventional LFG venting/combustion drains that would otherwise been implemented under the baseline scenario along the landfill lifetime as part of the forecasted expansion of the area of the landfill).

By taking into account the existent requirement of destroying methane at the CR do Recreio landfill in order to address safety and odor concerns, it is thus assumed that all pre-project infrastructure encompassing the use of passive and conventional LFG venting/combustion drains would be kept/maintained in the absence of the project activity.

By taking into account the definitions of "*LFG capture system*", “*Existing LFG capture and destruction system*” and "*existing LFG capture system*" as per ACM0001 (version 15.0)[36], it is thus assumed that there was an “*existing LFG capture and destruction system*” at the CR do Recreio landfill in the pre-project scenario (prior to the implementation of the project activity). It is also assumed that such

[36] 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." ACM0001 (version 15.0) also defines “*LFG capture system” as “*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.”*

existing LFG capture and destruction system would also be existent along the baseline scenario (scenario in the absence of the project activity).

While combustion of LFG in passive (conventional) venting/combustion drains clearly represents destruction of methane (despite of its relatively very low efficiency), it is thus assumed that there were a pre-project conventional LFG capture and destruction system implemented at the CR do Recreio landfill prior to the implementation of the project activity (which was replaced (under a certain extent) by the project's LFG collection and destruction infrastructure). It is also assumed that such conventional system would also be existent along the whole baseline scenario in the absence of the project activity.

In summary, by taking the above presented facts and assumptions into account, the following is thus valid/applicable for the CR do Recreio landfill in the absence of the project activity (baseline scenario) in the context of the application of the methodological guidance of ACM0001 (version 15.0):

- Existing LFG capture and destruction system: YES

Therefore, Case 2 (which is an option/case associated to no existence of LFG capture and destruction in the absence of the project activity) is regarded as a not applicable case for the determination of $F_{CH4,BL,y}$ in the context of the demonstration of the continuation of baseline scenario and determination of baseline emissions for the 2nd 7-year renewable crediting period of the project activity.

Thus, the only remaining possibly valid alternative (case) (after the analysis of Existence of LFG capture and destruction system at the CR do Recreio landfill) is Case 4.

In summary, the only option/case applicable for the CR do Recreio landfill (in the absence of the project activity) is Case 4.

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 = YES
- Existing LFG capture and destruction system = YES

By taking into account the outcome of the above presented analysis the following methodological approach is valid for the determination of $F_{CH4,BL,y}$:

Application of methodological guidance valid for Case 4:

Under Case 4 of the methodological guidance for the determination of $F_{CH4,BL,y}$, the following is applicable as per ACM0001 (version 15.0):

$F_{CH4,BL,y}$ shall be determined based on information in contract of regulation requirements and data related to the existing LFG capture system, as follows:

$$F_{CH4,BL,y} = \max \{F_{CH4,BL,R,y}; F_{CH4,BL,sys,y}\} \quad \textbf{(22)}$$

Where:

$F_{CH4,BL,R,y}$	= Amount of methane in the LFG which is flared in the baseline due to a requirement in year y (in tCH_4/yr)
$F_{CH4,BL.sys,y}$	= Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system (in tCH_4/yr)

$F_{CH4,BL,R,y}$ and $F_{CH4,BL.sys,y}$ shall be determined according to the respective procedures for Case 2 and Case 3.

By considering the above-quoted requirement, $F_{CH4,BL,R,y}$ and $F_{CH4,BL.sys,y}$ are thus determined as follows:

Determination of $F_{CH4,BL,R,y}$ by following applicable guidance/procedure for Case 2 (in the context of application of Case 4):
By (i) taking into account the applicable definition of "*requirement*"[37] as per ACM0001 (version 15.0); by (ii) also ackowledging that Case 2 is not an applicable case for the project activity, but by applying the applicable guidance of Case 2 as part of application of the guidance valid for Case 4, it is assumed the following in the particular context of the CR do Recreio landfill:

While in the context of the assumed existent non-regulatory and non-contractual requirement for addressing safety and odor concerns at the CR do Recreio landfill, it was never assumed or considered any particular previously defined or recommended amount (quantity) or percentage of generated LFG that is to be combusted in order to address such concerns, by taking into consideration the nature, non-regulatory and the non-contractual characteristics of the assumed/considered requirement (where the concerns about safety and odor are assumed as required to be addressed by partial combustion of LFG which is vented through the drains under a undefined quantity[38]), the installation of a conventional system to destroy LFG (applying conventional passive LFG venting/combustion drains) with an assumed default and conservative CH_4 destruction efficiency of 20% (as established by ACM0001 (version 15.0)) is thus considered under a conservative and

[37] As per Step A.2 of ACM0001(version 15.0) "requirement" is defined as follows:

> *"This step provides a procedure to determine the amount of methane that would have been captured and destroyed (by flaring) in the baseline due to regulatory or contractual requirements, or to address safety and odour concerns (collectively referred to as requirement in this step)."*

[38] Under the baseline scenario, as per the construction, design and operational requirements applicable for the CR do Recreio landfill, it is assumed by SIL – Soluções Ambientais Ltda. that venting LFG through all conventional venting/combustion drains (without promoting LFG combustion in a non-defined share of the existent drains) would not regarded as a sufficient practice to address the existent odor and safety concerns. Indeed during the pre-project scenario (prior to the implementation of the project activity), combustion of LFG is a non-defined but representative share of the existent venting/combustion drains were indeed a practice. Combustion of LFG is thus seen as required to address the existent concerns (especially the existent odor concerns). Under the baseline scenario, it is assumed that operating the landfill with no combustion of LFG at all in the conventional drains would not represent a landfill operational practice where the available operational requirements for odor would be sufficiently met.

simplified approach [39].

Thus, the following equation is applicable:

---

[39] As per ACM0001 (version 15.0), the following is valid for the application of guidance of Case 2 (as part of the application of guidance for Case 4):

> *"Case 2: Requirement to destroy methane exists and no existing LFG capture system*
> *(…)*
> $F_{CH4,BL,y} = F_{CH4,BL,R,y}$
> $F_{CH4,BL,R,y}$ *should be determined based on the information contained in the requirement to destroy methane, as follows:*
> *(…)*
> *If the requirement does not specify the amount or percentage of LFG that should be destroyed but requires the installation of a capture system, without requiring the captured LFG to be flared then:*
> $F_{CH4,BL,R} = 0$"

This is not an applicable equation for the baseline scenario of the project activity as although the existent requirement does not specify the amount or percentage of LFG that should be destroyed and indeed requires the installation of a capture system, it is however required that captured LFG is to be flared in a non-defined share of the existent drains. Thus the term "*without requiring the captured LFG to be flared"* is clearly not applicable for the particular case of the baseline scenario of the project activity.

The following is also valid for the application of guidance of Case 2 (as part of the application of guidance for Case 4) as per ACM0001 (version 15.0):

> *"(…)*
> *If the requirement does not specify any amount or percentage of LFG that should be destroyed but requires the installation of a system to capture and flare the LFG, then a typical destruction rate of 20% is assumed:*
>
> $F_{CH4,BL,R} = 0.2 * F_{CH4,PJ,capt,y}$
>
> *"This default value of 20% is based on assuming a situation in which: the efficiency of the LFG capture system in the project is 50%; the efficiency of the LFG capture system in the baseline is 20%; and, the amount captured in the baseline is flared using an open flare with a destruction efficiency of 50% (consistent with the default value provided in the .Tool to determine project emissions from flaring gases containing methane.)."*

By taking into account the combustion of LFG in pre-project existent conventional LFG venting/combustion drains have occurred in order to address an existent design and operational requirement for the CR do Recreio landfill in terms of safety and odor concerns, the equation above is thus assumed as applicable.

System to capture and flare the LFG in the baseline scenario:

The situation quoted above indeed represents the case/circumstance applicable for the baseline scenario. As the assumed existent non-regulatory and non-contractual requirement to collect LFG does not specify any amount or percentage of LFG that should be collected and destroyed but indeed requires LFG to be combusted (destroyed), the installation of a system to capture and flare LFG is implicitly assumed as required. The system in the particular case of the project activity are the conventional LFG venting/combustion drains which are used to vent and combust (flare) LFG in a non-controlled, non-continuous and non-systematic manner. The pre-project and baseline conventional LFG venting/combustion drains sufficiently meet the definition of "*existing LFG capture system*" as per ACM0001 (version 15.0). By promoting combustion of LFG, such system also meets the definition of "*LFG capture and destruction system*" of ACM0001 (version 15.0). It is important to note that the table above with the summary of the cases for determining methane captured and destroyed in the baseline as per ACM0001 (version 15.0) (Case 1, Case 2, Case 3 and Case 4) includes the criteria "*Existing LFG capture and destruction system*" (at the start of the project activity). It is crucial to note that in the context of the application of the whole stepwise approach for determining $F_{CH4,BL,y}$. it is required to take into consideration the practical difference/distinction between an "*Existing LFG capture system*" and an "*Existing LFG capture and destruction system*", where, as per the applied methodological approach, the latest definition is applicable for any system that promotes effective and/or real destruction of LFG through combustion in conventional flares or drains (such as in the situation in the particular case of the CR do Recreio landfill in the baseline scenario (absence of the project activity)). In this context, the formulae above ($F_{CH4,BL,R} = 0.2 * F_{CH4,PJ,capt,y}$) is indeed the applicable one.

Considerations about the efficiency of the LFG capture and destruction system in the baseline scenario:

Although, based on existent technical literature and years of field experience, it is the perception of the project participant SIL – Soluções Ambientais Ltda. that assuming a default value of 20% represents a very conservative and not realistic methodological approach (at least in the particular case of the project activity, which is implemented in a very big landfill), the selection of the 20% default value is any way applied in the context of the determination of baseline emissions for the project activity during the 2nd 7-year crediting period in order to follow the guidance.

$$F_{CH4,BL,R,y} = 0.2 * F_{CH4,PJ,capt,y} \quad \textbf{(23)}$$

Where:

$F_{CH4,PJ,capt,y}$ = Amount of methane in the LFG which is captured in the project activity in year *y* (in tCH_4/yr).

__Determination of $F_{CH4,BL.sys,y}$ by following applicable guidance/procedure for Case 3 (in the context of application of Case 4):__

By (i) taking into account the applicable definition of "*requirement*" as per ACM0001 (version 15.0); by (ii) also ackowledging that Case 3 is not an applicable case for the project activity, but by applying the applicable guidance of Case 3 as part of application of guidance for Case 4 in the particular context of the CR do Recreio landfill, it is assumed the following[40]:

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

$$F_{CH4,BL.sys,y} = 0.2 * F_{CH4,PJ,y} \quad \textbf{(24)}$$

By comparing the aplicable guidance for Case 2 and Case 3 (both in the context of application of guidance for Case 4), the following is relevant:

While the term "$0.2 * F_{CH4,PJ,capt,y}$" > "$0.2 * F_{CH4,PJ,y}$" (by considering the equation valid for the determination of $F_{CH4,PJ,y}$); it is thus fair and correct to assume that $F_{CH4,BL,R,y} > F_{CH4,BL,sys,y}$.

Thus, the following is applicable for the determination of $F_{CH4,BL,y}$ by following the guidance for Case 4:

$$F_{CH4,BL,y} = F_{CH4,BL,R,y} = 0.2 * F_{CH4,PJ,capt,y} \quad \textbf{(25)}$$

Where: In accordance with applicable guidance of ACM0001 (version 15.0), $F_{CH4,PJ,capt,y}$ is assumed as the sum of the amount of methane that is sent to the flare(s) and/or engine-generator sets in year *y* (as determined in Step A.1, however by not taking into account the working hours of the engine-generator sets and flare(s) efficiency in the particular case of its utilization for the determination of $F_{CH4,BL,y}$).

[40] As per ACM0001 (version 15.0), the following is valid for the application of guidance of Case 3 (as part of the application of guidance for Case 4):

"Case 3: No requirement to destroy methane exists and a LFG capture system exists

In this situation:

$F_{CH4,BL,y} = F_{CH4,BL,sys,y}$

(…)

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

$F_{CH4,BL,sys,y} = 0.2 * F_{CH4,PJ,,y}$

(…)"

In summary, $F_{CH4,BL,y}$ is determined as follows:

$$F_{CH4,BL,y} = 0.2 * F_{CH4,PJ,capt,y} \quad \textbf{(26)}$$

Where:

Note: In accordance with applicable guidance of ACM0001 (version 15.0), $F_{CH4,PJ,capt,y}$ is to be determined as the sum of the amount of methane that is sent to all installed high temperature enclosed flares and to all the engine-generator sets in year y (as determined in Step A.1, however by not taking into account the working hours of the power generation and flaring equipment and also not taking into account the applicable values for flare efficiency in the particular case of its utilization for the determination of $F_{CH4,BL,y}$ [41]).

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

As established by ACM0001 (version 15.0), 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 following is to be considered:

- 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*.

The “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” also 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:

$$BE_{EC,y} = \sum_{j} EC_{BL,k,y} * EF_{EL,k,y} * (1 + TDL_{k,y}) \quad \textbf{(27)}$$

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)[42]

[41] In the particular case of the determination of $F_{CH4,BL,y}$ for project activity, while for a given monitoring period, $F_{CH4,PJ,capt,y}$ is thus equal to accumulated value for amount of methane in the LFG which is destroyed by flaring in year *y* (in tCH_4) ($F_{CH4,flared,y}$) for the period in question being calculated without considering/monitoring the hours *h* that each individual flare has operated under conformance with operational requirements (as established/defined by the flare manufacturer) and by assuming a flare efficiency of 100% (project emissions from flaring being considered as zero (null)). This represents a conservative approach as the calculated value for $F_{CH4,BL,y}$ is maximized.

[42] After the implementation of project’s new electricity generation facility (which is currently expected to occur in May 2015), the project’s electricity demand is expected to be met by one of the following sources:

1. small fraction of electricity generated by the project activity (with most of generated electricity being exported through the National Electricity Grid of Brazil);
2. imports of grid-sourced electricity
3. installed backup captive off-grid electricity generator (fuelled by diesel) (only during temporary planned or unplanned circumstances where (a) project’s electricity generation facility is temporarily not under operation or (b) supply of grid-sourced electricity is temporarily interrupted).

$EF_{EL,k,,y}$	=	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:

$$BE_{EC,grid,y} = EC_{BL,y} * EF_{EL,grid,y} * (1 + TDL_{grid,y}) \quad \textbf{(27.1)}$$

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, the following is applicable:

> *"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 emission factor of the electricity grid to which the project activity is to be connected is determined by the following 6-step approach:

Calculation of $EF_{grid,CM,y}$

The decision of meeting the project's electricity demand (under normal project operational circumstances) through option (1) or (2) will depend on commercial and technical aspects related to commercialization of generated electricity, transmission of electricity generated by the project activity and/or agreements with the local electricity distribution/commercialization company which are yet to be addressed/confirmed. In the particular case of option (1), the parameter "Net amount of electricity generated using LFG in year *y*" ($EC_{BL,k,y}$) will be monitored and determined by taking into account the small share of electricity generated by the project activity and consumed by the project activity (e.g. LFG centrifugal blowers, anciallary equipment of the electricity generation facility and other equipment).

Combined margin CO_2 emissions factor is calculated in accordance with the "Tool to calculate the emission factor for an electricity system" (version 04.0). This methodological tool determines the CO_2 emission factor for the displacement of electricity generated by grid-connected power plants, by calculating the combined margin emission factor ($EF_{CM,y}$) of the electricity system. As per the "Tool to calculate the emission factor for an electricity system" (version 04.0), $EF_{CM,y}$ is determined as a weighted average of two CO_2 emission factors pertaining to the electricity system: the CO_2 operating margin emission factor ($EF_{OM,y}$) and the build margin emission factor ($EF_{BM,y}$). The operating margin emission factor refers to the group of existing power plants whose current electricity generation would be potentially affected by the proposed CDM project activity. The build margin emission factor refers to the group of prospective power plants whose construction and future operation would be potentially affected by the proposed CDM project activity.

The applicable procedures of "Tool to calculate the emission factor for an electricity system" (version 04.0) tool are described in the following steps:

- Step 1. Identify the relevant electricity systems:
For 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 and that can be dispatched without significant transmission constraints. The spatial extent of the project boundary includes the project site which is connected to the National Electricity Grid of Brazil which is named National Interconnected System (*Sistema Interligado Nacional – SIN*).

- Step 2. Choose whether to include off-grid power plants in the project electricity system (optional): Option I of the tool is chosen which is to include only grid power plants in the calculation.

- Step 3. Select a method to determine the operating margin (OM):
The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:
(a) Simple OM; or
(b) Simple adjusted OM; or
(c) Dispatch data analysis OM; or
(d) Average OM.

Any above method can be utilized. However, the simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production. This is not the case for the project electricity system being considered. Since the simple adjusted OM (option b) emission factor is a variation of the simple OM, where the power plants/units (including imports) are separated in low-cost/must-run power sources and other power sources, this is also not applicable to this project activity. For the similar reason, the option (d), average OM emission factor is not eligible for this project, since it is calculated as the average emission rate of all power plants serving the grid, using the methodological guidance for the simple OM, but including in all equations also low-cost/must-run power plants. Therefore, for the OM calculation method, the option (c) dispatch data analysis is preferred, since the Ministry of Science, Technology and Innovation of Brazil has been updated and published annually the information for power units[43].

[43] The Ministry of Science, Technology and Innovation have been calculating the CO_2 emission factor according to the methodology tool "Tool to calculate the emission factor for an electricity system" (version 2.2.0), approved by the CDM Executive Board. The CO_2 emission factor was obtained in the Brazilian DNA website. Source of data used: Tool to calculate the emission factor for an electricity system (version 2.2.0 and more recent versions): The actual value has been calculated by Ministry of Science, Technology and Innovation (MCTI), Brazilian Designated National Authority (DNA). The Emission Factor will be monitored through ex-post calculation, following the latest version of Tool to calculate the emission factor for an electricity system. The Brazilian DNA calculated the value based on the Tool. The Combined Margin is calculated through a weighted-average formula, considering both the $EF_{grid,OM\text{-}DD,y}$ and the $EF_{grid,BM,y}$ and the weights w_{OM} and w_{BM} (default values of 0.25 and 0.75, respectively).

For the dispatch data analysis OM, the year in which the project activity displaces grid electricity and the emission factor updating annually during monitoring is utilized.

- Step 4. Calculate the operating margin emission factor according to the selected method:
In order to determine the combined margin emission factor, the dispatch data analysis method has been selected among four options proposed in the methodology, since it is publicly available in Brazil.

The dispatch data analysis OM emission factor ($EF_{grid,OM-DDy}$) is determined based on the grid power units that are actually dispatched at the margin during each hour *h* where the project is displacing grid electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of $EF_{grid,OM-DDy}$., as the MCTI have been done.

The operating margin emission factor is calculated as follows:

$$EF_{grid,OM-DDy} = \frac{\sum_{h} EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}} \quad \textbf{(28)}$$

Where:

$EF_{grid,OM-DD,y}$	= Dispatch data analysis operating margin CO_2 emission factor in year *y* (in tCO_2/MWh)
$EG_{PJ,h}$	= Electricity displaced by the project activity in hour *h* of year *y* (in MWh)
$EF_{EL,DD,h}$	= CO_2 emission factor for grid power units in the top of the dispatch order in hour *h* in year *y* (in tCO_2/MWh)
$EG_{PJ,y}$	= Total electricity displaced by the project activity in year *y* (in MWh)
h	= Hours in year *y* in which the project activity is displacing grid electricity
y	= Year in which the project activity is displacing grid electricity

- Step 5. Calculate the build margin (BM) emission factor:
In terms of vintage of data, project participants can choose between one of the following two options:
<u>Option 1:</u> *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.*

<u>Option 2:</u> *For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions 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 for the 2nd 7-year crediting period of the project activity The build margin emissions factor is the generation-weighted average emission factor (in tCO_2/MWh) of all power units m during the most recent year *y* for which power generation data is available.

The DNA of Brazil has regularly published an official value for $EF_{grid,BM,y}$[44]. The latest published value (applicable for year 2014) is thus the value for the ex-ante selected parameter $EF_{grid,BM,y}$ and is calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \textbf{(29)}$$

Where:

$EF_{grid,BM,y}$	= Build margin CO_2 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)
$EF_{EL,m,y}$	= CO_2 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

- Step 6. Calculate the combined margin (CM) emissions factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM} \quad \textbf{(30)}$$

Where:

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

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."*

While values for the parameters $EF_{grid,BM,y}$, w_{OM} and w_{BM} (which are applicable for the whole 2[nd] 7-year crediting period) are selected ex-ante, annual values for $EF_{grid,OM,y}$ within the credting period will be determined ex-post as required by the "Tool to calculate the emission factor for an electric system" .Thus, during the 2[nd] 7-year crediting period, the combined margin CO_2 emission factor will be calculated and updated annually.

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.

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

[44] Details about the determination of values for the CO_2 emission factor for the national electricity grid of Brazil by the DNA of Brazil are made available online in the website of the DNA of Brazil: http://www.mct.gov.br/index.php/content/view/354731.html#ancora

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.

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

As established by ACM0001 (version 15.0), project emissions (PE_y) for the 2nd 7-year crediting period are calculated (in tCO_2/yr) as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} \qquad \textbf{(31)}$$

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

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

Since its start of operations, the project activity has consumed Liquefied Petroleum Gas (LPG) for igniting the currently installed 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,

$$PE_{FC,y} = PE_{LPG,y} \qquad \textbf{(32)}$$

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:

$$PE_{LPG,y} = FC_{LPG,y} * COEF_{LPG,y} \quad (33)$$

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:

$$COEF_{LPG,y} = NCV_{LPG,y} * EF_{CO2,LPG,y} \quad (34)$$

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:

- *"$EC_{PJ,k,y}$[45] 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, although LFG is destroyed in the baseline scenario ($F_{CH4,BL,y} > 0$), while no electricity has been used in the pre-project scenario for collecting and destroying LFG through the utilization of conventional LFG venting/combustion drains, this requirement is thus not applicable as no electricity would be used for collecting and combusting LFG in the baseline scenario (absence of the project activity).

---

[45] 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*.

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:

$$PE_{EC,y} = \sum EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y}) \quad \textbf{(35)}$$

Where:

$EC_{PJ,j,y}$	=	Quantity of electricity consumed by the project electricity consumption source j in year y (in MWh)[46]
$EF_{EL,j,y}$	=	CO_2 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:

$$PE_{EC,y} = PE_{EC,grid,y} + PE_{EC,captive,y} \quad \textbf{(36)}$$

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 tCO_2/yr)

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

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

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:

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

Where:

$EC_{PJ,grid,y}$	= Quantity of grid sourced electricity consumed by the project activity in year *y* (in MWh)

[46] After the implementation of project's new electricity generation facility, the project's electricity demand started to be met by one of the following sources:

(a) small fraction of electricity generated by the project activity (with most of generated electricity being exported through the National Electricity Grid of Brazil);

(b) imports of grid-sourced electricity

(c) installed backup captive off-grid electricity generator (fuelled by diesel) (only during temporary planned or unplanned circumstances where (a) project's electricity generation facility is temporarily not under operation or (b) supply of grid-sourced electricity is temporarily interrupted).

$EF_{EL,grid,y}$ = Emission factor for grid sourced electricity in year *y* (in tCO_2/MWh). Information related to 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.

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

Project emissions from the consumption of electricity generated by the backup captive off-grid diesel generators are 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:

$$PE_{EC,captive,y} = EC_{PJ,captive,y} * EF_{EL,captive,y} * (1 + TDL_{captive,y}) \quad \textbf{(38)}$$

Where:

$EC_{PJ,captive,y}$ = 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:

$$EF_{EL,captive,y} = (FC_{Diesel,y} * NCV_{Diesel,y} * EF_{CO2,Diesel,y}) \,/\, EG_{Diesel\text{-}generator} \quad \textbf{(39)}$$

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 all Diesel_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:

$$PE_{EC,captive,y} = FC_{Diesel,y} * COEF_{Diesel,y} \quad \textbf{(40)}$$

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:

$$COEF_{Diesel,y} = NCV_{Diesel,y} * EF_{CO2,Diesel,y} \quad \textbf{(41)}$$

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 (in 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:

$$PE_{EC,captive,y} = 11{,}400\ tCO_2/MWh * PP_{Diesel\text{-}generator} \quad \textbf{(42)}$$

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 07.0)
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	**GWP_{CH4}**
Unit	tCO2e/tCH4
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 values are 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[47] and also by taking into consideration the design and operational characteristics/aspects of the CR do Recreio landfill plus the general construction, design and forecasted implementation of the project's LFG collection network during the 2nd 7-year crediting period.

[47] 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%."*

Purpose of data	Calculation of baseline emissions (in the context of determination of ex-ante estimates of emission reductions to be achieved by the project activity). .
Additional comment	Selected value can also be represented as percentage, since 0.9280 = 92.80%

Data / Parameter	R_u
Unit	Pa.m^3/kmol.K
Description	Universal ideal gases constant
Source of data	Default value as per the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0)
Value(s) applied	8,314
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	**-**

Data / Parameter	MM_k
Unit	kg/kmol
Description	Molecular mass of gas *k*
Source of data	Default values as per the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 02.0.0)

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

Value(s) applied	For considered gases *k* that are greenhouse gases (GHGs), the values below are applied for MMi. As per the “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) 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	-

Data / Parameter	**MM_i**
Unit	kg/kmol
Description	Molecular mass of greenhouse gas *i*
Source of data	Default values as per the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 02.0.0)
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	-

Data / Parameter	P_n
Unit	Pa
Description	Total pressure at normal conditions
Source of data	Default value as per the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0)
Value(s) applied	101,325
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	T_n
Unit	K
Description	Temperature at normal conditions
Source of data	Default value as per the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 02.0.0)
Value(s) applied	273.15
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	MM_{H2O}
Unit	kg/kmol
Description	Molecular mass of water

Source of data	Default value as per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0)
Value(s) applied	18.0152
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	**$TDL_{grid,y}$**
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 (due to generation of electricity that is exported through the electricity grid and the consumption of grid-sourced electricity by the project activity).
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 by the project activity) + 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	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	$EF_{grid,BM,y}$
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. The selected value valid for all years encompassed by the 2nd 7-year crediting period is the value calculated by the DNA of Brazil and valid for year 2014 ($EF_{grid,BM,2014}$).
Value(s) applied	0.2963
Choice of data or Measurement methods and procedures	Official value is determined/calculated by the DNA of Brazil (http://www.mct.gov.br/index.php/content/view/354444.html#ancora)
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	$\varphi_{default}$
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 07.0). 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
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 (in the context of determination of ex-ante estimates of emission reductions to be achieved by the project activity)

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 07.0)
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions (in the context of determination of ex-ante estimates of emission reductions to be achieved by the project activity)
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 07.0)
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, under anaerobic conditions in the considered SWDS. A default value of 0.5 is recommended by IPCC.
Purpose of data	Calculation of baseline emissions (in the context of determination of ex-ante estimates of emission reductions to be achieved by the project activity)
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 07.0), 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 07.0): “*The CDM project activity mitigates methane emissions from a specific existing SWDS”.*
Purpose of data	Calculation of baseline emissions (in the context of determination of ex-ante estimates of emission reductions to be achieved by the project activity)
Additional comment	Application A of the methodological tool “Emissions from solid waste disposal sites” (version 07.0) 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 CR do Recreio landfill encompass utilization of appropriate MSW landfilling practices (covering, leveling and mechanical compacting of disposed material, etc.) as part of the operation of this landfill. The CR do Recreio landfill is regarded as a well-managed landfill site.
Purpose of data	Calculation of baseline emissions (in the context of determination of ex-ante estimates of emission reductions to be achieved by the project activity)
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 07.0), that refers to IPCC 2006 Guidelines for National Greenhouse Gas Inventories, (adapted from Volume 5, Tables 2.4 and 2.5).
Value(s) applied	see table below
Choice of data or Measurement methods and procedures	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 CR do Recreio landfill.

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

Purpose of data	Calculation of baseline emissions (in the context of determination of ex-ante estimates of emission reductions to be achieved by the project activity)
Additional comment	-

Data / Parameter	$\mathbf{k_j}$
Unit	1/yr
Description	Decay rate for the waste type *j*
Source of data	Values are selected as per applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 07.0). The methodological tools refers to values as per IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3).
Value(s) applied	(see table below)
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) = 18.15 ºC Mean Annual Precipitation (MAP) = 1,470 mm – (wet climate). Source of data for mean annual temperature (MAT) and mean annual precipitation (MAP): www.tempoagora.com.br
Purpose of data	Calculation of baseline emissions (in the context of determination of ex-ante estimates of emission reductions to be achieved by the project activity)
Additional comment	Domestic sludge was assumed to be rapidly degrading and rubber and leather slowly degrading waste.

Degradation speed	**Waste type**	$\mathbf{k_j}$
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

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 (in the context of determination of ex-ante estimates of emission reductions to be achieved by the project activity)
Additional comment	No composition analysis for MSW disposed at the CR do Recreio landfill is currently available.

Waste type *j*	**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

Data / Parameter	**$SPEC_{flare}$**
Unit	°C (for temperature values) Nm^3/h (for LFG flow values) Number of days (for maintenance schedule interval values)
Description	Manufacturer's flare specifications for temperature, flow rate and maintenance schedule interval.
Source of data	Flare manufacturer[48]

[48] The manufacturer of the flare is "Arquipélago Engenharia Ambiental Ltda.", which is a flaring equipment manufacturer based in Brazil.

<table>
<tr><td>Value(s) applied</td><td>The specifications of the currently installed flare are listed below:
<table>
<tr><th>$SPEC_{flare}$</th><th>Min.</th><th>Max.</th></tr>
<tr><td>Operational LFG flow (for continuous operation):</td><td>300 Nm^3/h</td><td>8,100 Nm^3/h</td></tr>
<tr><td>Required temperature of the exhaust gas of the flare (to ensure LFG destruction (combustion) under high CH_4 destruction efficiency):</td><td>500 ºC</td><td>1,000 ºC</td></tr>
<tr><td>Required minimum frequency for inspection and maintenance service (incl. inspection in the conditions of the flare isolation ceramics revetment material):</td><td colspan="2">Min. every year (min each 365 days)</td></tr>
<tr><td>Required/recommended minimum frequency for replacement of the flare isolation ceramics revetment material:</td><td colspan="2">After 10 years of regular and appropriate operation</td></tr>
</table></td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>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, if necessary converted to flow rate at reference conditions or heat flux,
(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.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions[49].</td></tr>
<tr><td>Additional comment</td><td>All flare specification and operation details/requirements are based on information provided by the equipment manufacturer.</td></tr>
</table>

Data / Parameter	**$PP_{CP,Diesel-generator}$**
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

[49] 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 the installed enclosed flare are considered in the context of the determination of baseline emissions (although ACM0001 (version 15.0) refers to the term “project emissions from flaring”.

Value(s) applied	0.144 The power generation unit is composed by a MWM International diesel powered engine (model 6.10.TCA) (215 HP of power output), and a brushless electricity generator set of 180 kVA of nameplate power generation capacity and nameplate power factor of 0.8.
Choice of data or Measurement methods and procedures	Not applicable
Purpose of data	Calculation of project emissions (due to the consumption of electricity sourced by captive off-grid electricity generator by the project activity).
Additional comment	The ex-ante determined default value for $PP_{CP,Diesel\text{-}generator}$ will only be used in case alternative approach 4 is used for the determination of Project emissions due to the consumption of electricity sourced by backup captive off-grid electricity generators (fuelled by Diesel) ($PE_{EC,captive,y}$).

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	-
Purpose of data	Calculation of project emissions (due to the consumption of electricity sourced by captive off-grid electricity generator by the project activity).
Additional comment	The ex-ante determined default value for $TDL_{captive,y}$ will only be used in case alternative approach 1 or approach 2 is used for the determination of Project emissions due to the consumption of electricity sourced by backup captive off-grid electricity generators (fuelled by Diesel) ($PE_{EC,captive,y}$).

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 (due to the consumption of electricity sourced by captive off-grid electricity generator by the project activity).
Additional comment	The ex-ante determined default value for $EF_{EL,captive,y}$ will only be used in case alternative approach 2 is used for the determination of Project emissions due to the consumption of electricity sourced by backup captive off-grid electricity generators (fuelled by Diesel) ($PE_{EC,captive,y}$).

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 2^{nd} 7-year renewable crediting period:

Determination of ex-ante estimations for baseline emissions (BE_y):

While the project activity encompasses collection of LFG and its destruction in high temperature enclosed flare(s) and/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)

$BE_{CH4,y}$ 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.

$F_{CH4,PJ,y}$ = 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:

Determination of ex-ante estimations of $F_{CH4,PJ,y}$:

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

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.

$BE_{CH4,SWDS,y}$ = 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).

$EF_{EL,grid,,y}$ = Emission factor for grid sourced electricity in year *y* (in tCO_2/MWh). Details about the approach for calculating $EF_{EL,grid,y}$ are presented in Sections B.6.1 and B.6.2. Moreover, a spreadsheet with all related calculations for the emission factor of the SIN grid is enclosed to this PDD. The resulting estimated combined grid CO_2 emission factor applied in the context of ex-ante estimation of emission reductions (to be achieved by the project activity during the 2nd 7-year crediting period) is determined as follows:

Ex-ante estimates of $EF_{grid,OM-DD,y}$:

In the context of ex-ante estimations of emission reductions, the adopted value for $EF_{grid,OM-DD,y}$ is the value provided by the brazilian DNA for the year 2014:

Operating Margin Emission Factor of Brazilian Integrated Electric System for year 2014

Operating Margin												
Average Emission Factor (tCO_2/MWh)												
Year	**Month**											
2014	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.6155	0.5989	0.5699	0.5772	0.5605	0.5678	0.5674	0.5862	0.5994	0.5901	0.5885	0.5825

Average $EF_{grid,OM-DD,2014}$ is then 0.5837 tCO_2/MWh

Values of $EF_{grid,OM-DD,2013}$ are determined and reported by the DNA of Brazil. Further details are available on its website: www.mct.gov.br/clima

Build margin CO2 emission factor ($EF_{grid,BM}$): The build margin CO_2 emission factor for the national electricity grid of Brazil is ex-ante determined as the value applicable for year 2014 as determined and published by the DNA of Brazil as follows:

Build Margin Emission Factor of Brazilian Integrated Electric System for year 2014:

Build Margin	
Average Emission Factor (tCO_2/MWh)	
Year	**2014**
0.2963	

$EF_{grid,BM,2014}$ = 0.2963 tCO_2/MWh

Values of $EF_{grid,BM,2014}$ are determined and reported by the DNA of Brazil. Further details are available on its website: www.mct.gov.br/clima

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 is valid for 2nd crediting periods as follow:

w_{OM} = 0.25

w_{BM} = 0.75

Further details about the determination of ex-ante selected values for w_{OM} and w_{BM} are presented in Section B.6.2.

$EF_{grid,CM,y}$ is thus calculated as follows:

$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y} = 0.25 * 0.5837 + 0.75 * 0.2963 =$ 0.3681 tCO_2/MWh

It is important to note that, as a simplification (only in the context of the ex-ante estimation of project emissions to be promoted by the project activity during the 2nd 7-year crediting period), it is assumed that the calculated combined margin grid emission factor ($EF_{grid,CM,y}$) valid for year 2014 (which is equal to 0.3681 tCO_2/MWh) will remain being the same until year 2021 (which is the last year of 2nd 7-year crediting period) regardless of the fact that annual values for the operating margin

CO_2 emission factor ($EF_{grid,OM,y}$) are to be ex-post determined every year. This simplification is in accordance with applicable CDM rules[50].

$TDL_{grid,y}$ = 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.

---

[50] In the context of ex-ante estimations of project emissions due to consumption of grid electricity by the project activity, it is reasonable to consider as a simplification that no major changes in the average and marginal CO_2 intensity for electricity generated at the national electricity grid of Brazil are expected to occur during the 2nd 7-year crediting period due to the following reason:

- As per official information published by the Brazilian Government, "*(…) According to national government's Power Expansion Plan (PEP) for 2011-2012, published by Brazil's Power Energy Research Company (EPE), the government is forecasting the percentage of capacity supplied by hydroelectricity to be reduced from 72.4% (the combined numbers of domestically-produced and imported from neighbouring countries) to 67%, while increasing the percentage of power produced by natural gas to 15%, as a direct result of the recent large oil and gas finds in Brazil. Other renewable energy sources such as small hydro, wind and biomass plants are forecasted to increase to 16% of the country's energy supply by 2020*"

  (http://export.gov/brazil/static/9.%20Electrical%20Power%20and%20Renewable%20Energy%20Industries_Latest_eg_br_054746.pdf). Thus, no significant changes in the average and marginal CO_2 intensity of electricity generation in Brazil is expected to occur by considering the high predominance of use of renewable energy sources for the generation of grid sourced electricity in Brazil in recent years.
- Although SIL – Soluções Ambientais Ltda. acknowledges that, in the particular case of Brazil, calculated annual values for the CO_2 Combined Margin emission factor for the National Electricity Grid of Brazil is somehow heavy influenced by unpredictable aspects such as rain patterns, level of dams in large hydropower plants, capacity factors for non-conventional renewable energy generation facilities (e.g. wind and biomass power plants, etc.), the above-quoted information represents, under a certain limit, a credible reasons for assuming a fixed value for $EF_{grid,CM}$ in the context of the ex-ante estimations of emission reductions to be achieved by the project activity during the 2nd 7-year crediting period.
- Regardless of the assumption of a fixed value for $EF_{grid,CM}$ in the context of the ex-ante estimations of emission reductions to be achieved by the project activity during the 2nd 7-year crediting period (only in the context of ex-ante estimation of emission reductions), as highlighted in Section B.6.1, the CO_2 combined emission factor for the national electricity grid of Brazil will be annually calculated ex-post.
- The ex-ante estimated values for annual project emissions due to consumption of grid electricity represent (in nominal terms) a very low fraction of estimated total annual emission reductions to be achieved by the project activity.

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 $BE_{EC,y}$ (tCO_2e)	Estimation of baseline emissions (tCO_2e)
Year	$F_{CH4,PJ,y} = n_{PJ} * BE_{CH4,SWDS,y} / GWP_{CH4}$	$F_{CH4,BL,r,y} = 0.2 * F_{CH4,PJ,y}$	$BE_{CH4,y} = ((1 - OX_{top\_layer}) * F_{CH4,PJ,y} - F_{CH4,BL,y}) * GWP_{CH4}$	$BE_{EC,y} = EC_{BL,y} * EF_{EL,grid,y} * (1 + TDL_{grid,y})$	$BE_y = BE_{CH4,y} + BE_{EC,y}$
2014	1,547	309	27,080	0	27,080
2015	21,184	4,237	370,714	10,854	381,568
2016	23,481	4,696	410,917	24,157	435,074
2017	25,508	5,102	446,390	24,157	470,547
2018	27,304	5,461	477,824	24,157	501,981
2019	28,903	5,781	505,797	24,157	529,954
2020	30,331	6,066	530,795	24,157	554,952
2021	28,979	5,796	507,126	22,105	529,231
Total	**187,237**	**37,447**	**3,276,643**	**153,745**	**3,430,388**

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 01/12/2014 to 31/12/2014 and from 01/01/2021 to 30/11/2021 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:

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

$PE_{EC,grid,y}$	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). $EC_{PJ,grid,y}$ is estimated as being 578 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 20 kW 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[51].

$EF_{EL,grid,y}$ Emission factor for grid sourced electricity in year *y* (tCO_2/MWh). Details about the estimated value for $EF_{EL,grid,y}$ are presented in Sections B.6.1 and B.6.2 and estimate value is presented above. Moreover, the estimated value of $EF_{EL,grid,y}$ in the context of ex-ante estimations of emission reductions are presented in the sub-section "*Determination of ex-ante estimations for baseline emissions (BE_y)*".

$TDL_{grid,y}$ Average technical transmission and/or 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:

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

Where:

[51] 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.

$COEF_{LPG,y}$ 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 $NCV_{LPG,y}$ is 0.0492 TJ/ton LPG (49.2 GJ/ton LPG) (value sourced by the Brazilian Energetic Balance Report, year 2015 (Table VIII.9 – Specific Mass and Heating Values – 2014)[52]).

$EF_{CO2,LPG,y}$ 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_2e)	LPG consumption by the project activity (ton)	Project emissions due to LPG consumption (tCO_2e)	Total Project emissions (tCO_2)
Year	$EC_{PJ,grid,y}$	$PE_{EC,y} = EC_{PJ,grid,y} * EF_{grid,y} * (1+TDL_{grid,y})$	$FC_{,LPG,y}$	$PE_{FC,y} = FC_{LPG,y} * EF_{LPG}$	PE_y
2014	48	21	0.015	0.05	21
2015	579	256	0.180	0.58	256
2016	579	256	0.180	0.58	256
2017	579	256	0.180	0.58	256
2018	579	256	0.180	0.58	256
2019	579	256	0.180	0.58	256
2020	579	256	0.180	0.58	256
2021	530	234	0.165	0.53	235
Total	**4,051**	**1,790**	**1.260**	**4.07**	**1,794**

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 01/12/2014 to 31/12/2014 and from 01/01/2021 to 30/11/2021 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:

[52] The Brazilian Energetic Balance Report – 2015 (Relatório Energético Nacional – 2015) is the latest report and it is based on data for year 2014. This official governmental report was published by the entity Empresa de Pesquisa Energética (EPE) and is available online: https://ben.epe.gov.br/BENRelatorioFinal.aspx?anoColeta=2015&anoFimColeta=2014

ER_y	Emission reductions (tCO_2e)
Year	$ER_y = BE_y - PE_y$
2014	27,059
2015	381,312
2016	434,817
2017	470,291
2018	501,725
2019	529,698
2020	554,696
2021	528,996
Total	**3,428,594**

Note: Values of ER_y 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 01/12/2014 to 31/12/2014 and from 01/01/2021 to 30/11/2021 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 2nd crediting period is enclosed to this PDD.

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

B.6.5.

Year	Baseline emissions ($t CO_2e$)	Project emissions ($t CO_2e$)	Leakage ($t CO_2e$)	Emission reductions ($t CO_2e$)
2014	27,080	21	0	27,059
2015	381,568	256	0	381,312
2016	435,074	256	0	434,817
2017	470,547	256	0	470,291
2018	501,981	256	0	501,725
2019	529,954	256	0	529,698
2020	554,952	256	0	554,696
2021	529,231	235		528,996
Total	3,430,388	1,794	0	3,428,594
Total number of crediting years	7			
Annual average over the crediting period	490,055	256	0	489,799

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 01/12/2014 to 31/12/2014 and from 01/01/2021 to 30/11/2021 respectively.

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) CR do Recreio landfill will be annually monitored on the basis of different sources, including *inter alia*: - Original construction and operational design of the CR do Recreio landfill; - Technical specifications and requirements for the management of the CR do Recreio 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 project's electricity generation facility 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 is currently installed as part of 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 07.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Original construction and operational design of the CR do Recreio 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	m³ wet gas/h
Description	Volumetric flow of LFG stream in time interval *t* on a wet basis for *j* (where *j* is the LFG delivery pipeline to each item of electricity generation and LFG delivery pipeline to the flare(s))
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).
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 project's electricity generation facility 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 is currently installed as part of 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 07.0) 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. 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.
Purpose of data	Calculation of baseline emissions.

Additional comment	This parameter will be monitored only in case Options B or C of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0) 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 for *j* (where *j* is the LFG delivery pipeline to each item of electricity generation and LFG delivery pipeline to the flare(s))
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).
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 project's electricity generation facility 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 is currently installed as part of 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 07.0) 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.

Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter will be monitored only in case Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0) 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 for *j* (where *j* is the LFG delivery pipeline to each item of electricity generation and LFG delivery pipeline to the flare(s))
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 project's electricity generation facility 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 is currently installed as part of 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 07.0) 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.
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter may be monitored only in case Options A, B or D of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0) 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 for *j* (where *j* is the LFG delivery pipeline to each item of electricity generation and LFG delivery pipeline to the flare(s))
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 project's electricity generation facility 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 is currently installed as part of 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 07.0) 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.
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 02.0.0) is applied for the determination of $F_{CH4,flared,y.}$ and $F_{CH4,EL,y}$. This parameter may be monitored in case Options A, B or D of the methodological tool is applied instead.

Data / Parameter	$\mathbf{M_{t,db}}$
Unit	kg/h
Description	Mass flow of the LFG stream in time interval *t* on dry basis for *j* (where *j* is the LFG delivery pipeline to each item of electricity generation and LFG delivery pipeline to the flare(s))
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 meters.

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 project's electricity generation facility 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 is currently installed as part of 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 07.0) 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.
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter will be monitored only in case Option D of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0) is applied for the determination of $F_{CH4,flared,y}$ and $F_{CH4,EL,y}$.

Data / Parameter	T_t
Unit	K[53]
Description	Temperature of the LFG stream in time interval *t*

[53] 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.

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 project's electricity generation facility 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 is currently installed as part of 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 07.0) 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.
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	P_t
Unit	Pa[54]
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 project's electricity generation facility 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 is currently installed as part of 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 07.0) 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.
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	-

[54] 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.

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 578 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/commercialization 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.
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 Julyt 2015). 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	<table><tr><th>Year</th><th>Values applied (MWh)</th></tr><tr><td>2014</td><td>0</td></tr><tr><td>2015</td><td>28,625</td></tr><tr><td>2016</td><td>63,708</td></tr><tr><td>2017</td><td>63,708</td></tr><tr><td>2018</td><td>63,708</td></tr><tr><td>2019</td><td>63,708</td></tr><tr><td>2020</td><td>63,708</td></tr><tr><td>2021</td><td>58,297</td></tr></table>Values within years 2015 and 2021 are applicable for the periods from 21/072015 (date for start of continuous operation of the electricity generation facility) to 31 Dec 2015 and from 1 Jan 2021 to 30 Nov 2021 respectively. Estimated net values for electricity generation are calculated by considering the nameplate installed capacity of the project's electricity generation facility, estimated average availability.
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 once a month.
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. Measurement records will be cross-checked against available electricity sales receipts/invoices issued by the local electricity commercialization/distribution company.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	$EF_{grid,OM,y} = EF_{grid,OM\text{-}DD,y}$
Unit	tCO_2/MWh
Description	Operating margin CO_2 emission factor in year y = Dispatch data analysis operating margin CO_2 emission factor in year *y*
Source of data	Data will be determined as per applicable guidance for dispatch data analysis operating margin CO_2 emission factor of the "Tool to calculate the emission factor for an electricity system". The selected value considered for all years encompassed by the 2nd 7-year crediting period in the context of the ex-ante estimation of emission reductions is the value calculated by the DNA of Brazil and valid for year 2014.
Value(s) applied	0.5837
Measurement methods and procedures	Data will be determined as per applicable guidance for dispatch data analysis operating margin CO_2 emission factor of the "Tool to calculate the emission factor for an electricity system".
Monitoring frequency	Yearly.
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

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 2nd 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	$F_{CH4,EG,t}$
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 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 project's electricity generation facility 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 is currently installed as part of 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 07.0) 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[55].
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

[55] 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).

Data / Parameter	$p_{H20,t,Sat}$
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 are ex-ante estimated by estimating the amount of methane in the LFG which is flared as part of the operation of the project activity in year y ($F_{CH4,PJ,y} = F_{CH4,flared,y}$) 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 07.0) 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	Data will be used for the determination of baseline emissions.
Additional comment	-

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

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 project's electricity generation facility 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 is currently installed as part of 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 07.0) 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(s) is/are 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[56].
Monitoring frequency	Continuous measurements will be recorded and reported with a least every minute frequency.
QA/QC procedures	Temperature measurement equipment should be replaced or calibrated in accordance with their maintenance schedule.
Purpose of data	Calculation of baseline emissions[57].

[56] In the particular case of the currently installed high temperature enclosed flare as part of the project activity, there are two thermocouples installed for measuring temperature in the exhaust gas of the flare. This requirement will thus be correctly considered as per recommendations from the flare's manufacturer. Additional flare may be installed in the future in order to address the forecasted increase in the amount of LFG collected by the project activity.

[57] 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).

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. 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.

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.
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 project's electricity generation facility 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 is currently installed as part of 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 07.0) 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.

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. 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.

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 project's electricity generation facility 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 is currently installed as part of 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 07.0) 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 ($SPEC_{flare,y}$).

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 180 kg (0.180 ton) of LPG will be consumed by the project activity per year during the 2nd 7-year crediting period[58].
Measurement methods and procedures	Recording of measurements of LPG consumed by project activity in year *y* by using appropriate mass meter (weight scale).
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	LPG purchasing receipts may be used for crosschecking of valid measurement records.
Purpose of data	Calculation of project emissions.
Additional comment	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.

[58] The estimated value is determined by taking into account the previously reported values of LPG consumed by the project activity during the monitoring periods 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[59]). Source of value applied in the context of ex-ante estimation of emission reductions during the 2nd 7-year crediting period: Brazilian Energetic Balance Report, year 2015 (Table VIII.9 – Specific Mass and Heating Values – 2014[60])
Value(s) applied	49.2
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.

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

[60] The Brazilian Energetic Balance Report – 2015 (Balanço Energético Nacional (BEN) – 2015) is the latest report and it is based on data for year 2014. This official governmental report was published by the entity Empresa de Pesquisa Energética (EPE) and is available online: https://ben.epe.gov.br/BENRelatorioFinal.aspx?anoColeta=2015&anoFimColeta=2014

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)[61]. 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.

[61] 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.
Purpose of data	Calculation of project emissions. .
Additional comment	Measurement records will be crosschecked against available diesel consumption receipts/invoices issued by the diesel supplying company. 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. $EC_{PJ,captive,y}$ will be monitored in case Alternative approach 1 or alternative approach 2 is used for the determination of Project emissions due to the consumption of electricity sourced by backup captive off-grid electricity generators (fuelled by Diesel) ($PE_{EC,captive,y}$).

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 as the installed backup off-grid electricity generator is expected to be used only during emergency situations.
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 specific fuel consumption specified by the equipment 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	**$NCV_{Diesel,y}$**
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[62]).
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 as the installed backup off-grid electricity generator is expected to be used only during emergency situations.
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 ($PE_{EC,captive,}y$).

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

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)[63]. 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 as the installed backup off-grid electricity generator is expected to be used only during emergency situations.
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	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 ($PE_{EC,captive,y}$).

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

Data / Parameter	$EG_{Diesel\text{-}Generator,y}$
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 as the installed backup off-grid electricity generator is expected to be used only during emergency situations.
Measurement methods and procedures	Use appropriate 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, $EG_{Diesel\text{-}Generator,y} = EC_{PJ,captive,y}$. $EG_{Diesel\text{-}generator,y}$ will be monitored in case Alternative approach 1 is used for the determination of Project emissions due to the consumption of electricity sourced by backup captive off-grid electricity generators (fuelled by Diesel) ($PE_{EC,captive,y}$).

Data / Parameter	CAPEX and OPEX
Unit	BRL (values in Brazilian Real (BRL) will be converted and also reported in Euros (EUR))
Description	Total investment to implement the project and total cost to operate the project
Source of data	Engineering procurement and construction contracts; and maintenance contracts and internal records
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	Total investment value will be calculated by project participants based on documentation from equipment suppliers, construction contractors and maintenance contracts. Operational costs will be calculated based on internal records.
Monitoring frequency	At the first issuance request after each phase of the project activity is fully implemented within the 2nd 7-year renewable crediting period.
QA/QC procedures	Reported values are to be audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors.
Purpose of data	Data will be occasionally used by the CDM Executive Board.
Additional comment	The information provided for CAPEX will indicate the investment made: (i) in the collection and flaring system; (ii) in the new electricity generation facility and its connection to the National Electricity Grid of Brazil. The information supplied for OPEX shall indicate the costs for: (i) staff and maintenance involved in the operation of the collection and flaring system; and (ii) staff and maintenance involved in the operation of new electricity generation facility. The monitoring of this parameter is required as the simplified procedures to identify the baseline scenario and demonstrate additionality was applied as outlined in Section B.4 and B.5 of the previously registered PDD valid for the currently expired 1st t-year renewable crediting period.

Data / Parameter	**Tariff of electricity exported**
Unit	BRL (values in Brazilian Real (BRL) will be converted and also reported in Euros (EUR))
Description	Tariff of the electricity exported
Source of data	Power purchase agreement
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	At the first issuance request after each phase of the project is fully implemented
QA/QC procedures	Values are to be audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors
Purpose of data	Data will be occasionally used by the CDM Executive Board.
Additional comment	The monitoring of this parameter is required as the simplified procedures to identify the baseline scenario and demonstrate additionality is applied as outlined in Section B.4 and B.5 of the previously registered PDD valid for the currently expired 1st t-year renewable crediting period.

B.7.2. Sampling plan

>>
Not applicable.

B.7.3. Other elements of monitoring plan

>>

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)[64]:

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 engine-generator set, with separated measurement data being recorded and reported for each flare and each engine-generator set of the electricity generation facility)	A	Volume flow – dry basis; Volumetric fraction dry or wet basis	$V_{t,db,j}$	Volumetric flow of LFG stream *j* in time interval *t* on a dry basis (in m^3 dry gas/h). *j* = LFG delivery pipeline to each operative high temperature enclosed flare
	B	Volume flow – wet basis; Volumetric fraction dry basis	$V_{t,wb,j}$	Volumetric flow of LFG stream *j* in time interval *t* on a wet basis (in m^3 dry gas/h). *j* = LFG delivery pipeline to each operative high temperature enclosed flare
	C	Volume flow – wet basis; Volumetric fraction wet basis	$V_{t,wb,j}$	Volumetric flow of LFG stream *j* in time interval *t* on a wet basis (in m^3 wet gas/h). *j* = LFG delivery pipeline to each operative high temperature enclosed flare
	D	Mass flow – dry basis; Volumetric fraction dry or wet basis	$M_{t,db,j}$	Mass flow of LFG stream *j* in time interval *t* on a dry basis (in kg/h). *j* = LFG delivery pipeline to each operative high temperature enclosed flare
Continuous CH_4 content gas analyser unit	-		$v_{CH4,t,db/wb,j}$	Volumetric fraction of methane on the LFG stream directed to the flares 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	**-**		P_t	Pressure of the LFG stream directed to the flares 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

[64] Measurement options defined in the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0) 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.

Different measurement options are indeed defined in the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0) when referring to "Adequate volumetric or mass flow meter (s)". The applicable guidance of the methodological tool "Project emissions from flaring" (Version 02.0.0) also refers to different measurement and calculation options.

Instrument or Source of data	Measurement option	Data monitored	
			volumetric or mass flows in normalised units.
LFG temperature sensor	-	T_t	Temperature of the LFG stream directed to the flares in time interval *t* (in K or ºC) 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.
Not based on measurements. Monitoring performed in the context of operation/monitoring for the project activity (based on calculations)	-	$p_{H20,t,Sat}$	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.
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)
Not based on measurements. Monitoring performed in the context of operation/monitoring for the project activity (based on calculations)	-	$EF_{grid,OM,y}$ = $EF_{grid,OM\text{-}DD,y}$	Operation margin CO_2 emission factor in year *y* = Dispatch data analysis operating margin CO_2 emission factor in year *y.* (in tCO_2/MWh). Data will be determined as per applicable guidance for dispatch data analysis operating margin CO_2 emission factor of the “Tool to calculate the emission factor for an electricity system”.
Mass/weight scale		$FC_{LPG,y}$	Amount of LPG consumed by the project activity in year *y* (in ton)
	Calculation approach (option) 1 or 3	$FC_{Diesel,y}$	Quantity of fuel Diesel combusted by the captive off-grid electricity generator (in liters)

Instrument or Source of data	Measurement option	Data monitored	
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 calculations)		**$NCV_{LPG,y}$**	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".
Not based on measurements Monitoring performed in the context of operation/monitoring for the project activity (based on calculations)	**Calculation approach (option) 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".

Instrument or Source of data	Measurement option	Data monitored	
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 approapriate 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 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

Instrument or Source of data	Measurement option	Data monitored	
			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.
Not based on measurements Monitoring performed in the context of operation/monitoring for the project activity (based on calculations)	-	**CAPEX and OPEX**	Total investment to implement the project and total cost to operate the project (BRL). Data will be determined as per applicable guidance of the baseline and monitoring methodology ACM0001 (version 15.0). Reported values are to be audited by professional, independent financial auditors.
Not based on measurements Monitoring performed in the context of operation/monitoring	-	**Tariff of electricity exported**	Tariff of the electricity exported (BRL). Data will be determined as per applicable guidance of the baseline and monitoring methodology ACM0001 (version 15.0). Reported values are to be audited by professional, independent financial auditors.

Instrument or Source of data	Measurement option	Data monitored
for the project activity (based on calculations)		

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/commercialization 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 be 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 be 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. All data recorded by the data logger / data acquisition system will be made 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 SIL – Soluções Ambientais Ltda., 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.

Monitoring of the management of the landfill:

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

- Original design of the landfill;
- Technical specifications for the management of the CR do Recreio 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, when compared to the landfill management and operation condition prior to 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 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").

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

>>

Completion date for the application of ACM0001 (version 15.0) for the renewal of crediting period: 31/07/2015 (date of completion of the initial version of the PDD for the 2nd 7-year crediting period: version 9.0).

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

The revised version of the PDD (version 9.2, dated 16/06/2017) 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).

- The formula for the determination of baseline emissions of methane ($BE_{CH4,y}$) applied in the context of ex-ante estimates of emission reductions to be achieved by the project activity is corrected in the emission reduction calculation spreadsheet that is enclosed to the PDD with related annual values being corrected accordingly. Figures for ex-ante estimates of emission reductions to be achieved by the project activity during the 2nd 7-year crediting period as reported in Section B.6.3 are corrected accordingly.

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

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

>>
At the time the CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CCRLGP)" was validated and registered as a CDM project activity (during period encompassing the year of 2006), the start date of the project was selected as being "*December 1st, 2007*".

C.1.2. Expected operational lifetime of project activity

>>
A total operational lifetime of 21 years has been expected for the project activity.
While the project activity started to operate in December 2007, the currently expected remaining operational lifetime for the LFG collection and destruction component of the project activity is about 13 years. For the project's electricity generation component, an operational lifetime of at least 20 year is expected.

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 01/12/2014 (by considering the 1st 7-year renewable crediting period has expired on 30/11/2014 and by also taking into account the CDM Secretariat was appropriately informed by SIL Soluções Ambientais Ltda. about its intention of renewing the crediting period for the project activity).

C.2.3. Length of crediting period

7 years and 0 months.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
At the time of the project's initial design conceptualization, the possible environmental impacts were analyzed by the FEPAM (Fundação Estadual de Proteção Ambiental) – Rio Grande do Sul environmental agency. The first Operating License for CR do Recreio landfill was issued on 18

September 2001, which was renewed five times (on 2002, 2003, 2004, 2008 and 2010), in order to obtain the most recent Operating Licence 4268/2012-DL (which is valid until 25/07/2016). There will be no transboundary impacts resulting from the CRRLGP. All relevant impacts will occur within Brazilian borders and will be mitigated to comply with the environmental requirements for the project's implementation.

For the implementation of the project's electricity generation component, a separate installation license was issued by FEPAM on 13/01/2014 (Installation License 41/2014-DL, valid until 01/07/2015). An operating license was also issued by FEPAM on 18/06/2015 (Operating License 4439/2015-DL, valid until 18/06/2019). Possible environmental impacts of the electricity generation facility were also analysed by FEPAM during the licensing process.

D.2. Environmental impact assessment

>>

At the time of the project's initial design conceptualization, no significant environmental impacts were expected as a result of the implementation and operation of the project activity. The infra-structure to collect and flare the landfill gas were assumed as not likely to generate significant impacts at the site. At that time, the Central de Resíduos do Recreio landfill was one of the few landfills in the Rio Grande do Sul State that has the Environmental License from FEPAM. SIL Soluções Ambientais Ltda. has been totally committed with the environmental integrity in its practices.

Flaring gas, nevertheless, may cause gaseous emissions, such as volatile organic compounds and dioxins that need to be controlled. At the time of the project's initial design conceptualization, it was assumed that during the environmental licensing procedures, all the necessary measurements would be made in order to mitigate such impacts, as requested for the issuance of the Operational License by the environmental agency.

For the implementation of the project's electricity generation component, no Environmental Impact Assessment (EIA) was required as part of the environmental process within the local environmental authority FEPAM. This is in accordance with the Federal resolution CONAMA nº 001/86[65]. This federal resolution defines in its article 2 that only for electricity generation power plants with nameplate installed capacity above 10 MW, regardless of its energy source, an EIA is required to be performed."

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

Prior to the development and implementation of the project activity, SIL Soluções Ambientais Ltda. organized and performed a public call in order to receive comments from local stakeholders when constructing CR do Recreio landfill.

As required by the Interministerial Commission on Global Climate Change, the Brazilian DNA, invitations for comments were sent to local stakeholders as part of the procedures for analyzing CDM projects and issuing letters of approval. This procedure was followed by SIL Soluções Ambientais Ltda. in order to take its GHG mitigation initiative to the public. Letters and the Executive Summary of the project activity were sent to the following recipients:

- Prefeitura Municipal de Minas do Leão – RS / *Municipal Administration of Minas do Leão - RS*
- Secretaria Municipal de Agricultura / *Municipal Agriculture Secretariat;*

[65] Available on line at: http://www.mma.gov.br/port/conama/res/res86/res0186.html

- Câmara dos Vereadores de Minas do Leão – RS / *Municipal Legislation Chamber of Minas do Leão - RS*
- Secretaria Estadual do Meio Ambiente / *Environmental Secretariat of Rio Grande do Sul State*
- Associação dos Moradores do Bairro Coréia / *Coréia District Representative Association*
- Ministério Público do Estado do Rio Grande do Sul / *Public Attorney of Rio Grande do Sul State*
- Fórum Brasileiro de ONGs / *Brazilian NGO Forum*

E.2. Summary of comments received

>>
SIL Soluções Ambientais Ltda. received comments from the Coréia District Representative Association, from the Municipal Agriculture Secretariat, from the Municipal Administration of Minas do Leão and from the Environmental Secretariat of Rio Grande do Sul State. In summary, the four comments congratulate SIL Soluções Ambientais Ltda. for the CRRLGP's initiative and emphasyze that the use of degraded areas as a landfill is a positive measure that results on the recovery of the area, reducing the environmental impact and is an important measure to the correct disposal of municipal solid waste.

The comments also say that the flaring of LFG will contribute to improve the environmental conditions, eliminating the gas odor that reaches the local population.

Finally, the four comments say that CRRLGP will contribute with the sustainable development, will enhance the population's local income and will generate job opportunities.

E.3. Report on consideration of comments received

>>
SIL Soluções Ambientais Ltda. appreciated the four comments received, which confirs all the positive impacts from the CRRLGP. The comments were received as an incentive for SIL Soluções Ambientais Ltda. to implement the project at the CR do Recreio landfill.

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 Brazil (dated 19/09/2006). Copy of such LoA and related assessment details are made available at the project's page at UNFCCC's CDM website.

Host Country Approval from Brazil confirmed the voluntary participation of SIL – Soluções Ambientais Ltda. as project participant in the CDM project activity. It is clearly stated in LoA issued by the DNA of Brazil that the project activity is considered to contribute towards Sustainable Development in Brazil. This is also assessed and reported in the Validation Report for the project activity.

Moreover, a LoA from the Annex I Party Japan was issued by the DNA of Japan authorizing and approving Japan Carbon Finance, Ltd. as project participant.
It is crucial to note that Japan Carbon Finance, Ltd. is not any longer a project participant (as outlined in the issued MoC Annex 2 (Withdraw Project Participant), which is valid from 28/02/2014 onwards).

- - - - -

Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
Organization name	Companhia Riograndense de Valorização de Resíduos S/A
Street/P.O. Box	Largo Visconde do Cairú, 12 - Sala 130I
Building	
City	Porto Alegre
State/region	RS
Postcode	90030-110
Country	Brazil
Telephone	+55 11 3124-3681
Fax	
E-mail	dnicoletti@vega.com.br
Website	www.crvr.com.br
Contact person	Diego Nicoletti
Title	Director
Salutation	Mr.
Last name	Nicoletti
Middle name	
First name	Diego
Department	
Mobile	
Direct fax	
Direct tel.	

Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
Organization name	Companhia Riograndense de Valorização de Resíduos S/A
Street/P.O. Box	Largo Visconde do Cairú, 12 - Sala 130l
Building	
City	Porto Alegre
State/region	RS
Postcode	90030-110
Country	Brazil
Telephone	+55 51 3652-2962
Fax	
E-mail	rsalamoni@crvr.com.br
Website	www.crvr.com.br
Contact person	Rafael Hollweg Salamoni
Title	Manager
Salutation	Mr.
Last name	Salamoni
Middle name	Hollweg
First name	Rafael
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
Organization name	Biogás Riograndense Ltda.
Street/P.O. Box	Rodovia BR 290, Km 181, s/n Prédio 1, Sala 2, Coreia
Building	
City	Minas do Leão
State/region	RS
Postcode	9675500
Country	Brazil
Telephone	+55 11 3124-3600
Fax	
E-mail	dnicoletti@vega.com
Website	
Contact person	Diego Nicoletti
Title	Manager
Salutation	Mr.
Last name	Nicoletti
Middle name	
First name	Diego
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
Organization name	Belektron d.o.o
Street/P.O. Box	Cvetkova ulica, 25
Building	
City	Ljubljana
State/region	
Postcode	1000
Country	Slovenia
Telephone	+386 1 620 88 54
Fax	
E-mail	Bostjan.bandelj@belektron.eu
Website	www.belektron.eu
Contact person	Bostjan Bandelj
Title	Manager
Salutation	Mr.
Last name	Bandelj
Middle name	
First name	Bostjan
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

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 Engenheiro 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	
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.	+ 55 11 9 8596 0950
Personal e-mail	nuno@unicarbo.com.br

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 9.2, dated 16/06/2017) 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).

- The formula for the determination of baseline emissions of methane ($BE_{CH4,y}$) applied in the context of ex-ante estimates of emission reductions to be achieved by the project activity is corrected in the emission reduction calculation spreadsheet that is enclosed to the PDD with related annual values being corrected accordingly. Figures for ex-ante estimates of emission reductions to be achieved by the project activity during the 2nd 7-year crediting period as reported in Section B.6.3 are corrected accordingly.

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