Project design document form
(Version 11.0)

BASIC INFORMATION	
Title of the project activity	ITVR Sao Leopoldo landfill gas project
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	5.1
Completion date of the PDD	01/02/2021
Project participants	Companhia Riograndense de Valorizacao de Residuos S.A. Solvi Participacoes S.A. Norwegian Ministry of Climate and Environment
Host Party	Brazil
Applied methodologies and standardized baselines	ACM0001 - “Flaring or use of landfill gas” (version 19.0)
Sectoral scopes	Sectoral Scope: 13 - Waste handling and disposal
Estimated amount of annual average GHG emission reductions	133,303 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Summarized description of the project activity:

The registered CDM project activity “ITVR Sao Leopoldo landfill gas project” promotes methane destruction through collection and combustion of landfill gas (LFG) at the ITVR São Leopoldo landfill[1]. As per its project design configuration, combustion of collected LFG occurs in high temperature enclosed flare(s).

LFG (which is rich in methane (CH_4) has been historically generated at the ITVR São Leopoldo landfill as a result of anaerobic decomposition of municipal solid waste (MSW) disposed in this solid waste disposal site (SWDS).

By promoting effective and efficient collection and combustion of LFG at the ITVR São Leopoldo landfill, the project activity thus promotes real and measurable greenhouse gas (GHG) emission reductions through destruction of methane in the installed high temperature enclosed flare (project’s methane destruction devices). It is assumed that, in the absence of the project activity, methane would otherwise be directly emitted into the atmosphere.

The ITVR São Leopoldo landfill started its operations in 2008. This landfill site has been operated by the host country project participant and project owner Companhia Riograndense de Valorizacao de Residuos S.A. (CRVR) since its commissioning date. The ITVR São Leopoldo landfill is located in the municipality of Paulínia, in São Paulo State, Brazil.

As a summary, the project design thus encompasses the following:

(i) Forced capturing/collection of LFG at the ITVR São Leopoldo landfill
(ii) Methane destruction through combustion of collected LFG in high temperature enclosed flare(s)[2]
(iii) Monitoring of quantity and quality of collected LFG which is sent for combustion in the high temperature enclosed flare(s) as well as monitoring of conditions/status of occurrence of LFG combustion in each one of such methane destruction devices in order to both determine combustion efficiency for the flare(s) (in terms methane destruction) as required by applied CDM baseline and monitoring methodology and applicable methodological tools.
(iv) Monitoring of consumption of grid-sourced electricity by the project activity.

Equipment and infrastructure installed and/or monitored as part of the project activity (under its revised design configuration) thus encompasses the following:

- a LFG collection network comprising a number of vertical LFG collection wells (with eventual

[1] The designation of the landfill hosting the project activity (ITVR São Leopoldo) is an abbreviation (in Portuguese language) for “*Indústria de Tratamento e Valorização de Resíduos*” (which is translated into English language as São Leopoldo Industry for Waste Treatment and Recovery). It is relevant to note that although the name of the landfill site is correctly written as ITVR São Leopoldo (using “São”), the project activity was registered by UNFCCC in year 2013 as “ITVR Sao Leopoldo landfill gas project” (using “Sao”). For sake of uniformity, this PDD refers to the title of the project activity as it is currently registered as UNFCCC.

[2] As outlined in Section A.3, the project’s description in terms of LFG flaring infrastructure currently encompasses the installation and operation of one high temperature enclosed flare, of which specifications are also detailed in Section A.3 and B.6.2 (ex-ante determined parameter $SPEC_{flare}$). The number of operational flares may however temporarily or permanently change along the 2^{nd} 7-year crediting period of the project activity as a response to change in the quantity of collected LFG available to be combusted by flaring (as part of the operation of the project activity).

implementation of horizontal LFG collection trenches being also considered[3]);

- a LFG flaring station (currently comprising 1 high temperature enclosed flare[4] and all required monitoring and control systems);

Summarized description of the baseline scenario under the 2nd 7-year crediting period:
For the 2nd 7-year crediting period of the project activity, the baseline scenario for LFG management at the ITVR São Leopoldo landfill (in terms of emissions of methane at the ITVR São Leopoldo landfill) remains being the same as the scenario existing prior to the implementation of the project activity at this landfill site:

- LFG generated at the ITVR São Leopoldo landfill (with high content of methane) being freely directly emitted into the atmosphere without any treatment, collection, continuous combustion or control through the surfaces of the landfill (with small fraction being destroyed through combustion in conventional passive LFG venting/combustion drains in order to address safety and/or odour concerns[5]).

- 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 conventional passive LFG venting/combustion drains.

GHG emission reductions to be achieved by the project activity during its 2nd 7-year crediting period:
By promoting permanent and real destruction of methane, the project activity is expected to promote total combined GHG emission reductions of 933,122 tCO_2e during its 2nd 7-year crediting period. This value is equivalent to average annual GHG emission reductions of 133,303 tCO_2e/year.

Environmental and climate change positive aspects of the project activity:
While methane is a powerful greenhouse gas (GHG), the pre-project situation of emission of LFG into the atmosphere thus contributes to global warming. Collection and combustion of LFG promote real and permanent abatement of GHG emissions at the ITVR São Leopoldo landfill.
Besides climate change mitigation, the project activity provides other important local environmental benefits: LFG contains trace amounts of volatile organic compounds, which are regarded as local air pollutants. Capturing of LFG using an active forced collection system and its combustion thus also promote reduction of emission of local pollutants.

As officially acknowledged in the Letter of Approval (LoA) for the project activity that was issued by the Designated National Authority (DNA) of Brazil, the project activity contributes towards Sustainable Development in Brazil.

Other contribution of the project activity towards Sustainable Development locally and in the whole country Brazil:
The project also provides the following additional important local environmental and social benefits:

- Destruction of other air pollutants, such as hydrogen sulphide, that is present in trace quantities in LFG;

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[3] In February/2021, the implemented project's LFG collection system encompassed about 29 vertical LFG collection wells under regular and continuous operation. No horizontal LFG collection trenches have so far been utilized for collecting LFG at the ITVR São Leopoldo landfill.

[4] In February/2021 there was 1 high temperature enclosed flare installed as part of the project activity. The number of operational high temperature enclosed flares may permanently or temporarily change during the 2nd 7-year crediting period of the project activity. In case of occurrence of permanent change of the number of installed flares, this will be opportunely addressed as per applicable guidance for addressing post-registration changes in the project design. Specification details for the currently installed high temperature enclosed flare are included in Section A.3.

[5] 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 the 2nd 7-year crediting period) for address safety and odour concerns is further explained in Section B.6.1.

- Improved LFG management at the ITVR São Leopoldo landfill promotes reduction of risks of occurrence of fire and explosion at the landfill as well as reduction of odour;
- Promotion of local job opportunities

Non-representing of CPA excluded from a previously registered PoA:
While previously registered as a project activity under the CDM on 21/05/2013 (date of the registration act)[6], the project activity does not represent a Component Project Activity (CPA) that has been excluded from a previously registered CDM Programme of Activities (CDM-PoA) as a result of erroneous inclusion of CPAs.

A.2. Location of project activity

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Physical/Geographical location of the project activity:

The project activity is implemented within the limits of the ITVR São Leopoldo landfill. The ITVR São Leopoldo landfill is located in the Socorro Road, 1550, in the municipality of São Leopoldo, Rio Grande do Sul State, Brazil.

The project geographical coordinates are as follows:

- Latitude: 29 44' 45" S or -29.7461
- Longitude: 51° 11' 45" W or -51.1966

The following pictures show the location of the project activity (which is implemented at the ITVR São Leopoldo landfill) within the limits Brazil, State of Rio Grande do Sul and municipality of São Leopoldo:

[6] While the project's registration act as a CDM project activity is dated 21/05/2013, its registration date under the CDM is assumed as being 27/12/2012.

Figure 1 – ITVR São Leopoldo landfill location within Brazil
(Source: Google Earth Web Application)

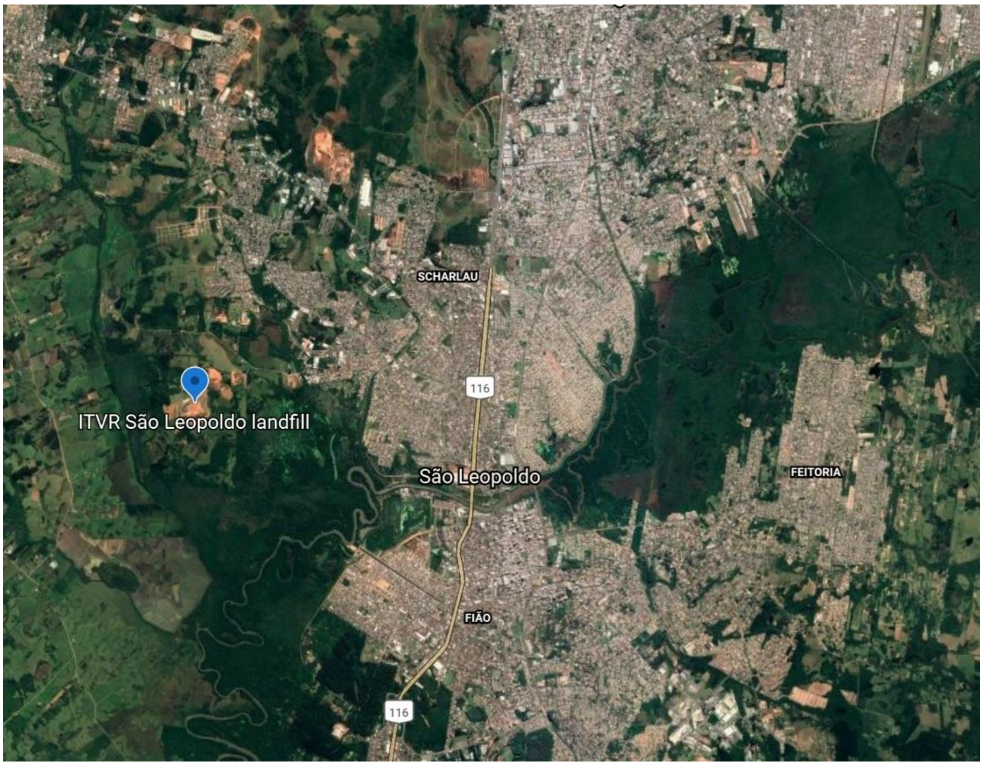

Figure 2 – ITVR São Leopoldo landfill within São Leopoldo Municipality
(Source: Google Earth Web Application)

Figure 3 – Aerial view of ITVR São Leopoldo landfill
(Source: Google Earth Web Application)

A.3. Technologies/measures

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Pre-project situation at the ITVR São Leopoldo landfill:

Municipal Solid Waste (MSW) disposal at the ITVR São Leopoldo landfill started in 2008. The pre-project situation (situation prior to the implementation of the project activity) at the ITVR São Leopoldo landfill represents the non-existence of appropriate equipment/infrastructure and/or practice dedicated to promote effective LFG management (LFG collection and destruction) at this particular landfill site.

As part of the previously performed CDM validation for the project (during year 2012), the above summarized pre-project situation was demonstrated to represent the baseline scenario for the project activity, with a set of conventional and to some extent rudimentary conventional passive LFG venting/combustion drains being used in the landfill's permanent MSW disposal area in order to allow sporadic/eventual passive combustion of LFG[7] (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 whole time period encompassing the 2nd 7-year crediting period of the project activity, it is assumed that in the baseline scenario (absence of the currently registered project activity), proper infrastructure for promoting effective and more efficient LFG collection and destruction would still being inexistent at the ITVR São Leopoldo landfill site. Currently (February/2021) there are still no legal municipal, state or national requirements in the municipality of São Leopoldo, State of Rio Grande do Sul nor in the country of Brazil (respectively) that establish any requirement or guidance in terms of LFG management in new or existing landfills or waste dumpsites[8].

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[7] As further explained and justified in Section B.6.1, the pre-project existing conventional LFG venting/combustion drains (which are assumed to be the only LFG management infrastructure to be used along the baseline scenario) were of somehow rudimentary design and, in most of the cases, such drains would not allow continuous combustion of LFG as these rudimentary LFG management solutions are typically not conceived/designed for ensuring continuous or efficient combustion of LFG. LFG has never been continuously and efficiently 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:

- Limited 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. rains)),
- Typical operational conditions at the ITVR São Leopoldo landfill prior to the implementation of the project activity (where no working staff has ever been required to attempt ensuring continuous or efficient combustion of LFG in such pre-project drains and/or monitoring the conditions/status of such drains (e.g. regular checking whether the drains are alight));
- There are still no applicable legal/regulatory requirements to collected and destroy or utilize methane in the ITVR São Leopoldo landfill.
- In the absence of the project activity (baseline scenario), as the operator of the ITVR São Leopoldo landfill, Companhia Riograndense de Valorizacao de Resíduos S.A. would not have any real technical or legal incentive or obligation to convert the existing LFG venting/combustion drains into a more appropriate LFG flaring system/solution as such conversion would represent additional costs.

Thus, in the absence of the currently registered CDM project activity, it is assumed that continuous and efficient 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 its 2nd 7-year crediting period). The practice in the baseline scenario is assumed as being both venting and combustion of LFG under uncontrolled, inefficient and non-systematic manner in the existent conventional LFG venting/combustion drains.

[8] Section B.6.1 includes further explanations regarding the expected continuation of the non-obligation of destroying/utilizing LFG (in order to meet legal or regulatory requirements) also during the time period to be covered by the 2nd 7-year crediting period of the project activity.

The baseline scenario for emissions of methane (CH_4) at the ITVR São Leopoldo landfill remains being the continuation of the pre-project practice (only a minor share of generated LFG being collected and destroyed by pre-project conventional passive LFG venting/combustion drains at the landfill (and additional drains that would otherwise the installed along the baseline scenario)). The baseline scenario for emissions of methane in the landfill site is therefore identical to the scenario existing prior to the implementation of the project activity (pre-project scenario) and remains unchanged for its 2nd 7-year crediting period.

The previously conceived overall design, operation and management plan of the ITVR São Leopoldo landfill has not compromised or changed as a result of the occurred implementation and starting of operations of the project activity. The previously conceived overall design, operation and management plan of the ITVR São Leopoldo landfill is not expected to change during the time period to be encompassed by the 2nd 7-year 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 crediting period of the project activity either. As required by the applied baseline and monitoring methodology ACM0001 (version 19.0), the occurrence or planning of any change in the management of the ITVR São Leopoldo landfill during the time period to be encompassed by the 2nd 7-year crediting period of the project activity will be reported and will be justified by referring to applicable technical or regulatory specifications.

Technology and measures encompassed by the project design:

Employed technology encompasses deep improvements of LFG management at the ITVR São Leopoldo landfill through the installation and operation of an active LFG collection system composed by LFG collection wells and LFG transportation pipeline network + methane destruction through combustion of collected LFG in high temperature enclosed flare(s).

Such measures allow methane contained in the LFG to be destroyed, thus avoiding emissions of methane into the atmosphere and, due to that, promoting real and permanent GHG emission reductions.

The project system is to be equipped with all needed monitoring system to ensure that all required measurements and monitoring are performed as established by ACM0001 (version 19.0) and applicable methodological tools. Such measurements include continuous monitoring of LFG flow to the flare(s), continuous monitoring of methane content in collected LFG, continuous monitoring of operational conditions/status of the flare(s) combusting LFG (methane destruction devices), etc.). In summary, the project technology is environmentally safe and sound.

Destruction of methane in LFG flaring infrastructure:

The project activity's design and construction encompass the following characteristics/technology to promote controlled combustion of collected LFG through flaring:

- Safe and low emission combustion of LFG guaranteed by the utilization of high temperature enclosed flare(s) that allow controlled and efficient combustion of LFG;
- Use of best practice safety devices for the flare(s) (such as flame detectors and slam shut valve);
- Continuous measurement of temperature of the exhaust gas of the flare (with continuous monitoring of the flare status (with every minute recording of the status signal of flame detector) being available during the 2nd 7-year crediting period).

The expected operational lifetime for the project's LFG collection and flaring infrastructure is at least 20 years. However, related equipment and infrastructure 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 included equipment/instruments. No major and further technology or equipment replacement is expected to occur during the 2nd 7-year crediting period when compared to the currently existing project's configuration[9]. While the project's LFG collection and flaring infrastructure started its continuous operations (as part of its 1st crediting period) in March/2019[10], thus the remaining operational lifetime for related equipment potentially exceeds 20 years in April/2039.

[9] The project participant Companhia Riograndense de Valorizacao de Resíduos S.A. acknowledges however that due to malfunction or repair need or even due to the need of meeting calibration requirements, project equipment and/or monitoring instruments may be temporarily or permanently replaced. Furthermore, in order to accommodate projected increment in the amount of LFG to be collected and destroyed by the project activity, additional equipment may be installed during its 2nd 7-year crediting period (e.g. additional high temperature flare(s), additional centrifugal blowers, etc.).

[10] The construction of the project's LFG capture and destruction system (using high temperature enclosed flare) was initiated in November/2018 and was concluded in February/2019. The official starting of operations of the project activity (with monitoring data measurements being recorded) is 06/03/2019. The starting of regular and continuous operation of the project activity in March/2019 is reported and assessed in the documentation for the previously performed 1st verification for the project activity (Monitoring Report and Verification Report).

While ACM0001 (version 19.0) requires ex-post monitoring whether equipment combusting LFG operates under compliance with operational requirements and/or recommendations as set by equipment manufacturer, the main operational characteristics and specifications of the currently installed high temperature enclosed flare[11] [12] are defined as follows:

Characteristics/specifications of the installed high temperature enclosed flare
Manufacturer: Biotecnogás srl Min. LFG flaring capacity (for continuous operation): Flow rate of 500 Nm^3/h Max. LFG flaring capacity (for continuous operation): Flow rate of 2,500 Nm^3/h Min. CH_4 destruction efficiency: 99.5% 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): 1,200 ºC Required frequency for inspection service (incl. inspection in the conditions of the flare's isolation ceramics revetment material): every year Required replacement for the flare isolation ceramics revetment material: after 10 years of regular and appropriate operation.

Source: Equipment technical declarations made available by Biotecnogás srl.

In Section B.3, a schematic flow diagram that summarizes the project boundary and delineates the project activity (equipment, parameters to be monitored, and GHGs included in the project boundary) complements information about the project's main equipment/infrastructure.

[11] The currently installed high temperature enclosed flare represents the only equipment combusting LFG installed as part of the project activity and of which compliance with operational specifications/requirements (as established y equipment manufacturer) should be monitored as per applicable guidance of ACM0001 (version 19.0) and applicable methodological tools. Thus, operational specifications and characteristics of this equipment are thus reported in this Section. Design and/or operational specifications of other equipment which are part of the project's LFG collection and destruction infrastructure (e.g. centrifugal blowers, valves, flow meters, gas analyzer, etc.) are not presented in this PDD. However, specification details of all equipment and instrument are expected to be regularly reported in the Monitoring Reports to be issued along the 2nd 7-year crediting period of the project activity. This is in accordance with applicable guidelines for completing the PDD form, completing the Monitoring Report form and also in accordance with applicable methodological and monitoring requirements as set by ACM0001 (version 19.0) and applicable methodological tools.

[12] The project participant Companhia Riograndense de Valorizacao de Resíduos S.A. acknowledges that additional high temperature enclosed flare(s) may be eventually installed during the 2nd 7-year crediting period of the project activity in order to fully accommodate previously projected potential gradual increase in the amount of LFG to be collected by the project activity.

In case installation of additional flare(s) be indeed confirmed/occurred, information made available in different Sections of this PDD (which outline specifications and/or operational requirements and conditions for the flare) will be updated accordingly by applying applicable CDM procedure for addressing post-registration changes (e.g. correction in information that does not affect the project design). This PDD does not include detailed specifications and maintenance requirements for other equipment which are part of the project activity (e.g. centrifugal blowers, CH_4 content gas analyzer unit, LFG pressure and temperature sensors, thermocouple (for measuring temperature of the exhaust gas of the flare), etc.). While, differently than the case of the high temperature enclosed flare, compliance of maintenance requirements and specifications for such additional equipment of the project's LFG collection and flaring infrastructure are not required to be monitored through dedicated monitoring parameters, it is important to note that such equipment (i.e. centrifugal blowers, thermocouples, flow meter) may be changed during the 2nd crediting period (due to malfunction, maintenance schedules, calibration events, etc.). The non-inclusion of specification and maintenance details of such additional equipment in the PDD is in accordance with applicable CDM rules and requirements (incl. requirements of ACM0001 (version 19.0) and applicable guidelines for completing the PDD for a CDM project activity). Details about such additional ancillary equipment (incl. monitoring instruments/equipment) will be made available in the Monitoring Reports for regular monitoring periods for the project activity.

Figure 4 – View of the project's currently installed high temperature enclosed flare

Consumption of electricity by the project activity:
Since the start of operation of the project activity in March/2019, all electricity demand for the project activity has been entirely met by consumption of grid-sourced electricity.

Technology transfer:
While the currently installed high temperature enclosed flare and some of the monitoring instruments (some of the currently installed meters and sensors) are manufactured in Italy, the project activity uses National components (equipment, instruments, etc.). While all currently existent forced (active) LFG collection and destruction systems under operation in landfills located in Brazil were implemented (or are currently being implemented/validated) as project based initiatives under the CDM, such project activities indeed involve transfer of technology and improvements in practices for LFG management to the host country Brazil.

No change in the design and operational conditions of the ITVR São Leopoldo landfill:

Design and operational aspects of the ITVR São Leopoldo landfill are not expected to change during the 2nd 7-year crediting period of the project activity. The ITVR São Leopoldo landfill is expected to still being operated with the application of the same and previously applied MSW landfilling technics and procedures.

Companhia Riograndense de Valorizacao de Residuos S.A. has designed and has managed and operated the ITVR São Leopoldo landfill in accordance with its design, construction, operational and management requirements as required and established in the environmental permits and licenses applicable for the ITVR São Leopoldo landfill and as per best available practices for landfill construction and operation in Brazil.

The whole management and operation plan of the ITVR São Leopoldo landfill has been approved and has been regularly monitored by the competent environmental authority of Rio Grande do Sul State)[13].

The ITVR São Leopoldo landfill has always been regarded as a very well-designed and very well-managed landfill. As established by the valid environmental and operational permits, disposed MSW is constantly covered and levelled with the use of heavy equipment (excavators, compacting equipment, etc.). Furthermore, safety requirements are defined and addressed as part of the operation of the landfill by using a preventative approach.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Companhia Riograndense de Valorizacao de Residuos S.A. (Private Entity)	No
Brazil (host)	Solvi Participacoes S.A. (Private Entity)	No
Norway	Norwegian Ministry of Climate and Environment	No

A.5. Public funding of project activity

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

A.6. History of project activity

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The project activity “ITVR Sao Leopoldo landfill gas project” is registered under the CDM and it (and/or the infrastructure/components it encompasses) was not previously included as a component project activity (CPA) in a registered CDM programme of activities (PoA). Prior of being registered under the CDM, the project activity (and/or the infrastructure/components it encompasses) did not represent any part or a whole previously registered CDM project activity that had been deregistered. Prior of being registered under the CDM, the project activity (and/or the infrastructure/components it

[13] The competent environmental authority in Rio Grande do Sul State is the Fundação Estadual de Proteção Ambiental - FEPAM. Copies of related construction, design, operational and management documents and procedures valid for the ITVR São Leopoldo landfill (incl. copies of all licensing and permit documentation) were made available to the DOE in charge of the validation assessment for the renewal of the crediting period for the project activity.

encompasses) were not part of a previous CPA that has been excluded from a previously registered CDM PoA either.

The project activity (and/or the infrastructure/components it encompasses) does not represent or part of a previously registered CDM project activity or a CPA under a previously registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) which existed within the same or other geographical location as the CDM project activity.

A.7. Debundling

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Not applicable.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

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The following CDM baseline and monitoring methodology is applied:

- Consolidated baseline and monitoring CDM methodology ACM0001 - “Flaring or use of landfill gas” (version 19.0) (https://cdm.unfccc.int/methodologies/DB/JPYB4DYQUXQPZLBDVPHA87479EMY9M);

The following methodological tools are applied:

- Emissions from solid waste disposal sites (version 08.0) (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v8.0.pdf);

- Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0) (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf);

- Project emissions from flaring (version 03.0) (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v3.0.pdf);

- Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0) (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf);

- Tool to calculate the emission factor for an electricity system (version 07.0) (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf/history_view);

- Combined tool to identify the baseline scenario and demonstrate additionality (version 07.0) (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v7.0.pdf)

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

B.2. Applicability of methodologies and standardized baselines

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The approved baseline and monitoring methodology ACM0001 (version 19.0) is applied. In addition, the above-listed methodological tools (which are referred by this CDM baseline and monitoring methodology or by one of the applied methodological tools) are also applied. Demonstration applicability conditions for ACM0001 (version 19.0) and for all methodological tools referred in Section B.1 are included in the tables below:

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 19.0)	**Justification**
"The methodology is applicable under the following conditions: (a) *Install a new LFG capture system in an existing or new (Greenfield) SWDS where no LFG capture system was or would have been installed prior to the implementation of the project activity; or* (b) *Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that:* (i) *The captured LFG was vented or flared and not used prior to the implementation of the project activity; and* (ii) *In the case of an existing active LFG capture system for which the amount of LFG cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project system: historical data on the amount of LFG capture and flared is available;* (c) *Flare the LFG and/or use the captured LFG in any (combination) of the following ways:* (i) *Generating electricity;*	As per the CDM project standard for project activities (CDM-PS-PA), in the context of the renewal of crediting period for a previously registered CDM project activity, the PDD valid for the 2nd 7-year crediting period is to be completed by applying the latest version of applicable CDM baseline and monitoring methodology. The project activity was previously registered as a CDM project activity by applying the CDM baseline and monitoring methodology ACM0001 (version 13.0.0) (which was the latest valid version of ACM0001 baseline and monitoring methodology at that time). While version 19.0 currently represents the latest version of ACM0001, this version of ACM0001 is thus selected as the applicable methodology for the 2nd renewal of the crediting period of the project activity. In the context of the previous registration of the project activity under the CDM, as described in the latest version of the registered PDD valid for the 1st 7-year crediting period (PDD version 4, dated 28/11/2012), the project design encompassed the installation of an active (forced) LFG capture system in an existing SWDS partially replacing a previously existent conventional passive LFG combustion system (using conventional passive LFG venting/combustion drains)[14]. In this sense, condition (b – i) of the quoted applicability criteria is met. It is important to note that, at the time the project design was conceived as declared in the latest version of the PDD valid for the 1st 7-year crediting period and even later in March/2019 (when the project activity was actually implemented and started operating), there were no pre-project active/forced LFG capture system that has been in operation prior to the start of the project activity. This is also outlined in the latest

[14] The installed active (forced) LFG capture system as part of the project activity encompasses entirely new equipment (centrifugal blowers, flare, etc.). By assuming that the project activity 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 19.0), it is assumed that condition (a) is not applicable and condition (b – i) is applicable.

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 19.0)	Justification
(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;* *(v) Supplying the LFG to consumers through a dedicated pipeline;* *(d) Do not reduce the amount of organic waste that would be recycled in the absence of the project activity."*	version of the registered PDD valid for the 1st 7-year crediting period (PDD version 4, dated 28/11/2012). The project design encompasses collection of LFG (which is collected as part of the operation of the project activity) and its destruction through combustion in the installed high temperature enclosed flare. The project design does not encompass utilization of collected LFG. Thus, the project activity fully fulfills condition (c). As a result of the previously occurred implementation of the project activity, there were no quantitative, qualitative, procedural or regulatory change occurred in terms of MSW management activities and policies valid for the ITVR São Leopoldo landfill or applicable in any other potential waste treatment or disposal facility under the area of influence of this landfill (that would be promoted or triggered by the project activity) in comparison with what would occur in the absence of the project activity (baseline scenario). This situation is expected to remain the same during the 2nd 7-year crediting period of the project activity. 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, the implementation and operation of the project activity *per se* are not expected to promote or trigger any quantitative change in waste disposal activities undertaken at the ITVR São Leopoldo landfill. Furthermore, no quantitative or qualitative changes in terms of waste management practices are expected to be promoted or triggered in any other existent or potential waste disposal or waste treatment facility (located or to be located in the region of influence of the ITVR São Leopoldo landfill) as a direct outcome or consequence of the operation of the project activity during its 2nd 7-year crediting period. Thus, the mere previously occurred implementation of the project and its continuous operation during its 2nd 7-year crediting period are not expected to promote or trigger any reduction (or prevention) of the amount of organic type of MSW (or any other type of solid waste) that would eventually be recycled or utilized in the region of influence of the ITVR São Leopoldo landfill (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)).

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 19.0)	Justification
	As demonstrated in the applicable construction, design and operational requirements valid for the ITVR São Leopoldo landfill (as defined by Companhia Riograndense de Valorizacao de Residuos S.A. and confirmed in the previously issued environmental permits for the construction and the operation of this particular landfill site), the ITVR São Leopoldo landfill is not expected to include any activity or initiative promoting recycling or utilization of organic fraction of waste was to be disposed at this landfill (such as implementation of a large scale waste sorting or waste composting facility for example). Without any organic waste recycling activity or initiative being under operation within the limits of the ITVR São Leopoldo landfill, it is thus clearly not expected that the implementation and operation of the project activity could per se eventually reduce organic waste recycling activities in the ITVR São Leopoldo landfill. It is imperative to note that design, construction and operational aspects for the ITVR São Leopoldo landfill were previously defined in accordance with the commercial agreements that the project participant Companhia Riograndense de Valorizacao de Residuos S.A. currently holds and is expected to hold in the position of operator and owner of the ITVR São Leopoldo landfill and as regional waste management company (service provider) providing MSW disposal services. 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 ITVR São Leopoldo 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 the operation of the project activity per se does not represent any perverse incentive or driver for the promotion of any supposed quantitative or qualitative reduction or prevention of waste recycling related activities (or initiatives for any type of organic fraction of solid waste or solid residues) that would occur in the region of influence of this landfill[15]in the absence of the project

[15] As per the Brazilian Federal Law 12.305/10 passed in year 2010, 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/utilization 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 in the whole country, solid waste recycling initiatives in Brazil are still being quite limited (especially in the case of organic fraction of MSW) mainly due to economic restrictions. As outlined in the publication "*Panorama dos Resíduos Sólidos no Brasil – 2018/2019*" (tittle translated into English language as "*Outlook of Solid Waste Sector in Brazil – years 2018/2019"* and available online at: http://abrelpe.org.br/download-panorama-2018-2019/), 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 has represented one of the most credible annual outlook and statistics source for the solid waste management in the country. 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 is implemented).

In fact, in year 2012 the Brazilian Ministry of City Infrastructure (through its National Secretary of Sanitation) has published the year 2017 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 – 2017*" (tittle translated into English language as "Diagnostics of Urban Solid Waste Management - 2017" and available online at: http://www.snis.gov.br/diagnostico-residuos-solidos/diagnostico-rs-2017). Like the Report "*Panorama dos Resíduos Sólidos no Brasil – 2018/2019*", 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 ITVR São Leopoldo landfill (cities from which generated MSW is disposed at the landfill), all solid waste materials (organic or inert) to be eventually/potentially recycled (very small share of collected MSW) are normally previously sorted (under very limited percentiles) 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 landfills or dump sites) 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 appropriately sorted pulp/paper/cardboard waste materials have actually been regarded as recyclable material as per both available statistics and available recycling practices. Besides some particular inert waste materials with attractive commercial value (e.g. aluminum packaging material (e.g. cans), some types of clean plastic material and some types of glass), no other waste materials have been normally collected from stream of MSW to be disposed in landfills in order to be eventually recycled in the region where the project activity is implemented and/or even transported to be recycled in other region. This has also been the typical waste recycling scenario in other regions of Brazil.

Thus, in the particular case of the ITVR São Leopoldo 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 particular landfill would be expected to be collected and directed to any type of recycling facility (e.g. composting facility) after or prior its disposal at 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 ITVR São Leopoldo 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.

All of the above-summarized facts and aspects confirms that no relevant sorting and collection of recyclable organic material from MSW already disposed in the ITVR São Leopoldo landfill are expected to occur regardless of the implementation of the project activity (under both baseline and project scenarios). Thus, recycling or alternative use/utilization of organic fraction from 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 – 2017*"; information and data available in the "*Panorama dos Resíduos Sólidos no Brasil – 2018/2019*" and also based on common practice for waste collection, currently existing very limited and not relevant recycling initiatives in the region of the project activity and even in other regions in Brazil, and by also taking into account the particular 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 ITVR São Leopoldo 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 2017 (data organized and published in year 2019)).
- 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 being required especially for cases where solid waste is disposed in existing not-well-managed landfill or dump sites. Such required improvements include construction of better-designed landfills, use of more appropriated technics for waste compacting and covering, etc. In this particular sense, the ITVR São Leopoldo

landfill represents a very well designed and very well 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 ITVR São Leopoldo landfill, organic fraction of solid waste material that is collected as MSW has been historically disposed by applying landfilling techniques.

- In all geographical regions in Brazil, relative very 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 do not represent any driver or incentive for promoting any change in the MSW management situation in the region where it is 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 also 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 Companhia Riograndense de Valorizacao de Resíduos S.A. (as owner and operator of the ITVR São Leopoldo 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), the project participant Companhia Riograndense de Valorizacao de Resíduos S.A. is 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 ITVR São Leopoldo landfill or at other location in the region.
- The implementation and operation of the project-based initiative promoting collection of LFG and its destruction in high temperature flare and utilization as fuel for electricity generation at the ITVR São Leopoldo 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 Sections B.4 and 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. There is no applicable regulation/law that deals with LFG management in Brazil. Thus, the implementation (and operation) of more appropriate and environmentally safe management of LFG at the ITVR São Leopoldo 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 facts/aspects and information above-presented, the project activity clearly 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 19.0)	Justification
	activity at the ITVR São Leopoldo landfill. The same is actually also applicable for recycling of inert waste material. Furthermore, regardless of the non-existence of any MSW recycling or utilization facility with comparable capacity that could eventually somehow compete with the ITVR São Leopoldo landfill as disposal site for organic fraction of MSW waste, aspects and actions related to promotion of recycling or utilization of organic fraction of solid waste are to be seen as fully dependent on regional and/or national public service policies in the case of Brazil (including policies, laws, regulations and programs) and such aspects and actions 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. In Brazil, the administrations of municipalities typically are the entities responsible for all MSW management services. In this context, waste management companies such as Companhia Riograndense de Valorizacao de Residuos S.A. normally acts as service providers, providing MSW collection and disposal services as per directives and contractual requirements set by the municipalities from which generated MSW are to be managed (collected and disposed). In this sense, in the position of a MSW management company operating a LFG collection and destruction initiative in the landfill it operates and owns, Companhia Riograndense de Valorizacao de Residuos S.A. is not under a position to trigger, establish or promote any 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 policies and practices related to recycling of inert or organic solid waste in the region of influence of the ITVR São Leopoldo landfill (or even beyond such region). No change in this sense is expected to occur during the 2nd 7-year crediting period of the project activity either. As outlined in Section B.4 and B.6.1, so far, there are still no legal restrictions or requirements for LFG gas collection and its destruction using high temperature enclosed flare(s) or any other device/equipment in Brazil. Moreover, there are still no legal restrictions neither requirements for venting and/or combustion of LFG in conventional passive LFG destruction systems either (where combustion of small and not defined

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 19.0)	Justification
	share of generated LFG through use of conventional passive LFG venting/combustion drains is identified as the baseline scenario for the project activity). Actually, there are no applicable regulations that deal with LFG management in Brazil at all. Thus, the implementation of more appropriate and environmentally safe management of LFG at the ITVR São Leopoldo 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 ITVR São Leopoldo landfill (when compared to the situation that would occur in the absence of the project) either. In this sense, under no circumstance, the project activity *per se* potentially promotes any displacement of volumes of organic waste stream from treatment/utilization being performed in an existent or hypothetical MSW recycling/utilization facilities (e.g. a MSW composting plant for example) in order to be disposed at the ITVR São Leopoldo landfill as a direct result of the implementation and operation of the project activity. Therefore condition (d) is also satisfied.
"*The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is* *(a) Atmospheric release of LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons; and* *(b) In the case that the LFG is used in the project activity for generating electricity and/or generating heat in a boiler, air heater, glass melting furnace or kiln;* *(i) For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or* *(ii) For heat generation: that heat would be generated using fossil fuels in equipment located within the project boundary."* *(c) In the case of LFG supplied to the end-user(s) through natural gas distribution network, trucks or the dedicated pipeline, the baseline scenario is assumed to be displacement of natural gas.*	As further demonstrated in Section B.4, the most plausible baseline scenario for methane emissions remains being the release of LFG from the SWDS directly into the atmosphere (with minor share of generated LFG being partially destroyed in conventional passive LFG venting/combustion drains). The application of the procedure to identify the baseline scenario thus falls into (a). As the project activity does not encompass utilization of LFG as gaseous fuel for electricity generation nor for heat generation, condition (b) is thus not applicable. Finally, while the project activity does not encompass supply of LFG to the end-user(s) through natural gas distribution network, trucks or the dedicated pipeline, (c) is thus not applicable. While the ITVR São Leopoldo landfill does not represent a Greenfield SWDS, (d) is not applicable either.

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 19.0)	**Justification**
(d) *In the case of LFG from a Greenfield SWDS, the identified baseline scenario is atmospheric release of the LFG or capture of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.*	
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 in order to increase methane generation compared to the situation prior to the implementation of the project activity.*	Neither options (a) and/or (b) occur. Under the project design configuration, the only GHG emission reductions claimed are due to destruction of methane through combustion (in high temperature enclosed flare(s)) After the occurred implementation and starting of operations of the project activity, the landfill operator has continued with MSW disposal activities at the ITVR São Leopoldo landfill as per its normal and previously planned/defined operation conditions and practices (as per the existent practice prior to the previously occurred registration of the project activity under the CDM and/or its implementation and starting of operations). MSW disposal practices and management at the ITVR São Leopoldo landfill are not expected to change during the 2nd 7-year crediting period of the project activity[16]. The quoted applicability condition is thus satisfactory met.

[16] The operation of the ITVR São Leopoldo landfill in terms of disposal of MSW (practices of waste disposal, covering, levelling, compacting, leachate management, etc.) has not changed after the implementation of the project activity and no change is expected to occur along the 2nd 7-year crediting period either. Thus there is no valid action promoting increase in methane generation (like e.g. through addition of liquids, pre-treating waste, changing the shape of the landfill) that was triggered or promoted by the project activity at the landfill when compared to the situation prior to the implementation of the project activity.

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”	03.0	*“This tool provides procedures to calculate project emissions from flaring of a residual gas, where the component with the highest concentration is methane. The source of the residual gas is biogenic (e.g. landfill gas or biogas from wastewater treatment) or coal mine methane.* *(…)* *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:* *(a) Methane is the component with the highest concentration in the flammable residual gas; and* *(b) 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 methodological tool refers to the latest approved version of “TOOL08: Tool to determine the mass flow of a greenhouse gas in a gaseous stream”.*	As part of the project activity, collected LFG (whose component with the highest concentration is methane) is combusted in a high temperature enclosed flare. ACM0001 requires that, as part of the determination of baseline emissions, project emissions from flaring are to be determined. LFG is a flammable gas generated from the anaerobic decomposition of organic waste material disposed in the ITVR São Leopoldo 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). As demonstrated below, the applicability conditions for the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” are sufficiently met. Thus, the quoted applicability conditions defined in the methodological tool are sufficiently met.
“Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”	03.0	*”This tool provides procedures to estimate the baseline, project and/or leakage emissions associated with the consumption of electricity, and procedures to monitor the amount of electricity generated by the project power plant.* *(…)* *If emissions are calculated for electricity consumption, the tool is only applicable*	As established by ACM0001 (version 19.0), consumption of electricity by the project activity is to be accounted as project emissions. The electricity demand of the project activity (under its current design configuration) is expected to

Methodological tool	Version	Applicability conditions	Comments
		if one out of the following three scenarios applies to the sources of electricity consumption: *(a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer;* *(b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or* *(c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid."*	be met through imports of grid-sourced electricity. No backup captive offi-grid electricity generator fuelled by fossil fuel (i.e. diesel) is considered as part of the project design. Thus, Scenario A of the tool is applicable. In summary, the quoted applicability criteria defined in the methodological tool are sufficiently met.
"Emissions from solid waste disposal sites"	08.0	*"This tool provides procedures to calculate baseline, project or leakage emissions of methane from solid waste disposed or prevented from disposal at a solid waste disposal site (SWDS)."* *"The tool can be used to determine emissions for the following types of applications:* *(a) Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g.*	The project activity 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 in the context of calculations of ex-ante estimates of emission reductions to be achieved by the project activity during its 2nd 7-year crediting period as

Methodological tool	Version	Applicability conditions	Comments
		"ACM0001: Flaring or use of landfill gas"). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex ante estimation of emissions in the project design document (CDM-PDD). The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS); *(b) Application B: The CDM project activity avoids or involves the disposal of waste at a SWDS. An example of this application of the tool is ACM0022, in which municipal solid waste (MSW) is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS. The methane is generated from waste disposed or avoided from disposal during the crediting period. In these cases, the tool can be applied for both ex ante and ex post estimation of emissions. These project activities may apply the simplified approach detailed in 0 when calculating baseline emissions.*	established by ACM0001 (version 19.0). Thus, the quoted applicability criteria defined in the methodological tool are sufficiently met.
"Tool to calculate the emission factor for an electricity system"	07.0	*This methodological tool determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the "combined margin" emission factor (CM) of the electricity system.* *(…)* *The CM is the result of a weighted average of two emission factors pertaining to the electricity system: the "operating margin" (OM) and the "build margin" (BM). The operating margin is the emission factor that refers to the group of existing power plants whose current electricity generation would be affected by the proposed CDM project activity. The build margin is the emission factor that refers to the group of prospective power plants whose construction and future operation would be affected by the proposed CDM project activity.*	Project emissions due to the consumption of grid-sourced electricity by the project activity are determined by applying applicable guidance of methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (of which ACM0001 version 19.0 refers to). The methodological tool "Tool to calculate the emission factor for an electric system" is referred to in the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and

Methodological tool	Version	Applicability conditions	Comments
		(…) *This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).* *(…)* *In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country."*	monitoring of electricity generation" for the purpose of calculating project emissions in case where a project activity consumes electricity from the grid. The CO_2 emission factor for the electricity grid which sources electricity to the project activity is determined as the combined margin CO_2 emission factor[17]. The electricity grid (to which the project activity is connected to) is not located partially or totally in an Annex I country. The relevant applicability conditions of the methodological tool are thus fully met.
"Combined tool to identify the baseline scenario and demonstrate additionality"	07.0	"*This tool is only applicable to methodologies for which the potential alternative scenarios to the proposed project activity available to project participants cannot be implemented in parallel to the proposed project activity"* *(…)* *For example, in the following situations a methodology could refer to this tool:* - *For an energy efficiency CDM project where the identified potential alternative scenarios are: (a) retrofit of an existing equipment, or (b) replacement of the existing equipment by new equipment, or (c) the continued use of the existing equipment without any retrofits;* - *For a CDM project activity related to the destruction of a greenhouse gas in one site where the identified potential alternative scenarios are: (a) installation of a thermal destruction unit, or (b) installation of a catalytic destruction system, or (c) no abatement of the greenhouse gas.*	As established by ACM0001 (version 19.0), this methodological tool is applied as per the methodology for the demonstration of the continuation of the baseline scenario. The project activity encompasses destruction of a greenhouse gas in one site where one of the identified potential alternative scenarios is no abatement of the greenhouse gas. The continuation of the baseline scenario is demonstrated by applying the stepwise procedure of ACM0001 (version 19.0) for the determination of the baseline scenario. Baseline emissions are also determined by applying

[17] The DNA of Brazil has regularly calculated and reported values for the CO_2 emission factor of the National Electricity Grid of Brazil. Such values are reported as being determined/calculated through application of the methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0 and previous versions).

Methodological tool	Version	Applicability conditions	Comments
		In these cases, the project proponents could not implement the three alternatives in parallel but they could only implement one of them." *However, the tool is, for example, not applicable in the following situation: the CDM project activity is the installation of a Greenfield facility that provides a product to a market (i.e. electricity, cement, etc.) where the output could be provided by other existing facilities or new facilities that could be implemented in parallel with the CDM project activity."*	methodological approach also established by ACM0001 (version 19.0) and applicable methodological tools. The applicability condition of the methodological tool is thus met.
"Tool to determine the mass flow of a greenhouse gas in a gaseous stream"	03.0	"*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 19.0), this tool is applied as per the methodology for determining the mass flow of CH_4 which is sent for combustion in the flare. The applicability condition of the methodological tool is thus met.

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

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The boundary for the project activity includes the landfill site where LFG rich in methane is captured and destroyed (through combustion of LFG in an enclosed high temperature flare). The electricity grid to which the project activity is connected to 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	GHG	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 GHG 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.
Project scenario	Emissions from consumption of grid-sourced electricity by the project activity	CO_2	Yes	May be an important/material emission source.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

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

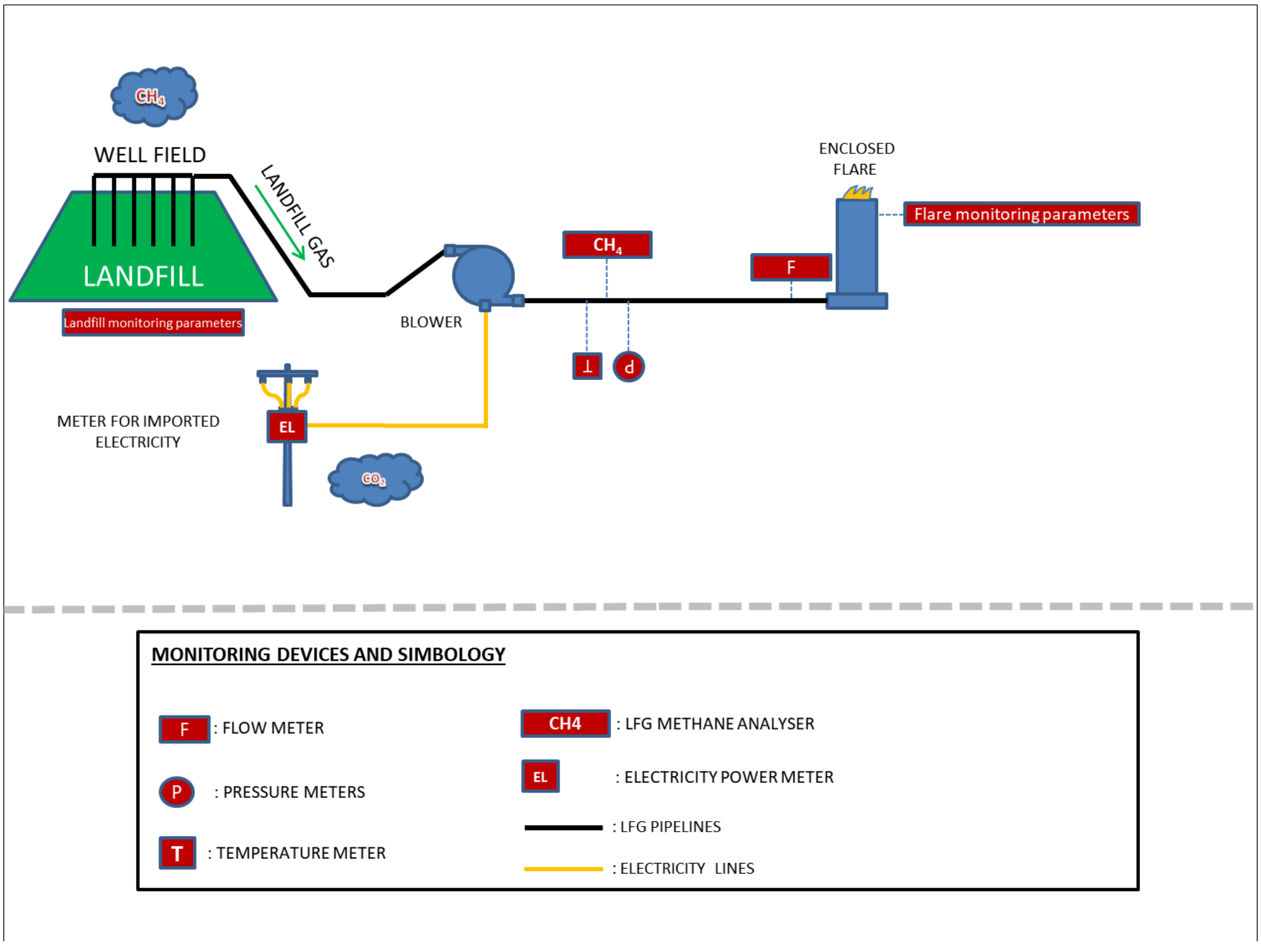

Figure 5 - Diagram summarizing the project boundary and delineating the project activity (equipment, parameters to be monitored, and GHG included in the project boundary)

B.4. Establishment and description of baseline scenario

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This Section includes the application of the stepwise approach of the latest version of methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" in order to confirm the identification of the baseline scenario for the project activity within its 2nd 7-year crediting period.

<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>

As per applicable guidance of the CDM project cycle procedure for project activities (CDM-PCP-PA), 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) (hereinafter referred to as "baseline validity tool") is to be applied in order to confirm the validity of the previously determined baseline scenario of the project activity.

Step 1 (of the "baseline validity tool"): Assess the validity of the current baseline for the next crediting period

Step 1.1 (of the "baseline validity tool"): Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

As further explained in Section B.6.1, prior to the registration of the project as a CDM, there was indeed no legal obligation to capture and destroy/utilize LFG (by using active (forced) collection systems and high temperature enclosed flare(s), internal combustion gas engines and/or any other methane destruction devices) at the ITVR São Leopoldo landfill and/or in any other existing (under operation or not) landfills in Brazil. This situation currently remains prevailing[18].
Although there are still no regional or national legal requirements in Brazil establishing LFG to be collected and destroyed or even utilized in landfills located in Brazil, in the particular case of the ITVR São Leopoldo landfill, it is anyhow assumed that in order to meet applicable design and operational requirements for this particular landfill site (in order to address safety and odor requirements), a set of conventional passive LFG venting/combustion drains would remain being existent and used as the unique LFG management measure in place for meeting such requirements in the absence of the project activity (baseline scenario).

The demonstration of continuation of the previously derived baseline scenario for the project activity in terms of methane emissions (under its revised design configuration) is thus under full compliance with existing/valid applicable mandatory national, regional and/or sectorial policies and requirements.

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[18] In February/2021, there were still no legal requirements for LFG gas collection and its destruction using active or passive high temperature enclosed flares in Solid Waste Disposals Sites (SWDS's) in Brazil (from open waste dumpsites to well-managed landfills). Moreover, in February/2021 there were still no legal restrictions neither legal requirements for passive venting of LFG or combustion of LFG in conventional LFG destruction systems (e.g. passive flares) valid for SWDS's located in the country either. Actually, there are still no applicable regulations that deals with LFG management in Brazil. *The Brazilian National Policy on Waste Management:* After years of studies and negotiations, the Brazilian Regulation termed National Policy on Waste Management, established by Decree No. 7,404/10 (the Decree) was finally published on 23/12/2010. In force since its publication and with no modifications/complementation since its issuance, this decree regulates the National Policy on Waste Management (PNRS) as established by Federal Law No. 12,305 (the LPNRS), and creates the Steering Committee for the Implementation of Reverse Logistics Systems (Steering Committee) and the PNRS Interministerial Committee. This most recent 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 pointed out by the law firm "Tauil & Chequer Advogados" about the *Regulation of the National Policy on Waste Management* in an article published in year 2011 (of which content remains valid since no related regulatory change was made since year 2011):

> *"(...) 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."* [SIC]

Step 1.2 (of the "baseline validity tool"): Assess the impact of circumstances

The previously identified baseline scenario for emissions of methane at the ITVR São Leopoldo landfill (at the validation stage of the project activity), an assessment of changes in market characteristics is thus required for its renewal of the crediting period as required by the methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" (version 03.0.1).

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

- The conditions and circumstances previously considered or taken into account to determine the baseline emissions of methane at the ITVR São Leopoldo landfill for the currently expired 1st 7-year crediting period remain being valid. LFG (rich in CH_4) generated at the ITVR São Leopoldo landfill would still be 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) through both the surface of the landfill and through the conventional passive LFG venting/combustion drains (whenever such drains are not alight) in the absence of the project activity.

- There are no changes 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 emissions of methane at ITVR São Leopoldo landfill for the 2nd 7-year crediting period of the project activity.

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

While the baseline scenario identified at the previously performed validation stage of the project activity was not selected at that time 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 in the context of determination of baseline for emissions of methane.

Step 1.4 (of the "baseline validity tool"): Assessment of the validity of the data and parameters

It is relevant to note that selected methodological requirements, ex-ante selected data and parameters which were previously determined during the project validation period and thus prior to the starting of the 1st 7-year crediting period as per the applicable requirements of the previously applied CDM baseline and monitoring methodology (ACM0001 (version 13.0.0)) will not any longer be valid/applicable during the 2nd 7-year crediting period of the project activity.

As per the applied version of the valid CDM baseline and monitoring methodology (ACM0001 (version 19.0)) and related methodological tools, there are differentiated applicable methodological approaches considered (when compared to the CDM baseline and monitoring methodology previously applied for the project activity (and ACM0001 (version 13.0.0)) (incl. some of the ex-ante determined parameters, other default values and even other assumptions). Due to that, new data and ex-ante determined parameters are applied in the context of the demonstration of the validity of the previously derived baseline scenario and also applied in the determination of baseline emissions for methane valid for the 2nd 7-year crediting period of the project activity. Thus, some of data and parameters as presented in the latest version of the PDD valid for the currently expired 1st 7-year crediting period are not any longer valid.

As a conclusion, since (i) the demonstration of validity of the previously derived baseline scenario, (ii) determination of baseline emissions of methane for the 2nd 7-year crediting period and (iii) ex-ante determined parameters and default values are all determined/calculated as per applicable guidance of ACM0001 (version 19.0) + applicable methodological tools, the validity of most of the previously defined ex-ante determined parameters is thus limited for the project activity. The methodological approaches for the demonstration of validity of the previously derived baseline scenario, baseline emissions during the 2nd 7-year crediting period, ex-ante determined parameters and monitored parameters for the project activity under its revised design configuration are all presented and justified in this Section, in Section B.6.1, Section B.6.2, and Section B.7.1 + B.7.3 respectively.

Step 2 (of the "baseline validity tool"): Update the current baseline and the data and parameters

Step 2.1 (of the "baseline validity tool"): Update the current baseline

The whole determination of the baseline scenario for the project activity (as per applicable guidance of ACM0001 (version 19.0) + applicable methodological tools) is included below under "*Determination of the baseline scenario*".

It is important to note that while the baseline scenario for the project activity is not changed for the 2nd 7-year crediting period (when compared to the baseline scenario assumed for the previous crediting period), the applied methodological approaches for the determination of baseline scenario and baseline emissions (as per ACM0001 (version 19.0) + applicable methodological tools) are indeed slightly different than the ones required by the previously applied methodology ACM0001 (version 13.0.0).

Thus, for completeness reasons, this updated version of the PDD includes the whole determination of the baseline scenario and baseline emissions for the project activity as per the applicable guidance and requirements and stepwise approaches of ACM0001 (version 19.0) (regardless the fact baseline scenario in terms of methane emissions remains being the same as the one valid for its currently expired previous 7-year crediting period).

The determination of baseline emissions (by following all applicable guidance and requirements of ACM0001 (version 19.0) and applicable related methodological tools) is presented in Section B.6.1. Related ex-ante estimations of baseline emissions for the 2nd 7-year crediting period of the project activity are summarized in Section B.6.3.

Determination of the baseline scenario for the project activity *(in order to demonstrate the continuation of previously identified baseline scenario by following applicable stepwise procedure of the "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0) as required by ACM0001 (version 19.0)):*

On the next steps, the continuation of the previously identified project's baseline scenario for methane emissions is confirmed/demonstrated through the application of the stepwise approach for determining baseline scenario as per the "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0) as required by ACM0001 (version 19.0).

Application of the stepwise approach for determining baseline scenario for emissions of methane at the ITVR São Leopoldo landfill as per the "Combined tool to identify the baseline scenario and demonstrate additionality" (hereafter in this Section termed as "Combined tool"):

STEP 0 (of the "Combined tool"): Demonstration whether the proposed project activity is the *First-of-its-kind*

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

STEP 1 (of the "Combined tool"): Identification of alternative scenarios

SUB-STEP 1a (of the "Combined tool"): Define alternatives to the proposed CDM project activity

Identification of alternatives for the destruction of LFG:

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

LFG1: The project activity undertaken without being registered as a CDM project activity. (i.e. capture and landfill or use of LFG). This is a plausible alternative scenario, however involves significant investment and operation & maintenance costs.

LFG2: Atmospheric release of the LFG or capture of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, or to address safety and odour concerns or for other reasons. This scenario corresponds to the continuation of the current situation (the proposed project activity or any other alternatives are not implemented).

LFG3: Atmospheric release of the LFG or capture of LFG in an unmanaged SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons. While the ITVR São Leopoldo landfill is a well-managed SWDS, this alternative is not applicable.

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

LFG5: LFG is partially not generated because part of the organic fraction of the solid waste is treated aerobically and not disposed in the SWDS;

LFG6: LFG is partially not generated because part of the organic fraction of the solid waste is incinerated and not disposed in the SWDS.

The project activity was developed and it is currently implemented at the ITVR São Leopoldo landfill site, which is a well-managed landfill site. This particular SWDS has been under continuous operation since year 2008. The purpose of the ITVR São Leopoldo landfill site is promoting final disposal of municipal solid waste through adopting of appropriate landfilling practices and techniques. The design, construction and operation of the ITVR São Leopoldo landfill do not encompass any recycling of the organic fraction of waste and its design is not expected to change in the future. Furthermore, as further explained in Section B.2, the project activity has not previously promoted and is not expected to promote any change in waste recycling activities in the region where the ITVR São Leopoldo landfill site is located. In this context, it is crucial to note that with or without the project activity being implemented, no recycling of the organic fraction of waste disposed at the ITVR São Leopoldo landfill site, neither aerobic treatment, neither incineration of disposed waste streams have occurred or have prevented (or would have occurred or would have prevented) at this particular landfill and/or in any other landfill, or recycling station located in the region where the landfill is located.

Thus, alternative scenarios LFG3, LFG4, LFG5 and LFG6 are hereby automatically excluded from the determination of baseline alternatives. Such exclusions are in accordance with applicable guidance of ACM0001 (version 19.0).

In fact, recycling of organic matter, aerobic treatment and incineration of Municipal Solid Waste (MSW) has not been common practice in Brazil[19]. The implementation and operation of the project activity has never promoted and is not expected to promote any quantitative change (including reduction) in the amount of organic solid waste that could or would be eventually recycled. This is an applicability condition/criteria of ACM0001 (version 19.0) of which compliance is further explained in Section B.2.

Identification of alternatives for electricity generation:

While the project activity does not encompass utilization of LFG for electricity generation, identification of alternatives for electricity generation is thus not applicable in the particular context of the application of the stepwise procedure of the methodological tool for the identification of baseline scenario. Therefore, existent scenarios E1, E2 and E3 of ACM0001 (version 19.0) are not considered either. This is also in accordance with ACM0001 (version 19.0).

Identification of alternatives for heat generation:

Heat generation scenarios using LFG collected at the landfill as fuel are not part of the project activity either, as there are no heat requirements at the landfill and the project activity does not encompass use of collected LFG for heating or thermal purposes (i.e. use of collected LFG as gaseous fuel in boiler, air heater, glass melting furnace(s) and/or kiln). Therefore, scenarios existent scenarios H1 trough H7 of ACM0001 (version 19.0) are not considered either. This is also in accordance with ACM0001 (version 19.0).

Identification of alternatives for supply of LFG to a natural gas distribution network and/or distribution of compressed/liquefied LFG by using trucks:

Supply of LFG to a natural gas distribution network and/or distribution of compressed/liquefied LFG by using trucks are currently not considered as part of the project activity either. Therefore, this option is not considered on the present analysis.

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[19] In fact, organic content of generated Municipal Solid Waste MWS in Brazil has been historically managed through disposal on solid waste dump sites or landfills (either controlled or uncontrolled). This is outlined in Figure 4.1.3.1 on page 46 of the publication "*Panorama dos Resíduos Sólidos no Brasil – 2018/2019*". Available online:

http://www.abrelpe.org.br/panorama_apresentacao.cfm

Outcome of SUB-STEP 1a: The only alternatives to be taken into consideration, after STEP 1a) are LFG1, LFG2 (in the particular context of identification of the baseline scenario for the project activity – that includes methane destruction as its unique measure).

SUB-STEP 1b (of the "Combined tool"): Consistency with mandatory applicable laws and regulations:

So far, there are still no legal restrictions or requirements/obligations for LFG collection and destruction in Brazil. Moreover, there are still no legal restrictions or requirements/obligations for utilizing collected LFG for generation of electricity (or any other type of LFG utilization) in Brazil either. Therefore, alternative LFG1 and LFG2 are thus under compliance with applicable mandatory laws and regulations.

Outcome of SUB-STEP 1b: the only remaining alternatives to be taken into consideration after SUB-STEP 1b) are identified as LFG1 and LFG2 (in the particular context of identification of the baseline scenario for the project activity – that includes methane destruction as its unique measure).

Application of STEP 2: Barrier analysis + **STEP 3: Investment analysis + STEP 4: Common practice analysis (of the "Combined tool"):** Differently than the latest version of the PDD valid for the currently expired 1st 7-year crediting period of the project activity (PDD version 4, dated 28/11/2012) which includes the whole description for the assessment and demonstration of additionality for the project activity, Section B.5 of this PDD does not include any description for such assessment and demonstration. Therefore, the application of the following subsequent steps of the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0) are thus not included/presented in Section B.5 and/or in any other Section: - STEP 2: Barrier analysis - STEP 3: Investment analysis - STEP 4: Common practice analysis As per applicable CDM rules and procedures, demonstration of additionality is not applicable/required for the renewal of the crediting period of a registered CDM project activity[20].

[20] It is relevant to note that as per the applicable methodological guidance of both ACM0001 (versions 13.0.0 and 19.0) and the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0), determining baseline scenario for a LFG collection and destruction/utilization under the CDM is a task which is somehow combined with the assessment and demonstration of additionality for such project activity.
While in the particular case of the renewal of the 7-year crediting period of the project activity, it is not required/necessary to re-assess and re-demonstrate the additionality neither demonstrating the validity of the previously assessed/demonstrated additionality, the application of STEP 2, STEP 3 and STEP 4 of the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0) are thus automatically regarded as not applicable / not required in the particular context of the demonstration of the continuation of the previously identified baseline scenario for emissions of methane at the ITVR São Leopoldo landfill for the project activity during its 2nd 7-year crediting period. This is in accordance with the methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" and other applicable CDM guidelines and rules.

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

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

As per ACM0001 (version 19.0), this procedure is only applicable (in the context of the determination of baseline scenario for the project activity) if LFG has been ever utilized in existing equipment that was in operation prior to the implementation of the project activity.

The project activity started to operate in March/2019 in a landfill site of which starting of MSW disposal operations is dated of year 2008. No type of LFG destruction and/or LFG utilization equipment was ever in place prior to the implementation of the project activity as there was no appropriate LFG management prior of the implementation of the project activity.

This step of ACM0001 (version 19.0) is thus not required in the context of the demonstration of the continuation of the baseline scenario for the project activity.

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

As an outcome of the application of the applicable guidance of the "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0) and ACM0001 (version 19.0), it is demonstrated the following:

Alternative "*LFG1" ("The project activity (i.e. capture of landfill gas (rich in methane) and its combustion (destruction) by flaring) undertaken without being registered as a CDM project activity")* does not represent the baseline alternative.

Thus, the baseline alternative for the project activity is identified as corresponding to alternative *LFG2* ("*Atmospheric release of the LFG or partial capture of LFG and destruction to comply with regulations or contractual requirements, or to address safety and odors concerns*").

Step 2.2 (of the "baseline validity tool"): Update the data and parameters

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

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

It is also important to consider that ACM0001 (version 19.0) and applicable methodological tools include set of parameters (ex-ante or ex-post determined) which were not previously applied/considered in the PDD valid for the currently expired 1st 7-year crediting period (as the PDD for such currently expired crediting period was previously completed in accordance with requirements and guidance of the baseline and monitoring methodology valid/applicable at that time).

B.5. Demonstration of additionality

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As also indicated in Section B.4, demonstration of additionality is not applicable/required for the renewal of the crediting period of a registered CDM project activity. Due to that, this Section is not completed.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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In accordance with ACM0001 (version 19.0) and applicable methodological tools, emission reductions (ER_y) to be achieved by the project activity during its 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:

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

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 19.0), baseline emissions (BE_y) for the project activity during its 2nd 7-year crediting period are determined according to equation (1) and comprises the following emission sources:

a) Baseline methane emissions from the SWDS[21] 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;

[21] As established by the methodological tool "Emissions from solid waste disposal sites" (version 08.0), "SWDS" refers to Solid Waste Disposal Site.

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)

In the particular case of the project activity, no collected LFG is currently expected to be used as gaseous fuel for heat generation purposes; and no LFG collected by the project activity is expected to be injected in a natural gas distribution pipeline or even displace/complement the use of natural gas either. Due to that, $BE_{HG,y}$ 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 crediting period and are thus regarded as null. Furthermore, since electricity generation using LFG as fuel is not considered/regarded as an additional GHG abatement/mitigation measure for the project activity, $BE_{EC,y}$ is not applicable in the context of the determination of baseline emissions for the project activity during its 2nd 7-year crediting period either. Thus, $BE_{EC,y}$ is also regarded as null.

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

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

Baseline methane emissions ($BE_{CH4,y}$) is calculated in conformance with ACM0001 (version 19.0) + applicable methodological tools respectively by following the approaches presented below:

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 set of high temperature enclosed flare(s)) 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 19.0)[22]:

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

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 which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* (in tCH_4/yr)
$F_{CH4,BL,y}$	Amount of methane that would be destroyed through flaring of LFG in the baseline scenario (absence of project activity) in year *y* (in tCH_4/yr)
GWP_{CH4}	Global warming potential of CH_4 (in tCO_2e/tCH_4)

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

As per ACM0001 (version 19.0), the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices (in tCH_4/yr) during its 2nd 7-year crediting period is to be ex-post determined as the sum of quantities of methane destroyed through combustion of collected LFG in flare(s) (s), power plant(s), boiler(s), air heater(s), glass melting furnace(s), kiln(s) (methane destruction devices) and/or by supply of collected LFG to consumer(s) through natural gas distribution network based on ex-post measurements, as follows:

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

Where:

$F_{CH4,flared,y}$	Amount of methane which is destroyed through combustion of collected LFG in the flare(s) in year *y* (in tCH_4).
$F_{CH4,EL,y}$	Amount of methane which is destroyed through combustion of collected LFG in the internal combustion gas engines in year *y* (in tCH_4).
$F_{CH4,HG,y}$	Amount of methane which is destroyed through combustion of collected LFG in heat generation device(s) in year *y* (in tCH_4/yr). The project design currently does not encompass combustion of collected LFG in heat generation device(s). Thus, $F_{CH4,HG,y}$ is assumed as null (zero).

[22] As established by ACM0001 (version 19.0), 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 (ITVR São Leopoldo landfill) in the absence of the project activity (baseline scenario). As per ACM0001 (version 19.0), 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" (version 08.0). 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.

$F_{CH4,NG,y}$	Amount of methane which is destroyed by supply of collected LFG to consumer(s) through natural gas distribution network in year *y* (in tCH_4/yr). The project design currently does not encompass supply of collected LFG to consumer(s) through natural gas distribution network. Thus, $F_{CH4,NG,y}$ is assumed as null (zero).

In summary, the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices will be ex-post determined as follows:

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

Determination of the amount of methane which is destroyed through combustion of collected LFG in the flare(s) ($F_{CH4,flared,y}$)

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

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

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

Where:

$F_{CH4,flared,y}$	Amount of methane which is destroyed through combustion of collected LFG in the flare(s) in year *y* (in tCH_4/yr)
$F_{CH4,sent\_flare,y}$	Amount of methane in collected LFG which is sent to the flare(s) 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/tCH_4)

$F_{CH4,sent\_flare,y}$ is determined by following applicable guidance of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0). As per the ACM0001 (version 19.0), the following requirements apply for the determination of $F_{CH4,sent\_flare,y}$:

- The gaseous stream that shall be considered in the application of the methodological tool is the stream of collected LFG which is sent for combustion in 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); and
- The mass flow should be calculated at least on a an hourly basis for each hour *h* in year *y*;

Applicable guidance of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) will be applied to determine $F_{CH4,sent\_flare,y}$ [23] by using one of the options A, B, C or D. The selection of the determination option will depend on project conditions

[23] In the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0), the mass flow of greenhouse gas in a gaseous stream (which in the particular case of the project activity is the amount of methane in collected LFG which is sent to the flare ($F_{CH4,sent\_flare,y}$) is actually represented as $F_{i,t}$.

and/or monitoring equipment/instruments under operation during monitoring periods within the 2nd 7-year crediting period of the project activity.

Use of Option A, B, C or D for the determination of $F_{CH4,sent\_flare,y}$:

Depending on the project conditions, one of the following measurement options will be chosen and the following formulas applied for the determination of as $F_{i,t}$ [24]:

Option	Flow of gaseous stream	Volumetric fraction
A	Volume flow dry basis	Dry or wet basis[25]
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)

[24] The selection of option A, B, C or D will occur on an ex-post basis depending on the type and/or specifications of monitoring equipment installed and under operation within the 2nd 7-year crediting period of the project activity.

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

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

$\rho_{i,t}$ Density of greenhouse gas *i* in the gaseous stream (in kg gas *i*/m^3 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.m^3/kmol.K)

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

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:

$$MM_{t,db} = \sum_{k} (v_{k,t,db} * MM_{k}) \qquad \textbf{(11)}$$

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:

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

with

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

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:

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

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)

<u>Option D:</u>

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:

$$V_{t,db} = M_{t,db}/\rho_{t,db} \tag{15}$$

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).

Determination of the absolute humidity of the gaseous stream

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:

Option 2: Simplified calculation without measurement of the moisture content

This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. If it is conservative to assume that the gaseous stream is dry, then $m_{H2O,t,db}$ is assumed to equal 0. If it is conservative to assume that the gaseous stream is saturated, then $m_{H2O,t,db}$ is assumed to equal the saturation absolute humidity ($m_{H2O,t,db,sat}$) and calculated using equation (7).

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

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 19.0), $PE_{flare,y}$ is determined by following applicable guidance of the methodological tool "Project emissions from flaring" (version 03.0).

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

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

STEP 1: Determination of the methane mass flow of the residual gas;

STEP 2: Determination of the flare efficiency;

STEP 3: Calculation of project emissions from flaring.

Step 1: Determination of the methane mass flow in the residual gas:
The methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) shall be used to determine, in kg, the mass flow of methane in the residual gaseous stream in the minute *m*: $F_{CH4,m}$.

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

- The methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) shall be applied to the residual gas.
- The flow of the gaseous stream shall be measured continuously;
- CH_4 is the greenhouse gas *i* for which the mass flow should be determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool); and
- The time interval *t* for which mass flow should be calculated is every minute *m*.

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

Step 2: Determination of flare efficiency:
As per ACM0001 (version 19.0), flare efficiency represents the combustion efficiency of LFG in the flare in terms of CH_4 by considering *inter alia* the time and conditions that the flare is operating. For determining the combustion efficiency for the enclosed flare, the selected option of the methodological tool "Project emissions from flaring" (version 03.0) are (i) the option to apply a default efficiency value or (ii) determining the flare efficiency based on monitored data (based on applicable measurements and calculations).

The time the 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 the installed 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" (version 03.0), where the flare efficiency will be determined on the basis of the performance of at least biannual basis related measurements.

In case at least 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” (version 03.0) will be used as an alternative.

Both options are summarized below:

Option A: Apply default value for flare efficiency.

Option B: Measure the flare efficiency.

Option A: Application of default value:
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. Furthermore, as also established by the methodological tool “Project emissions from flaring” (version 03.0), for enclosed flares that are defined as low height flares, the flare efficiency shall be adjusted, as a conservative approach, by subtracting 10 percentile points. For example, the default value applied shall be 80%, rather than 90%.

Option B: Measured flare efficiency:
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 of 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%.

By applying 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, the following calculation formula is applied:

Option B.1: Biannual measurement of the flare efficiency:

The calculated flare efficiency $\eta_{flare,calc,m}$ is determined as the average of at least two measurements of the flare efficiency made in year *y* ($\eta_{flare,calc,y}$), adjusted by an uncertainty factor of 5 percentile points as follows:

$$\eta_{flare,calc,y} = 1 - \frac{1}{2}\sum_{t=1}^{2}\left(\frac{F_{CH4,EG,t}}{F_{CH4,RG,t}}\right) - 0.05 \quad \textbf{(18)}$$

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[26]

Note: $F_{CH4,EG,t}$ is measured according to an appropriate national or international standard. $F_{CH4,RG,t}$ is calculated according to Step 1[27], 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:
Project emissions from flaring are calculated as the sum of emissions for each minute *m* in year *y*, based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

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

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 $F_{CH4,PJ,y}$

Ex-ante estimates of $F_{CH4,PJ,y}$ is required to estimate methane baseline emissions from the ITVR São Leopoldo landfill in the context of annual estimates the emission reductions to be achieved by project activity during its 2nd 7-year crediting period.

[26] As also established by the methodological tool "Project emissions from flaring" (version 03.0), if the monitoring period is shorter than one year, the measurement should be at least twice in a monitoring period and in a maximum timeframe of six months between each measurement.

[27] 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*.

As established by ACM0001 (version 19.0), $F_{CH4,PJ,y}$ is estimated as follows:

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

Where:

$BE_{CH4,SWDS,y}$	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" (version 08.0). 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 19.0);
- 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 which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices ($F_{CH4,PJ,y}$) during each year y of its 2nd 7-year crediting period, the calculation of $BE_{CH4,SWDS,y}$ is given by:

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

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 19.0). While as per the methodological tool "Emissions from solid waste disposal sites" (version 08.0), f_y is presented as a parameter to be monitored ex-post; by considering the related methodological approach of ACM0001 (version 19.0) and assigned value for f_y, this parameter will thus not be monitored ex-post during the 2nd 7-year credtiting period of the project activity.

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" (version 08.0) and ACM0001 (version 19.0). While the design of the project activity is limited to the promotion of collection and destruction/utilization of LFG at the ITVR São Leopoldo landfill (without promoting any change in the management and operation of this particular landfill), the project activity thus does not prevent any solid waste from being disposed at the ITVR São Leopoldo 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 its 2nd 7-year 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 19.0), this section 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 ITVR São Leopoldo landfill site due to eventually applicable regulatory or contractual requirements and/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 19.0). As also required by ACM0001 (version 19.0), 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 19.0)

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

Requirement to destroy methane:

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

Like the situation valid prior to the start of the 1st 7-year crediting period of the project activity, currently there is still being no legally obliged promoting any kind of capture and/or destruction/utilization of LFG at the ITVR São Leopoldo landfill[28]. Furthermore, this situation is currently not expected to be changed during the time period to be encompassed by the 2nd 7-year crediting period of the project activity either.

[28] In February/2021, 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 an article published in year 2011 of which content remains being valid:

> *"(...) 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."* [SIC]

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

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

In the case of the ITVR São Leopoldo landfill, it is assumed that a requirement to destroy methane due to safety and odor concerns does exist since its starting of operations due to following related aspects/facts:

- Although there is indeed no regional or national regulatory requirement in Brazil establishing or requiring LFG to be collected and destroyed in landfills (such as the ITVR São Leopoldo landfill) or waste dump sites, and although there is no contractual requirement to collect and destroy LFG either; in the particular case of the ITVR São Leopoldo landfill, as per the previously conceived design, construction and operational requirements (which were previously set by Companhia Riograndense de Valorizacao de Residuos S.A. and which are still valid/applicable for the ITVR São Leopoldo landfill), it is acknowledged that in the absence of the project activity 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 existent pre-project conventional passive LFG venting/combustion drains in order to appropriately address safety and odor concerns under the baseline scenario (absence of the project activity)[29].
- While the methodological approach of ACM0001 (version 19.0) applied 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 account the related definition of "*requirement*" as per ACM0001 (version 19.0), 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 ITVR São Leopoldo landfill.

By taking such assumptions into account, the following is thus valid/applicable for the ITVR São Leopoldo 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 directly regarded as not applicable cases for the determination of $F_{CH4,BL,y}$ (in the particular contexts of the demonstration of the continuation of the previously derived baseline scenario and determination of baseline emissions for the 2nd 7-year crediting period of the project activity). Thus, the remaining possibly valid alternatives (cases) (after the analysis of existence of non-regulatory and/or non-contractual requirements to destroy methane due to safety and/or odor concerns) are thus Case 2 and Case 4.

[29] As also established by applicable design, construction and operational requirements for the ITVR São Leopoldo landfill (as defined by Companhia Riograndense de Valorizacao de Resíduos S.A. 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 in order to address safety and odour concerns (measures that promote reduction of pressure and volume of LFG in the inner section of the landfill thus minimizing risks of fire, explosion and instability in the landfill cells that could result in slides of disposed material). Such operational requirements are still valid.

Existence of LFG capture and destruction system at the ITVR São Leopoldo landfill:

Prior to the previously occurred registration of the project activity under the CDM and/or its implementation and starting of operations, a very small and not defined fraction of methane generated at the ITVR São Leopoldo landfill was destroyed through combustion (very reduced share of generated LFG being combusted through use of conventional passive LFG venting/combustion drains). Such conventional and rudimentary LFG management solution was at that time the only existent infrastructure for LFG management existent at the project site.

Under the baseline scenario (absence of the project), it is assumed that such practice would continue to exist at the ITVR São Leopoldo landfill site. Destruction of a very small and undefined share of generated methane would 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 ITVR São Leopoldo 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 system*” and "*existing LFG capture system*" as per ACM0001 (version 19.0)[30], it is thus assumed that there was an “*existing LFG capture and destruction system*” at the ITVR São Leopoldo landfill in the pre-project scenario (prior to the implementation of the project activity). It is also assumed that such 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 was a pre-project conventional LFG capture and destruction system implemented at the ITVR São Leopoldo 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.

By taking the above presented facts and assumptions into account, the following is thus valid/applicable for the ITVR São Leopoldo landfill in the absence of the project activity (baseline scenario) in the context of the application of the methodological guidance of ACM0001 (version 19.0):

- 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 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 ITVR São Leopoldo landfill) is Case 4.

In summary, the only option/case applicable for the ITVR São Leopoldo landfill (in the absence of the project activity) is Case 4.

[30] As per ACM0001 (version 19.0), "*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 19.0), "*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."*

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 its 3rd and last crediting period:

- Requirement to destroy methane = YES
- Existing LFG capture and destruction system = YES

Relevant design, construction and operational aspects for the conventional LFG venting/combustion drains in the baseline scenario:

As set by the construction and design aspects of the ITVR São Leopoldo landfill site and also as set by operational requirements for the landfill, in the absence of the project activity (baseline scenario), the set of pre-project rudimentary, passive and conventional LFG venting and combustion drains would remain being the only available infrastructure on-site to promote any type of management of LFG at the landfill (with LFG being assumed as being combusted at such drains (instead of venting of LFG) as a priority).

As per the design and construction of such conventional passive LFG venting/combustion drains, whenever the drains are not lid, LFG is just freely vented into the atmosphere (through the drains). In practical terms, only a very small fraction of total amount of LFG generated at the landfill have been actually combusted in the set of conventional LFG venting/combustion drains prior to the implementation of the project activity due to the following reasons:

- The design and construction of the pre-project conventional passive LFG venting/combustion drains is somehow rudimentary, and it does not allow continuous combustion of LFG through the drains (as such drains are not conceived for assuring continuous combustion of LFG). Due to construction aspects and conditions of the drains (such as the diameter of the LFG venting drains, pressure of LFG in the drains, influence of wind and other climate aspects (e.g. rain)) as well as due to the typical day-today operational conditions at the ITVR São Leopoldo landfill prior to the implementation of the project activity (where no working staff were ever been required to attempt to ensure continuous combustion of LFG in the drains and/or monitor the conditions/state of such drains (e.g. regular checking whether the drains are alight)), LFG has never been continuously combusted in such pre-project passive LFG venting/combustion drains prior to the implementation of the project activity. Thus, in the absence of the CDM project activity, no continuous and/or not quantitatively relevant combustion of LFG in the pre-project the drains (and additional drains that would be otherwise installed instead of the project's LFG collection wells) would occur. As above-highlighted, there is still no legal requirement to destroy methane in the ITVR São Leopoldo landfill. The assumed requirement is of operational and/or design nature: requirement to address safety and odor concerns. It is also important to note that, as the owner and operator of the ITVR São Leopoldo landfill, Companhia Riograndense de Valorizacao de Residuos S.A. would not have any economic or operational incentive/motivation to convert the previously existing LFG venting/combustion drains into more a appropriate LFG flaring system (passive or active) in the absence of the project activity (baseline scenario).
- It is also important to note that non-continuous and/or non-quantitatively relevant combustion of LFG through conventional LFG venting/combustion drains has been the practice not only at the ITVR São Leopoldo landfill, but also in several others landfills and dump sites in Brazil and other countries in Latin America where no legal requirements for destruction of LFG exists. In

most of the cases (where combustion of LFG in order to address safety and odor requirements is not a relevant issue), LFG is actually directly vented through the drains and/or directly through the surface of the landfill (without any LFG being combusted)[31].

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 19.0):

"*$F_{CH4,BL,y}$ 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*" as per ACM0001 (version 19.0); 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 ITVR São Leopoldo landfill:

While in the context of the assumed existent non-regulatory and non-contractual requirement for addressing safety and odor concerns at the ITVR São Leopoldo 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

[31] It is important to observe that as per the situation valid in February/2021, the implementation of effective active LFG collection and destruction or utilization infrastructure in landfills in Latin America has so far been occurred in the context of the emission reduction project-based initiatives under the CDM. In the absence of the incentives of the CDM, converting conventional and rudimentary LFG venting/combustion drains into appropriate LFG flaring system at the ITVR São Leopoldo landfill would be an effort requiring capital investment, would face operational costs and would also represent extra work to be faced by Companhia Riograndense de Valorizacao de Resíduos S.A. which would not economically justified as there is still no national or regional legal or regulatory requirements in Brazil.

is vented through the drains under a undefined quantity[32]), the installation of a conventional passive 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 19.0)) is thus considered under a conservative and simplified approach[33].

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[32] Under the baseline scenario, as per the construction, design and operational requirements applicable for the ITVR São Leopoldo landfill, it is assumed by Companhia Riograndense de Valorizacao de Resíduos S.A. 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.

[33] As per ACM0001 (version 19.0), 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 19.0):

> *"(…)*
> *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 previously occurred in order to address an existent design and operational requirement for the ITVR São Leopoldo 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 19.0). By promoting combustion of LFG, such system also meets the definition of "*LFG capture and destruction system*" of ACM0001 (version 19.0). 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 19.0) (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 ITVR São Leopoldo 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.

Thus, the following equation is applicable:

$F_{CH4,BL,R,y} = 0.2 * F_{CH4,PJ,capt,y}$ **(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).

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

By (i) taking into account the applicable definition of "*requirement*" as per ACM0001 (version 19.0); 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 ITVR São Leopoldo landfill, it is assumed the following[34]:

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:

$F_{CH4,BL.sys,y} = 0.2 * F_{CH4,PJ,y}$ **(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 $F_{CH4,BL,R,} > F_{CH4,BL,sys,y}$.

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

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

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 Companhia Riograndense de Valorizacao de Resíduos S.A. 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 its 2nd 7-year crediting period in order to follow the guidance.

[34] As per ACM0001 (version 19.0), 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:*
>
> $F_{CH4,BL,sys,y} = 0.2 * F_{CH4,PJ,,y}$
> *(…)"*

Where: In accordance with applicable guidance of ACM0001 (version 19.0), $F_{CH4,PJ,capt,y}$ is assumed as the sum of the amount of methane that is sent to the project's methane destruction devices (e.g. high temperature enclosed flare(s)) in year *y*, however by not taking into account flare efficiency values in the particular case of its utilization for the determination of $F_{CH4,BL,y}$).

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:

In accordance with applicable guidance of ACM0001 (version 19.0), $F_{CH4,PJ,capt,y}$ is to be determined as the sum of the amount of methane that is sent to the project's methane destruction devices (i.e. the high temperature enclosed flare(s)) in year *y* (however by not taking into account the working hours of such devices and by not taking into account flare efficiency in the particular case of its utilization for the determination of $F_{CH4,BL,y}$ [35]).

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

Not applicable. As the project activity does not encompass utilization of LFG for electricity generation. baseline emissions associated with electricity generation ($BE_{EC,y}$) are not considered. In summary, this step is not applicable.

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

As the project activity 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. In summary, 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 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.

[35] 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 the sum of the accumulated values for amount of methane in the LFG which is destroyed by flaring in year *y* (in tCH_4) ($F_{CH4,flared,y}$) (in tCH_4/yr) for the underlying period (with values being calculated/determined without considering/monitoring the hours *h* that the 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, and baseline emissions are reduced proportionally.

Monitoring of the management of the landfill:

As required by ACM0001 (version 19.0), during the 2nd 7-year crediting period of the project activity, the design and operational conditions of the ITVR São Leopoldo landfill site 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 ITVR São Leopoldo landfill;
- Applicable local or national regulations

During the 2nd 7-year crediting period of the project activity, original operational design of the ITVR São Leopoldo landfill site should be confirmed not to be modified in order to ensure that no practice to deliberately or intentionally increase methane generation at the landfill have been occurring during the 2nd crediting period, when compared to the landfill management and operation condition prior to implementation of the project activity and/or during its currently expired 1st crediting period. As required by ACM0001 (version 19.0), 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").

Determination of project emissions (PE_y):

As established by ACM0001 (version 19.0), project emissions (PE_y) for the 2nd 7-year crediting period of the project activity are calculated (in tCO_2/yr) as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} \tag{27}$$

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 encompass any distribution of compressed/liquefied LFG, there will be no project emissions from the distribution of compressed/liquefied LFG using trucks ($PE_{DT,y} = 0$). Furthermore, while no fossil fuel is consumed by the project activity for purpose other than electricity generation, there will be no related project emissions either ($PE_{FC,y} = 0$)

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

While the only electricity source to be accounted in the context of determination of project emissions is grid-sourced electricity, project emissions from electricity consumption ($PE_{EC,y}$) are equal to project emissions due to consumption of grid-sourced electricity by the project activity ($PE_{EC,grid,y}$). $PE_{EC,grid,y}$ is calculated by following applicable guidance of the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0) as follows:

$$PE_{EC,gri,d,y} = EC_{PJ,grid,y} * EF_{EL,grid,PJ,y} * (1 + TDL_{grid,y}) \tag{28}$$

Where:

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

Determination of emission factor for grid-sourced electricity:
Since grid electricity is the only source of electricity consumed by the project activity, Option A.1 of the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" is thus selected for determining $EF_{EL,k,y}$. Thus, according to the selected option of the tool, 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 $EF_{grid,CM,y}$

Combined margin CO_2 emissions factor is calculated in accordance with the "Tool to calculate the emission factor for an electricity system" (version 07.0). 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", $EF_{CM,y}$ is determined as a weighted average of two CO_2 emission factors pertaining to the electricity system:

- the CO_2 operating margin emission factor ($EF_{OM,y}$)
- 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" 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 either.

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, Innovation and Communication (MCTIC) of Brazil has been updated and published annually the information for power units[36].

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 ($EF_{grid,OM\text{-}DDy}$) 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 $EF_{grid,OM\text{-}DDy}$., as the MCTIC have been done.

The operating margin emission factor is calculated as follows:

$$EF_{grid,OM\text{-}DDy} = \frac{\sum_{h} EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}} \quad \textbf{(29)}$$

[36] The Ministry of Science, Technology, Innovation and Communications (MCTIC) of Brazil has been calculating the CO_2 emission factor for the national electricity grid of Brazil according to the methodology tool “Tool to calculate the emission factor for an electricity system” (version 07.0 and previous versions). The CO_2 emission factor for the national electricity grid of Brazil can be directly obtained from the website of the Designated National Authority (DNA) of Brazil. The actual latest annual value (year 2020) has been calculated by Ministry of Science, Technology, Innovation and Communications (MCTIC), 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 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).

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 2 was previously selected for the currently expired 1st 7-year crediting period of the project activity. For the 2nd crediting period, the build margin emission 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 $EF_{grid,BM,y}$[37]. The latest published value (applicable for year 2019) is thus the value for the ex-ante selected parameter $EF_{grid,BM,y}$ and is calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \textbf{(30)}$$

Where:

$EF_{grid,BM,y}$ Build margin CO_2 emission factor in year *y* (tCO_2/MWh)

[37] 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: https://antigo.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

$EG_{m,y}$	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:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * w_{OM} + EF_{grid,BM,y} * w_{BM} \quad \textbf{(31)}$$

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, 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 2^{nd} 7-year crediting period are selected ex-ante, annual values for $EF_{grid,OM,y}$ will be determined ex-post within the crediting period as required by the methodological tool “Tool to calculate the emission factor for an electric system”. Thus, during the 2^{nd} 7-year crediting period of the project activity, the combined margin CO_2 emission factor will be calculated and updated annually.

<u>Determination of leakage emissions (LE_y):</u>

No leakage emissions are expected to occur. Moreover, no leakage effects are accounted for under ACM0001 (version 19.0).

B.6.2. Data and parameters fixed ex ante

Data/Parameter	$OX_{top\ layer}$
Data unit	Dimensionless
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Consistent with how oxidation is accounted for in the methodological tool "Emissions from solid waste disposal sites" (version 08.0)
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 19.0)
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/Parameter	GWP_{CH4}
Data unit	tCO_2e/tCH_4
Description	Global warming potential of CH_4
Source of data	"Global Warming Potential for Given Time Horizon" in table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon. Available at: www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14 The applied 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}
Data 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[38] and by also taking into consideration the design and operational characteristics/aspects of the ITVR São Leopoldo landfill plus the general construction, design and forecasted implementation of the project's LFG collection network during its 2nd 7-year crediting period.
Purpose of data	Calculation of baseline emissions
Additional comment	Selected value can also be represented as percentage, since 0.9280 = 92.80%

[38] 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 *"(…) landfill gas collection efficiencies should routinely reach 100%."*
Practical results, shown on table 4 of the study: Weighted average collection efficiency, show a collection efficiency of 92.8 to 96.1% on well-engineered landfills with vacuum systems to extract LFG.
The paper "*Measuring landfill gas collection efficiency using surface methane concentration*" is available at https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.498.2784&rep=rep1&type=pdf

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

Data/Parameter	**MM_i**
Data unit	kg/kmol
Description	Molecular mass of greenhouse gas *i*
Source of data	Default values as per the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0)
Value(s) applied	The following values of molecular mass are applicable for CH_4 (the only GHG which is considered): <table><tr><th>Compound</th><th>Structure</th><th>Molecular mass (kg/kmol)</th></tr><tr><td>Methane</td><td>CH_4</td><td>16.04</td></tr></table>
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

<table>
<tr><td>Data/Parameter</td><td>MM_k</td></tr>
<tr><td>Data unit</td><td>kg/kmol</td></tr>
<tr><td>Description</td><td>Molecular mass of gas k</td></tr>
<tr><td>Source of data</td><td>Default values as per the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0)</td></tr>
<tr><td>Value(s) applied</td><td>For considered gases k that are greenhouse gases (GHGs), the values below are applied for MM_k.

As per the methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0) the following is applicable for the particular case of the project activity:

“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 19.0) 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.

<table><tr><td>Compound</td><td>Structure</td><td>Molecular mass (kg/kmol)</td></tr><tr><td>Nitrogen</td><td>N_2</td><td>28.01</td></tr></table></td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>-</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions.</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

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

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

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

Data/Parameter	$\varphi_{default}$
Data unit	-
Description	Default value for the 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 08.0). 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
Additional comment	-

Data/Parameter	**OX**
Data unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Applicable default value as per the methodological tool “Emissions from solid waste disposal sites” (version 08.0)
Value(s) applied	0.1
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**F**
Data unit	-
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 08.0)
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
Additional comment	-

Data/Parameter	**$DOC_{f,default}$**
Data unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	Applicable default value as per the methodological tool “Emissions from solid waste disposal sites” (version 08.0), 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 08.0): “*The CDM project activity mitigates methane emissions from a specific existing SWDS”.*
Purpose of data	Calculation of baseline emissions
Additional comment	Application A of the methodological tool “Emissions from solid waste disposal sites” (version 08.0) is the applicable case of the project activity.

Data/Parameter	**$MCF_{default}$**
Data unit	-
Description	Methane correction factor
Source of data	Value is sourced by the methodological tool "Emissions from solid waste disposal sites" (version 08.0), 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 ITVR São Leopoldo landfill encompasses utilization of appropriate MSW landfilling practices (covering, leveling and mechanical compacting of disposed material, etc.) as part of the operation of this landfill. The ITVR São Leopoldo landfill is regarded as a well-managed landfill site.
Purpose of data	Calculation of baseline emissions
Additional comment	-

<table>
<tr><td>Data/Parameter</td><td>DOC_j</td></tr>
<tr><td>Data unit</td><td>-</td></tr>
<tr><td>Description</td><td>Fraction of degradable organic carbon in the waste type j (weight fraction)</td></tr>
<tr><td>Source of data</td><td>Values are selected as per applicable guidance of the methodological tool “Emissions from solid waste disposal sites” (version 08.0), that refers to IPCC 2006 Guidelines for National Greenhouse Gas Inventories, (adapted from Volume 5, Tables 2.4 and 2.5).</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th>Waste type j</th><th>DOC_j
(% wet waste)</th></tr>
<tr><td>Wood and wood products</td><td>43</td></tr>
<tr><td>Pulp, paper and cardboard (other than sludge)</td><td>40</td></tr>
<tr><td>Food, food waste, beverages and tobacco
(other than sludge)</td><td>15</td></tr>
<tr><td>Textiles</td><td>24</td></tr>
<tr><td>Garden, yard and park waste</td><td>20</td></tr>
<tr><td>Glass, plastic, metal, other inert waste</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>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 ITVR São Leopoldo landfill.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

Data/Parameter	**k_j**
Data 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 08.0). 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	<table><tr><th>Degradation speed</th><th>Waste type</th><th>k_j</th></tr><tr><td rowspan="2">Slowly degrading</td><td>Wood, wood products, rubber and leather</td><td>0.03</td></tr><tr><td>Pulp, paper and cardboard (other than sludge), textiles</td><td>0.06</td></tr><tr><td>Moderately Degrading</td><td>other (non-food) organic putrescible Garden, yard and park waste</td><td>0.1</td></tr><tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.185</td></tr></table>
Choice of data or measurement methods and procedures	Parameters are selected in accordance to the climate zone valid for the project site: Mean Annual Temperature (MAT) = 19.5 ºC Mean Annual Precipitation (MAP) = 1,4401 mm – (wet climate). Source of data for mean annual temperature (MAT) and mean annual precipitation (MAP): https://pt.climate-data.org/search/?q=s%C3%A3o+leopoldo
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**W_j**
Data unit	-
Description	Weight fraction of the waste type *j*
Source of data	Values are selected as per applicable guidance of IPCC 2006 Guidelines for National Greenhouse Gas, Volume 5, Chapter 2, tables 2.3-2.5, MSW composition regional default values for South-America.
Value(s) applied	see table below
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	No composition analysis for MSW disposed at the ITVR São Leopoldo 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

<table>
<tr><td>Data/Parameter</td><td>SPECflare</td></tr>
<tr><td>Data unit</td><td>Temperature - °C
Flow rate or heat flux – kg/h or Nm^3/h
Maintenance schedule - number of days</td></tr>
<tr><td>Description</td><td>Manufacturer’s flare specifications for temperature, flow rate and maintenance schedule</td></tr>
<tr><td>Source of data</td><td>Flare manufacturer[39]</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><td>$SPEC_{flare}$</td><td>Min.</td><td>Max.</td></tr>
<tr><td>Operational LFG flow (for continuous operation)</td><td>500 Nm^3/h</td><td>2,500 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>1,200 ^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 6 months</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 flare(s), including:
a) Minimum and maximum monitoring records for data regarding inlet LFG flow rate,
(b) Minimum and maximum monitoring records for data of temperature in the exhaust gas of the high temperature enclosed flare; and
(c) Duration in days of time periods between maintenance events for the high temperature enclosed flare.</td></tr>
<tr><td>Purpose of data</td><td>Data is used as a reference for later ex-post determination of values of flare efficiency ($\eta_{flare,m}$) for the high temperature enclosed flare in the context of determination of baseline emissions[40].</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>

[39] The designer and manufacturer of the Flare is “Biotecnogás srl”, which is a flaring equipment manufacturer based in Italy.

Data/Parameter	w_{BM}
Data unit	%
Description	Weighting of build margin emissions factor
Source of data	Applicable default value as per the methodological tool “Tool to calculate the emission factor for an electricity system” (version 07.0)
Value(s) applied	0.75 (75%) during the 2nd 7-year crediting period
Choice of data or measurement methods and procedures	The applicable value for the 3rd crediting period of a CDM project activity as per the methodological tool “Tool to calculate the emission factor for an electricity system” (version 07.0) is selected.
Purpose of data	Data is used for determination of project emissions due to the consumption of electricity by the project activity.
Additional comment	The ex-ante determined default value for w_{BM} is to be used for the determination of project emissions due to the consumption of electricity by the project activity ($PE_{EC,y}$).

Data/Parameter	w_{OM}
Data unit	%
Description	Weighting of operating margin emissions factor
Source of data	Applicable default value as per the methodological tool “Tool to calculate the emission factor for an electricity system” (version 07.0)
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 3rd crediting period of a CDM project activity as per the methodological tool “Tool to calculate the emission factor for an electricity system” (version 07.0) is selected.
Purpose of data	Data is used for determination of project emissions due to the consumption of electricity by the project activity.
Additional comment	The ex-ante determined default value for w_{OM} is to be used for the determination of project emissions due to the consumption of electricity by the project activity ($PE_{EC,y}$).

[40] As also highlighted in Section B.3, it is important to note that residual project emissions of CH_4 due to the combustion of LFG in enclosed flares are considered in the context of the determination of baseline emissions (although ACM0001 (version 19.0) refers to the term “project emissions from flaring”.

Data/Parameter	**$EF_{grid,BM,y}$**
Data unit	tCO_2/MWh
Description	Build margin CO_2 emission factor in year *y*
Source of data	The value previously determined for the currently expired 2nd 7-year crediting period is also used for the 2nd 7-year crediting period of the project activity. The previously selected value valid for all years encompassed by the currently expired 2nd 7-year crediting period of the project activity is the value calculated by the DNA of Brazil and valid for year 2019 ($EF_{grid,BM,2019}$).
Value(s) applied	0.1020[41]
Choice of data or measurement methods and procedures	Data is determined as per applicable guidance of the methodological tool “Tool to calculate the emission factor for an electricity system” (version 07.0).
Purpose of data	Data will be used for the determination of project emissions (due to the consumption of electricity by the project activity).
Additional comment	The ex-ante determined default value for $EF_{grid,BM,y}$ is to be used for the determination of project emissions due to the consumption of electricity by the project activity ($PE_{EC,y}$).

[41] Data is made available online: https://antigo.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

B.6.3. Ex ante calculation of emission reductions

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As presented in Section B.6.1, while emission reductions to be achieved by the project activity during its 2nd 7-year crediting period are determined as the difference between baseline emissions (BE_y) and project emissions (PE_y), as established by ACM0001 (version 19.0), 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 period:

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

While the project activity encompasses methane destruction (through collection and combustion of LFG in high temperature enclosed flare(s)) as its unique GHG abatement measure, by following the applicable methodological approaches and assumptions + ex-ante determined values (as presented in Section B.6.1 and B.6.2 respectively), baseline emissions (BE_y) are thus determined as follows:

$BE_y = BE_{CH4,y}$

Where:

$BE_{CH4,y}$ Baseline emissions of methane from the SWDS in year y (tCO_2e/yr)

Determination of $BE_{CH4,y}$:

$BE_{CH4,y}$ 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 have been captured and destroyed in the baseline scenario (absence of the CDM project activity). $F_{CH4,BL,y}$ is determined as being equivalent to 20% of $F_{CH4,PJ,y}$ ($F_{CH4,BL,y} = 0.2 * F_{CH4,PJ,capt,y}$). 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 combusted in the installed flare(s) in year y (tCH_4/yr). In the particular context of the ex-ante estimation of emission reductions to be achieved by the project activity, as established by ACM0001 (version 19.0), $F_{CH4,PJ,y}$ is determined (in tCH_4/year) as follows:

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

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

Where:

η_{PJ} Efficiency of the LFG capture system that will be installed in the project activity. η_{PJ} is ex-ante determined as 0.9280. See Section B.6.2 for further details.

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

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

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

For the determination of $BE_{CH4,SWDS,y}$, the ex-ante determined values for all parameters in the formulae above as well as historical and forecasts of MSW disposal at the ITVR São Leopoldo landfill site are applied. See Section B.6.2 for details about such ex-ante determined values for such parameters.

A calculation spreadsheet including ex-ante estimates of emission reduction to be achieved by the project activity is enclosed to this PDD. This calculation spreadsheet includes all required related calculations for the ex-ante estimation of $BE_{CH4,y}$ and $BE_{EC,y}$ of the project activity during its 2nd 7-year crediting period.

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

	Estimation of $BE_{CH4,SWDS,y}$ (tCO_2e)	Estimation of $F_{CH4,PJ,Y}$ (tCH_4)	Estimation of $F_{CH4,BL,y}$ (tCH_4)	Estimation of $BE_{CH4,y}$ = Baseline emissions (BE_y) (tCO_2e)
Year	$BE_{CH4,SWDS,y} = \varphi (1-f) * GWP_{CH4} * (1-OX) * 16/12 * F * DOC_f * MCF * \Sigma\Sigma w_{j,x} * DOC_j * e^{-kj(y-x)} * (1-e^{-kj})$	$F_{CH4,PJ,y} = n_{PJ} * BE_{CH4,SWDS,y} / GWP_{CH4}$	$F_{CH4,BL,y} = 0.2 * F_{CH4,PJ,capt,y}$	$BE_y = BE_{CH4,y} = ((1- OX_{top\_layer}) * F_{CH4,PJ,y} - F_{CH4,BL,y}) * GWP_{CH4}$
2020	163,877	3,058	612	53,518
2021	176,954	6,569	1,314	114,949
2022	189,241	7,025	1,405	122,930
2023	200,867	7,456	1,491	130,483
2024	211,942	7,867	1,573	137,677
2025	222,559	8,261	1,652	144,574
2026	232,797	8,641	1,728	151,224
2027	242,722	4,468	894	78,188
Total	**1,640,959**	**53,345**	**10,669**	**933,543**

Note: Above reported values of $BE_{CH4,SWDS,y}$ for years 2020 and 2027 are valid for the entire years regardless of the starting and ending dates of the crediting period (from 01/07/2020 to 30/06/2027 respectively). All other values applicable for years 2020 and 2027 ($F_{CH4,PJ,y}$, $F_{CH4,BL,y}$, $BE_y = BE_{CH4,y}$) are valid for the 184-day and 181-day fractions of these years which are encompassed by the 2nd 7-year crediting period of the project activity: from 01/07/2020 to 31/12/2020 and from 01/01/2027 to 30/06/2027 respectively. It is relevant to note that, as reflected in related calculations, year 2020 is leap year (bissextile year) including 366 days. Estimates of baseline emissions for the 184-day share of the crediting period within year 2020 are thus calculated based on the ratio 184/366.

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 electricity. The related ex-ante estimations of the corresponding project emissions are determined as follows:

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

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

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

Where:

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

$EC_{PJ,grid,y}$ Quantity of grid sourced electricity consumed by the project activity in year *y* (in MWh). $EC_{PJ,grid,y}$ is estimated as being 262.8 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 + ancilary equipement) 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 of the project activity[42].

$TDL_{grid,y}$ Average technical transmission and/or distribution losses for grid sourced electricity consumed by the project activity in year *y.* For the particular case of estimates of $PE_{EC,grid,y}$, $TDL_{,grid,y}$ is selected as 20%. Further details are included in Section B.7.1.

$EF_{EL,grid,y}$ CO_2 emission factor for grid-sourced electricity in year y (in tCO_2/MWh). Details about the estimated value for $EF_{EL,grid,y}$ are presented in Sections B.6.1 and B.6.2. Moreover, a emission reduction calculation spreadsheet that includes related calculations for the $EF_{EL,grid,y}$ is enclosed to this PDD. The calculated ex-ante determined combined margin grid CO_2 emission factor valid for the 2nd 7-year crediting period is determined as summarized below:

Ex-ante estimates of $EF_{grid,CM,y}$:
By following procedure and guidance described in Section B.6.1, the combined margin CO_2 emission factor ($EF_{grid,CM,y}$) for the elecricity grid of Brazil (SIN grid) is estimated as follows:

$$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y}$$

Where:

w_{OM} Weighting of operating margin emissions factor. w_{OM} is ex-ante determined as 25% (0.25). See Section B.6.2 for further details.

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[42] 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 of the project activity (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).

w_{BM} Weighting of build margin emissions factor. w_{BM} is ex-ante determined as 75% (0.75). See Section B.6.2 for further details.

$EF_{grid,BM,y}$ Build margin CO_2 emission factor in year y. The build margin CO_2 emission factor for the national electricity grid of Brazil is ex-ante determined as the value applicable for year 2019 (as determined and published by the DNA of Brazil). Thus, in the particular case of the project activity, $EF_{grid,BM,y}$ = $EF_{grid,BM,2019}$ is ex-ante determined as 0.1020 tCO_2/MWh. Further details are available online at the website of the DNA of Brazil and in Section B.6.2.

$EF_{grid,OM,y}$ Operating margin CO_2 emission factor in year *y* (in tCO_2/MWh). In the particular case of the project activity, $EF_{grid,OM,y}$ = $EF_{grid,OM-DD,y}$.

Operational Margin CO_2 emission factor (dispatch analysis calculation method ($EF_{grid,OM-DD,y}$):
In the particular context of ex-ante estimations of emission reductions to be achieved by the project activity, the adopted value for $EF_{grid,OM-DD,y}$ is the value published by the DNA of as being the calculated value which is valid for year 2020 (the latest year for which values are available at the time of the completion of the this PDD):

Operating Margin Emission Factor of Brazilian Integrated Electric System for year 2020 (dispatch analysis calculation method)

Operating Margin Emission Factor, year 2020 CO_2 Emission Factor (tCO_2/MWh)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.5627	0.5258	0.3843	0.2964	0.3575	0.4758	0.3932	0.3994	0.3287	0.5723	0.5401	0.6106

The average value of $EF_{grid,OM-DD,2020}$ is thus calculated as 0.4539 tCO_2/MWh. Values of $EF_{grid,OM-DD,2020}$ are determined and reported by the DNA of Brazil. Further details are available online at the website of the DNA of Brazil.

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

$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y} = 0.25 * 0.4539 + 0.75 * 0.1020 = 0.1900$ tCO_2/MWh (where related calculations are summarized in the emission reduction calculation spreadsheet enclosed to this PDD).

It is important to note that, as a simplification (only in the particular 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 ($EF_{grid,CM,y}$) based on the value of $EF_{grid,OM-DD,2020}$ (valid for year 2020) and the value of $EF_{grid,BM,2019}$ is used for the determination of ex-ante estimates of emission reductions for all years encompassed by the 2nd 7-year crediting period of the project activity (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, thus potentially affecting the value to be calculated for $EF_{grid,CM,y}$ for each individual year encompassed by the crediting period). This simplification is anyway under conformance with applicable CDM rules[43].

Information related to the determination of the combined margin CO_2 emission factor for the national electricity grid of Brazil is made available in the website/web portal of the DNA of Brazil[44].

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

[43] 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 major changes in the average and marginal CO_2 intensity for electricity generated at the national electricity grid of Brazil are not expected to occur during the 2nd 7-year crediting period of the project activity 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 Companhia Riograndense de Valorizacao de Resíduos S.A.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 its 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 3rd and last 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.

[44] Calculation of CO_2 emission factor for the National Electricity Grid of Brazil: Data source is available online: https://antigo.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

PE_y	Electricity consumed from the grid (MWh)	Project emissions due to electricity consumption (tCO_2e)	Total Project emissions promoted the project activity (PE_y) (tCO_2e)
Year	$EC_{PJ,grid,y}$	$PE_{EC,y}$ = ($EC_{PJ,grid,y}$ * $EF_{EL,grid,y}$ * ($1+TDL_{grid}$)	$PE_y = PE_{EC,y\ +}$
2020	132	31	31
2021	263	60	60
2022	263	60	60
2023	263	60	60
2024	263	60	60
2025	263	60	60
2026	263	60	60
2027	130	30	30
Total	**1,840**	420	**420**

Note: Values of $EC_{PJ,grid,y}$ and $PE_{EC,y}$ applicable for years 2020 and 2027 are valid for the 184-day and 181-day fractions of these years which are encompassed by the 2nd 7-year crediting period of the project activity: periods from 01/07/2020 to 31/12/2020 and from 01/01/2027 to 30/06/2027 respectively. It is relevant to note that, as reflected in related calculations, year 2020 is leap year (bissextile year) including 366 days. Estimates of project emissions for 184-day share of the crediting period within year 2020 are thus calculated based on the ratio 184/366.

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 its 2nd 7-year crediting period are summarized as follows:

Emission reductions (tCO_2e)	
Year	*Emission reductions =* $ER_y - PE_y$
2020	53,487
2021	114,889
2022	122,870
2023	130,423
2024	137,617
2025	144,514
2026	151,164
2027	78,158
Total	**933,122**
Annual average	133,303

Note: Values applicable for years 2020 and 2027 are valid for the 184-day and 181-day fractions of these years which are encompassed by the 2nd 7-year crediting period: from 01/07/2020 to 31/12/2020 and from 01/01/2027 to 30/06/2027 respectively. It is relevant to note that, as reflected in related calculations, year 2020 is leap year (bissextile year) including 366 days. Estimates of emission reductions for the184-day share of crediting period within year 2020 are thus calculated based on the ratio 184/366.

Details about all 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 its 2nd crediting period is enclosed to this PDD.

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

Year	Baseline emissions ($t\ CO_2e$)	Project emissions ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions ($t\ CO_2e$)
2020	53,518	31	0	53,487
2021	114,949	60	0	114,889
2022	122,930	60	0	122,870
2023	130,483	60	0	130,423
2024	137,677	60	0	137,617
2025	144,574	60	0	144,514
2026	151,224	60	0	151,164
2027	78,188	30	0	78,158
Total	**933,543**	**420**	0	**933,122**
Total number of crediting years	7			
Annual average over the crediting period	133,363	60	0	133,303

Note: Values of $ER_{,y}$ applicable for years 2020 and 2027 are valid for the 184-day and 181-day fractions of these years which are encompassed by the 2nd 7-year crediting period: from 01/07/2020 to 31/12/2020 and from 01/01/2027 to 30/06/2027 respectively. It is relevant to note that, as reflected in related calculations, year 2020 is leap year (bissextile year) including 366 days. Estimates of emission reductions for the 184-day share of the crediting period within year 2020 are thus calculated based on the ratio 184/366.

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	Management of SWDS
Data unit	Dimensionless
Description	Management of the SWDS
Source of data	Monitoring performed by the project participants and/or appointed 3rd party. The design and operational conditions of the solid waste disposal site (SWDS) ITVR São Leopoldo landfill will be annually monitored on the basis of different sources, including *inter alia*: - Original construction and operational design of the ITVR São Leopoldo landfill; - Technical specifications and requirements for the management of the ITVR São Leopoldo 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 ITVR São Leopoldo 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 its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Original construction and operational design of the ITVR São Leopoldo landfill should be confirmed as not being modified during the 2nd 7-year crediting period of the project activity. 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 19.0), any change in the management of the ITVR São Leopoldo 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	$V_{t,wb}$
Data unit	m^3 wet gas/h
Description	Volumetric flow of LFG stream in time interval *t* on a wet basis
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG flow 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 its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) 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 meters 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. Monitoring equipment/instrument(s) 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	This parameter will be monitored in case Options B or C of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) are applied for the determination of $F_{CH4,flared,y}$.

Data/Parameter	$V_{t,db}$
Data unit	m^3 dry gas/h
Description	Volumetric flow of LFG stream in time interval *t* on a dry basis
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG flow 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 its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) 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. Monitoring equipment/instrument(s) 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	This parameter will be monitored in case Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied for the determination of $F_{CH4,flared,y}$.

Data/Parameter	$v_{CH4,t,db}$
Data unit	$m^3 CH_4/m^3$ dry gas
Description	Volumetric fraction of CH_4 in the collected LFG in time interval *t* on a dry basis
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying an appropriate continuous CH_4 content gas analyzer.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measurements to be performed by appropriate continuous gas analyzer(s) 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(s) 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. Monitoring equipment/instrument(s) 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	This parameter will be monitored in case Option B of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied for the determination of $F_{CH4,flared,y}$. This parameter may be monitored in case Options A or D of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) are applied instead.

Data/Parameter	$v_{CH4,t,wb}$
Data unit	m^3 CH_4/m^3 wet gas
Description	Volumetric fraction of CH_4 in the collected LFG in time interval *t* on a wet basis
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate continuous CH_4 content gas analyzer(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 its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measurements to be continuously performed by appropriate gas analyzer(s) 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 analyzer(s)). 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(s) 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. Monitoring equipment/instrument(s) 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	This parameter will be monitored in case Option C of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied for the determination of $F_{CH4,flared,y}$. This parameter may be monitored in case Options A or D of the methodological tool are applied instead.

Data/Parameter	**$M_{t,db}$**
Data unit	kg/h
Description	Mass flow of the LFG stream in time interval *t* on a dry basis
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG flow 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 its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) 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. Monitoring equipment/instrument(s) 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	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 03.0) is applied for the determination of $F_{CH4,flared,y}$.

Data/Parameter	**T_t**
Data unit	K[45]
Description	Temperature of the LFG stream in time interval *t*
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG temperature sensor.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) 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. Monitoring equipment/instrument(s) 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.

[45] Measurements for T_t will be recorded and reported in ^{o}C. Recorded/reported data will be converted to Kelvin in order to also being recorded/reported in K.

Data/Parameter	**P_t**
Data unit	Pa[46]
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 its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) 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. Monitoring equipment/instrument(s) 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	-

[46] 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	**$p_{H20,t,Sat}$**
Data 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 its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) 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	**$EC_{PJ,grid,y}$**
Data 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 262.8 MWh of grid sourced electricity per year during its 2nd 7-year crediting period. In the context of the ex-ante estimation of emission reductions to be achieved by the project activity during its 2nd 7-year crediting period, it is considered that the project's electricity demand will be met entirely by imports of grid-sourced electricity.
Measurement methods and procedures	Authorized electricity meter(s). Measurement records will be cross-checked against available electricity consumption receipts/invoices issued by the local

	electricity distribution company. The parameter $EC_{PJ,grid,y}$ is equivalent to the parameter $EG_{EC,y}$ as indicated in ACM0001 (version 19.0).
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. Monitoring equipment/instrument(s) 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 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. The installed centrifugal blowers are the most electricity intensive equipment of the project activity). Also as a conservative assumption, it is considered that the project activity will operate 24 hours a day during its 2nd 7-year crediting period. Measurement records will be cross-checked against available receipts/invoices/reports for imports and/or purchase of grid-sourced electricity.

Data/Parameter	$\mathbf{EF_{grid,OM,y} = EF_{grid,OM\text{-}DD,y}}$
Data unit	tCO_2/MWh
Description	Operation 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 methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0). The selected value considered for all years encompassed by the 2nd 7-year crediting period of the project activity in the context of the ex-ante estimation of emission reductions represents the value calculated by the DNA of Brazil and valid for year 2020 (the most recent value available).
Value(s) applied	0.4539[47]
Measurement methods and procedures	Data will be determined as per applicable guidance for dispatch data analysis operating margin CO_2 emission factor of the methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0).
Monitoring frequency	Yearly.
QA/QC procedures	-
Purpose of data	Calculation of project emissions

[47] Data is made available online: https://antigo.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

Additional comment	-

Data/Parameter	$F_{CH4,EG,t}$
Data unit	kg
Description	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period *t*
Source of data	Measurements undertaken by a third party accredited entity for each operational flare
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 its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measure the mass flow of methane in the exhaust gas of each operational flare 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). Monitoring equipment/instrument(s) 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[48].
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.

[48] 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	$T_{EG,m}$
Data unit	ºC
Description	Temperature in the exhaust gas of the enclosed flare in minute *m*
Source of data	Measurements performed for each operational flare 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 its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measure the temperature of the exhaust gas of each operational high temperature enclosed flare by appropriate temperature measurement equipment (e.g. thermocouples). Measurements outside the operational temperature specified/recommended by the manufacturer may indicate that the flare is not functioning correctly and may require maintenance. Flare manufacturers must provide suitable monitoring ports for the monitoring of the temperature of the exhaust gas of the flare. These would normally be expected to be in the middle third of the flare. Where more than one measurement port for temperature of the exhaust gas of the flare is fitted to the flare, the flare manufacturer must provide written instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the operation of the flare according to manufacturer's specifications for temperature[49].
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.
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.

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

	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. Monitoring equipment/instrument(s) 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	**$Flame_m$**
Data unit	Flame status "*on*" or flame status "*off*"
Description	Flame detection of flare in the minute *m*
Source of data	Measurements/monitoring for each operational flare 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 its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measure for each operational flare 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	The condition will be regularly monitored for the 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. Monitoring equipment/instrument(s) 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	**$Maintenance_y$**
Data 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 its 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 which is destroyed by the project activity through combustion of collected LFG in the project's flare (methane destruction device) 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 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 applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) 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 ($SPEC_{flare}$).

Data/Parameter	**$TDL_{grid,y}$**
Data unit	-
Description	Average technical transmission and distribution losses for grid sourced electricity consumed by the project activity.
Source of data	Use of recent, accurate and reliable data available within the host country or selection of applicable default value as per Option C.III of the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0) or use of recent, accurate and reliable data available within the host country.

Value(s) applied	20%
Measurement methods and procedures	Value should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses in the grid should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation.
Monitoring frequency	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
QA/QC procedures	-
Purpose of data	Data is used for determination of project emissions (due to consumption of grid-sourced electricity by the project activity).
Additional comment	-

Data/Parameter	**Status of biogas destruction device**
Data unit	-
Description	Operational status of biogas destruction device(s)
Source of data	Not applicable.
Value(s) applied	Not applicable.
Measurement methods and procedures	Monitoring and documenting may be undertaken through monitoring of the operation of the flare(s) (by means of s flame detector) in order to demonstrate the actual destruction of methane in such installed biogas destruction devices. Emission reductions will not accrue for periods in which the underlying destruction device(s) (high temperature enclosed flare(s)) is/are not operational.
Monitoring frequency	Continuous measurements will be recorded and reported with a least every minute frequency.
QA/QC procedures	Not applicable.
Purpose of data	Calculation of baseline emissions.
Additional comment	Monitoring records for the monitoring parameter “Flame detection of flare in the minute *m*” ($Flame_m$) will be considered for the installed flare(s).

B.7.2. Sampling plan

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Not applicable.

B.7.3. Other elements of monitoring plan

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General monitoring:
The following instruments/equipment will be used to monitor required data along the 2nd 7-year crediting period of the project activity (depending on the applied measurement options and calculation approaches - to be chosen ex-post)[50]:

Instrument or Source of data	Measurement option		Data monitored	
Appropriate volumetric or mass flow meter	A	Volume flow – dry basis; Volumetric fraction dry or wet basis	$\mathbf{V_{t,db}}$	Volumetric flow of LFG stream *j* in time interval *t* on a dry basis (in m^3 dry gas/h).
	B	Volume flow – wet basis; Volumetric fraction dry basis	$\mathbf{V_{t,wb}}$	Volumetric flow of LFG stream *j* in time interval *t* on a wet basis (in m^3 dry gas/h).
	C	Volume flow – wet basis; Volumetric fraction wet basis	$\mathbf{V_{t,wb}}$	Volumetric flow of LFG stream *j* in time interval *t* on a wet basis (in m^3 wet gas/h).
	D	Mass flow – dry basis; Volumetric fraction dry or wet basis	$\mathbf{M_{t,db}}$	Mass flow of LFG stream *j* in time interval *t* on a dry basis (in kg/h).
Continuous CH_4 content gas analyser unit	-		$\mathbf{v_{CH4,t,db/wb}}$	Volumetric fraction of methane on the LFG stream directed to the flare in a time interval *t* on a dry or wet basis (in m^3 CH_4/m^3 dry or wet gas)
LFG pressure sensor	**-**		$\mathbf{P_t}$	Pressure of the LFG stream directed to the flare in time interval *t* (in Pa or mbar) Note: $\mathbf{P_t}$ may not be monitored when using LFG flow meters that automatically consider and measures LFG temperature and LFG pressure, thus expressing LFG volumetric or mass flows in normalised units.

[50] Measurement options defined in the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0) when referring to “*Adequate volumetric or mass flow meter(s)*” and defined in the methodological tool Project emissions from flaring” (version 03.0) 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 03.0) when referring to “Adequate volumetric or mass flow meter (s)”. The applicable guidance of the methodological tool “Project emissions from flaring” (version 03.0) also refers to different measurement and calculation options.

Instrument or Source of data	Measurement option	Data monitored	
LFG temperature sensor	-	$\mathbf{T_t}$	Temperature of the LFG stream directed to the flare in time interval *t* (in K or ºC) Note: $\mathbf{T_t}$ 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)	-	$\mathbf{p_{H20,t,Sat}}$	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 meters		$\mathbf{EC_{PJ,grid,y}}$	Amount of grid electricity consumed 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)	-	$\mathbf{EF_{grid,OM,y}}$ = $\mathbf{EF_{grid,OM\text{-}DD,y}}$	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 methodological tool “Tool to calculate the emission factor for an electricity system” (version 07.0).
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
Measurements undertaken by a third party accredited entity	**B.1**	$\mathbf{F_{CH4,EG,t}}$	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.

Instrument or Source of data	Measurement option	Data monitored	
			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 flare.
Thermocouple	**A or B.1**	$\mathbf{T_{EG,m}}$	Temperature in the exhaust gas of the enclosed flare in minute *m* (ºC)
			It will be continuously measured the temperature of the exhaust gas through use of appropriate temperature measurement instrument (e.g. thermocouples). Measurements outside the operational temperature specified by the flare manufacturer may indicate that the flare is not functioning correctly and may require maintenance or repair work. The temperature of the exhaust gas in the flare has to be measured in a suitable monitoring port. In high temperature enclosed flares, monitoring ports are normally expected to be located within the middle third of the flare. In case more than one temperature port is fitted to the high temperature enclosed flare, the flare manufacturer must provide written instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the operation of the flare according to manufacturer's specifications for temperature of exhaust gas. The high temperature enclosed flare 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.
Optical flame detector (using ultra violet or infra-red technology or both	**A or B.1**	$\mathbf{Flame_m}$	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).
Records from the project participants gathered as part of	**B.1**	$\mathbf{Maintenance_y}$	Maintenance events completed in year *y* (Calendar dates) for each one of the high temperature enclosed flare combusting LFG.

Instrument or Source of data	Measurement option	Data monitored	
the operation of the project activity.			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	**Calculated or application of default value**	**$TDL_{grid,y}$**	Use of recent, accurate and reliable data available within the host country or selection of the applicable default value as per the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0).
Project participants	**-**	**Status of biogas destruction device**	Operational status of biogas destruction device The same procedures as adopted for monitoring parameter $Flame_m$ will be applied. Continuous monitoring of flame detection through use of appropriate installation (e.g. optical flame detector (using ultra violet or infrared technology or both).

During the 2nd 7-year crediting period of the project activity, all continuously measured LFG related parameters as well as measurements related to the exhaust gas of the flare(s) (temperature in the exhaust gas of the flare(s)) and parameters related to flare operational conditions (i.e. status of this methane destruction device) 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 grid-sourced electricity consumed by the project activity will also be recorded. Records from invoices of purchased grid-sourced electricity (issued by local electricity transmission/commercialization company) may 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 Companhia Riograndense de Valorizacao de Residuos S.A., access to monitoring data will be restricted and controlled. All monitoring records will be kept archived until at least two years after the end of the crediting period or at least two years after the last issuance of CER's for the project activity, whichever occurs later.

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

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

Maintenance and calibration for monitoring instruments/equipment and project's equipment/components in general:
During the 2nd 7-year crediting period of the project activity, 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 its 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;
f) General competence development about methane destruction through combustion of LFG in high temperature enclosed flare(s);

The monitoring plan will be implemented and operationalized during the 2nd 7-year crediting period of the project activity 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 19.0), the design and operational conditions of the ITVR São Leopoldo landfill during the 2nd 7-year crediting period of the project activity will be monitored on the basis of different sources, including *inter alia*:

- Original design of the landfill;
- Technical specifications for the management of the ITVR São Leopoldo landfill;
- Applicable local or national regulations

During the 2nd 7-year crediting period of the project activity, 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 19.0), 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").

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

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At the time the CDM project activity "ITVR Sao Leopoldo landfill gas project" was validated and registered as a CDM project activity, the start date of the project was selected and indicated in the PDD valid for the 1st 7-year crediting period as being 01/03/2013.

C.2. Expected operational lifetime of project activity

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The expected operational lifetime for both the project's infrastructure is at least 20 years. However, the lifetime of equipment of such project components may even exceed 20 years if required service and maintenance is appropriately performed (as per recommendation and requirements set by equipment manufacturers/suppliers).

While the project activity started its continuous operations (as part of its 1st crediting period) in March/2019[51], thus the remaining operational lifetime for the project's LFG collection and destruction infrastructure potentially exceeds the next 18 years.

[51] The starting of regular and continuous operation of the project activity in March/2019 is reported and assessed in the documentation for the occurred 1st verification for the project activity (Monitoring Report and Verification Report). These documents are available on-line:

https://cdm.unfccc.int/Projects/DB/Germanischer1356618603.64/view

C.3. Crediting period of project activity

C.3.1. Type of crediting period

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

C.3.2. Start date of crediting period

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The 2nd 7-year crediting period of the project activity starts on 01/07/2020.

C.3.3. Duration of crediting period

>>

7-year (renewable)

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

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Information about the analysis of the environmental impacts for the project activity (under its previous design configuration) and related validation assessment by the responsible DOE are all presented in the latest version of its PDD valid for the currently expired 1st 7-year crediting period of the project activity (PDD version 4, dated 28/11/2012) + Validation Report for the project activity (dated 26/12/2012).

D.2. Environmental impact assessment

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Information about the analysis of the environmental impacts for the project activity (under its previous design configuration) and related validation assessment by the DOE are presented in the latest version of the PDD valid for the currently expired 1st 7-year crediting period of the project activity (PDD version 4, dated 28/11/2012) + Validation Report for the project activity (dated 26/12/2012).

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

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Information about previously occurred solicitation of comments from local stakeholders (including received comments) and related validation assessment by the DOE are presented in the latest version of the PDD valid for the currently expired 1st 7-year crediting period of the project activity (PDD version 4, dated 28/11/2012) + Validation Report for the project activity (dated 26/12/2012).

E.2. Summary of comments received

>>

Information about solicitation of comments from local stakeholders (including received comments) and related validation assessment by the DOE are presented in the latest version of the PDD valid for the currently expired 1st 7-year crediting period of the project activity (PDD version 4, dated 28/11/2012) + Validation Report for the project activity (dated 26/12/2012).

E.3. Consideration of comments received

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Information about the previously occurred solicitation and consideration of comments from local stakeholders (including received comments) and related validation assessment by the DOE are presented in the latest version of the PDD valid for the currently expired 1st 7-year crediting period of the project activity (PDD version 4, dated 28/11/2012) + Validation Report for the project activity (dated 26/12/2012).

SECTION F. Approval and authorization

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The project activity has been previously granted with Letter of Acceptance (LoA) (dated 20/12/2012) by the Designated National Authority (DNA) of the host party Brazil. Copy of such LoA and related assessment details are made available at the project page at UNFCCC's CDM website and in the Validation Report for the project activity[52]. Host Country Approval from Brazil confirmed the voluntary participation of Companhia Riograndense de Valorizacao de Residuos S.A. 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 (dated 26/12/2012).

More recently in year 2017, the Annex I country Norway also became a Party for the project activity. LoA from Annex I Party Norway was issued by the DNA of Norway on 06/07/2017. This LoA authorizes and approves Nordic Environment Finance Corporation as project participant.

[52] The project webpage at UNFCCC's CDM website (information valid for the currently expired 1st 7-year crediting period of the project activity): https://cdm.unfccc.int/Projects/DB/Germanischer1356618603.64/view

Appendix 1. Contact information of project participants

Organization name	Companhia Riograndense de Valorizacao de Residuos S.A.
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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 methodologies and standardized baselines

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 Sections B.7.1. and B.7.3.

Appendix 6. Summary report of comments received from local stakeholders

Information about solicitation of comments from local stakeholders (including received comments) and related validation assessment by the DOE are presented in the latest version of the PDD valid for the currently expired 1st 7-year crediting period (PDD version 4, dated 28/11/2012) + Validation Report for the project activity (dated 26/12/2012).

Appendix 7. Summary of post-registration changes

This initial version of the PDD valid for the 2nd 7-year crediting period of the project activity does not encompass post-registration changes.

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.

Version	*Date*	*Description*
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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