

TEMPLATE

- Transition Request Form - Project
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VERSION **1.0**

RELATED SUPPORT

- **TEMPLATE GUIDE Key Project Information & Project Design Document v.1.2**

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Summary:

The projects transitioning from **CDM or other Standards to Gold Standard for Global Goals (GS4GG)** shall submit the transition request form and PDD (this document). The **Transition Request Form** is also to be completed for projects that are already registered with GS4GG for CER labelling and seek to move to GSVER stream to issue Gold Standard GS VERs.

This document contains the following Sections

Section - Transition Request Form

[TRF.1 ELIGIBILITY CHECK FOR TRANSITION](#)

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Key Project Information

Section - Project design document

Section A – Description of project

Section B - Application of approved Gold Standard Methodology (ies) and/or demonstration of SDG Contributions

Section C – Duration and crediting period

Section D – Summary of Safeguarding Principles and Gender Sensitive Assessment

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Appendix 1 – Safeguarding Principles Assessment (mandatory)

Appendix 2 - Contact information of Project participants (mandatory)

Appendix 3 - LUF Additional Information (project specific)

Appendix 4 - Summary of Approved Design Changes (project specific)

The following table summarises how different sections of this document shall be filled to facilitate request for transition from other standard to GS4GG.

Section	Required for	How to complete the section
Transition Request Form		
TRF.1 Eligibility check for transition	All projects	Answer the assessment questions and provide supporting information as needed
TRF.2 Transition project information	All projects	Provide project information pertaining to the standard the project is transitioning from (e.g., CDM)
TRF.3 Transition checklist	All projects	Answer the assessment questions and provide supporting in the section in the PDD section as needed
Project Design Document		
Key project information	All projects	Include project details pertaining to GS4GG
Section A to E	All projects	Provide information as needed. Any section/subsections - that requires information/justification or additional information as per transition checklist, AND - that involves update/revision to the information provided for registration with other standards. In such cases, the project shall copy and paste the information from registered PDD (other standard) and mark the additional information in track changes.

SECTION – TRANSITION REQUEST FORM

TRF.1 ELIGIBILITY CHECK FOR TRANSITION

To be completed for all projects seeking transition to GS4GG from other standards.

Requirement	To be completed by project developer
The project must have a crediting period start date with CDM/other standard on or after 01 January 2016	Is the project crediting period start date after 01 January 2016? ☐ Yes ☒ No (go to questions below)
The project that has a crediting period start date with CDM/other standard before 01 January 2016 shall demonstrate the risk of discontinuation without carbon revenue.	The proposed GS project activity was already included in a presentation to Gold Standard as a Deviation sent to the TAC in June 2022 (which received a response from the GS4GG on 14/07/2022). The proposed GS project activity is truly dependent on Carbon Revenues. As demonstrated below, previously forecasted carbon revenues were regarded as instrumental to maintain expected project operational/activity levels at the time of the project's initial conceptualization design. At the time of the project's initial conceptualization design, forecasted carbon revenues (based on CER price expectations/forecasts valid at that time) were regarded as instrumental to make the project activity feasible from a financial/economical perspective. In summary, previously expected carbon revenues were taken into account on the decision of the project developer to invest in LFG power generation. In the absence of carbon revenues (termination/expiration of previously established Emission Reduction Purchasing Agreements (ERPAs) and/or lack of interested parties on acquiring/purchasing CDM CERs), the project has reduced its activity levels during years 2018¹ and 2019.

¹ Elements of the project's LFG collection infrastructure (i.e. LFG collection wells, LFG pipeline, centrifugal blowers, etc.) had to be completely redesigned and/or overhauled in year 2018 in order to have collected LFG meeting the minimum required specification (i.e. LFG with higher CH₄ fraction, lower O₂ fraction and lower moisture content) in order to meet operational requirements for LFG from the later installed engine-generator sets of the project's electricity generation infrastructure. The location of the LFG destruction facility was changed in year 2018. The occurred change in the positioning of the flares and other ancillary equipment in year 2018 were due to technical and operational requirements of the project activity (under its gradual/phased implementation status). Such redesign, overhauling and relocation of the project's infrastructure required inter alia significant temporary interruption in the operation of the whole project

A brief summary of the occurred implementation of the proposed GS project activity under the CDM:

- During the period from year 1985 to year 2007, more than 2,000 ton of Municipal Solid Waste (MSW) daily generated in the metropolitan area of Recife (capital of the State of Pernambuco in Northeast Brazil) were daily disposed at the Muribeca dumpsite under a completely unmanaged and uncontrolled manner. This particular open MSW dumpsite operated for more than 20 years with had more than 3,000 people making a living (by independently and informally working as waste scavengers in the site²).
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- The Ecoparque Candeias landfill (previously termed as CTR Candeias landfill) was designed by using state-of-the-art engineering solutions and technics for the construction and operation of landfill sites and has entered into operation in year 2007. By becoming the permanent disposal site for MSW stream that used to be disposed at the Muribeca landfill, the starting of operations of the Ecoparque Candeias landfill therefore represented permanent cease of

infrastructure (which was directly reflected in the dramatic decrease in issuance of CDM CER for the particular case of year 2018).

² It is instrumental to note that the Muribeca dumpsite was not located in the same location as the Ecoparque Candeias landfill. This uncontrolled MSW dumpsite was operated by the municipality of Jaboatão dos Guararapes (which was later responsible for a program for reintegrating the former scavengers through professionalization courses). The following information related to the designed program for reintegrating the former scavengers through professionalization courses is included in a Master of Science dissertation from the Postgraduate Program of Civil and Environmental Engineering of the Federal University of Pernambuco (located in Pernambuco, the state capital):

"The state government has been promoting, since 2013, actions related to municipal solid waste, as an example the "State Plan for Consortium and Integrated Solid Waste Management", which consolidates a regionalization proposal, aiming to guide the government in interventions aimed at the sector, in the sense of financing the planning and integrated definitions. The Labor and Employment State Secretariat focused on developing the waste scavengers category, with a project which finances capacitation courses, inclusion of scavengers in assistance programs, among other actions which stimulate the collective labor, through associations or cooperatives."

Dissertation available online at:

<https://repositorio.ufpe.br/bitstream/123456789/14960/1/Disserta%20c3%a7%c3%a3o%20Silvanda%20ENTREGA%20BIBLIOTECA.pdf>

uncontrolled and unmanaged disposal of MSW at the Muribeca³ dumpsite.

- The Ecoparque Candeias landfill is located within the geographical limits of the municipality of Jaboatão de Guararapes, not far from Muribeca.
- The Ecoparque Candeias landfill has MSW disposal of capacity of 5,000 ton per day and it is currently owned and operated by the company Orizon Valorização de Resíduos S.A. The landfill has hosted since year 2011 the registered CDM project activity titled "CTR Candeias Landfill Gas Project" (UNFCCC reg. no. 3958).
- The CDM project activity CTR Candeias Landfill Gas Project was design to include, as part of its design conceptualization, landfill gas (LFG) being initially collected and destroyed under efficient and controlled conditions by flaring (in appropriate high temperature enclosed flares).
- As part of the previously considered gradual/phase project implementation schedule for the project activity, LFG is utilized as gaseous fuel for electricity generation (initially forecasted to occur by year 2012 and later starting to be implemented with starting of operation occurring only in August/2019).
- Due to economical, regulatory and commercial constrains/challenges of the Brazilian Electricity Market, the construction of the project's electricity generation infrastructure only took place in August/2019 and initially encompassed the installation and operation of 10 engine-generator sets of individual nameplates installed capacity of 1.42 MW. Currently (year 2023), the project's electricity generation infrastructure encompasses the installation and

³ Since the Muribeca dumpsite was closed (in 2008) all activities related to disposal of municipal solid waste (MSW) previously occurring in this not appropriately managed dumpsite have been promoted at the Ecoparque Candeias landfill. While the design and operation requirements for the Ecoparque Candeias landfill does not include the presence of waste scavengers under any circumstance, the waste scavengers to which the CDM PDD for the project activity initially referred to underwent professionalization courses (as part of a social and economic development initiative promoted by local governmental authorities) and have not continued with scavenging activities in the Muribeca dumpsite, Ecoparque Candeias landfill or any other landfill in the region.

continuous operation of a total of 20 identical engine-generator sets which represents total combined installed capacity for the infrastructure of 28.52 MW.

- Since its starting of operations, the CDM project activity has generated more than 1.3 million CERs.
- The project activity has managed to increase its activity level along its historical operation (with incremental CER generation), except in years 2018 and 2019 when, due to the fact that there was no valid CER commercialization contract in place, the level of operation of the plant was severely reduced in order to lower the operational costs. It is relevant to note that there was no project infrastructure promoting utilization of collected LFG as gaseous fuel for electricity generation before August/2019.

- The registered CDM project activity "CTR Candeias Landfill Gas Project" has operated during the whole period from the end of year 2012 to year 2018 with CER revenues representing the only income/revenue source for the project activity.

Such revenue stream was instrumental to have generated LFG kept being qualitatively and quantitatively evaluated along the period from year 2012 to year 2018. Confirmation of quantitative and qualitative patterns for collected LFG was one of the requisites for the later occurred decision-making process of investing in infrastructure promoting utilization of LFG as gaseous fuel for electricity generation using state-of-the-art electricity generation technology fully fueled by LFG.

- CER revenue generation assurance was also regarded as instrumental in the context of the decision-making process for investing in the project's power generation infrastructure fully fueled by LFG. While most of CAPEX were incurred in hard currency (USD/EUR), revenues from commercialization of electricity are in local currency (BRL), thus posing an exchange rate risk for the project's financials. It is crucial to

note that the BRL currency has suffered from previously unforeseen severe depreciation against USD/EUR within the latest 5 years (more than 40% since year 2019), thus negatively impacting the whole financial attractiveness of the project activity.

- Due to the current stranded situation of the CDM (and new flexible mechanisms) and due to all uncertainty regarding the expected migration of project activities previously registered under the CDM as a GHG mitigation project-based initiative under Article 6.4 of Paris Agreement, the migration of the project activity into Gold Standard is therefore perceived as instrumental to ensure the overall feasibility of the project activity (assurance of carbon revenues).
- With total accumulated CAPEX expenditures predicted over USD 32 MM (2012-2026) and OPEX within the range of USD 1 MM per year until 2019, the project activity has suffered to amortize all incurred CAPEX and OPEX.
- Even considering the CERs revenues with vintage from year 2012 to year 2020 which were issued from 2013 onwards, the project activity remains financially unattractive and has been kept under operation as a result of the overall expectation by its project developer of generation of future carbon revenue stream (due to the commercialization of GS VERs) under more attractive conditions and representing a revenue source complementary to the carbon revenue so far promoted under non-attractive conditions (in the average)).
- Therefore, future carbon revenues are perceived as being instrumental to both keep the project activity under operation and to have its future expansion (in terms of electricity generation nameplate installed capacity) still being considered.
- The project implementer plans to add extra capacity of the electricity generation plant with the expected Gold Standard carbon revenues.

Thus, the project seriously depends on carbon revenues.

The project that has a crediting period start date with CDM/other standard before 01 January 2016 shall demonstrate how the project has been operational in the absence of carbon revenue, if carbon credits have not been issued to the project in recent years.	Not applicable. Carbon revenues (due to the commercialization of CERs issued under by the project activity under the CDM) were promoted by the project activity during its operational years. In fact, expected future GS carbon revenue assurance has been regarded as instrumental to keep efforts on maintaining the project under high operational/activity levels. The occurred lack of carbon credit income indeed triggered reduction of the project's activity level during the period encompassing years 2018 and 2019 (with electricity generation only starting in August/2019). Carbon revenue generation was assumed as instrumental in the context the decision-making process to implement the project's power generation using collected LFG as gaseous fuel since August/2019. The unattractiveness of the CDM within the latest 10 years and its more recent discontinuation have indeed represented a gap in terms of carbon revenues for the project developer, seriously negatively affecting and posing risks for the continuation of the project activity.
List of supporting documents	- CDM-PDD document, which contains the Key Project Information; - Stakeholder Consultation Report, along with annexes as evidences; - Emission Reductions calculation spreadsheet;

TRF.2 TRANSITION PROJECT INFORMATION

Project developer shall provide project information (in grey rows), pertaining to the standard, the project is transitioning from (e.g., CDM) in the table below.	
Name of the original standard	☒ CDM ☐ Other (<u>Add the standard name here</u>)
Project status with original standard	<i>The current status of project with CDM/other standard at the time of submission of this form.</i> ☒ Active (registration status is valid) ☐ Withdrawn (deregistered) ☐ Provisional (awaiting guidance from the CMP at CMP 16, CDM PoA only)
CDM/ other standard reference ID	<i>Reference number/ID allocated to the project by CDM/other standard.</i> CDM 3958
Project reference weblink	<i>The weblink of the project page of CDM/other standard.</i>

	<a href="https://cdm.unfccc.int/Projects/DB/ERM-
CVS1283351787.62/view?cp=1">https://cdm.unfccc.int/Projects/DB/ERM- CVS1283351787.62/view?cp=1	
Title of Project	The title of the project used for registration with CDM/other standard. CTR Candeias Landfill Gas Project	
New title of Project (if applicable)	The title of the project if it has been changed for registering with Gold Standard. Ecoparque Candeias Landfill Gas Project	
Activity Scale	Project scale registered with CDM/other standard. Large-scale	
Methodology used	Methodology title and the version number applied for registration with CDM /other standard. ACM0001 - Consolidated baseline and monitoring methodology for landfill gas project activities (version 19.0)	
Amount of reductions	Average annual emission reductions (tCO ₂ eq/year). 482,464 tCO ₂ e	
Registration date	The project registration date with CDM/other standard. 29/09/11 (date of registration action 30/12/2011)	
Type of crediting period	☒ renewable crediting period ☐ fixed crediting period	
Crediting period	The project registered crediting period start date and end date with CDM/other standard. Start date: 29/09/2011 (1 st crediting period) End date: 28/09/2018 Start date: 29/09/2018 (2 nd crediting period) End date: 28/09/2025	
Total Monitoring Periods issued	The total period that has already been issued by CDM/other standard. Start date: 29/09/2011 (1 st crediting period) End date: 28/09/2018 Start date: 29/09/2018 (2 nd crediting period) End date: 31/12/2020	
Latest monitoring period	The latest monitoring period that has already been issued or submitted for issuance to CDM/other standard. Start date: 03/03/2020 End date: 31/12/2020	
	Issuance Status	☒ Issued ☐ Awaiting issuance
	Date of Issuance, if issued.	11/08/2021
Declaration	Click on the tick box to confirm.	

	The Project Developer/Representative hereby acknowledges that project developer; ☐ Option 1 - has included information in this document that has not been validated/verified as part of CDM PDD OR ☒ Option 2 - has copied all validated information as it appears in the original and then used tracked changes to highlight any information that not been validated/or has changed - <i>Note if option 2 is selected the project developer shall fill all sections in the PDD template of this document.</i> The Project Developer/Representative hereby acknowledges that project developer; ☒ is aware that for a given vintage, a registered Gold Standard project can request the issuance of the emission reductions under only one standard/certification scheme. (applicable to all projects). ☒ is aware that all projects that transition to GS4GG shall demonstrate Ongoing Financial Need at the time of renewal of their crediting period following applicable GS4GG requirements. (applicable to all projects). ☒ confirms that the project developer/representative will make a declaration, in writing, in the monitoring report submitted to Gold Standard that (applicable to CDM PoA/CPAs) - project will/has not issue both a CER/other compliance units under Paris Agreement and a GSVER for the same vintage. - project developer agrees to comply with all future UNFCCC COP/CMP decisions⁴ including adjustment of GWP values
Project Developer/ authorised signatory	<i>Name and designation of the project developer/authorised signatory</i> Orizon Valorização de Resíduos S.A.

TRF.3 TRANSITION CHECKLIST

Project developer shall answer all assessment questions listed below and provide additional information/justification in the PDD section, where required. Please note

⁴ CDM clarification available on this topic as on date can be referred to [here](#).

that the checklist is based on the [GHG Emissions Reductions and Sequestration Product Requirements](#).

The checklist also provides relevant requirements applicable to project transitioning to GS4GG for easy referencing. The PD shall refer to relevant GS4GG documents, as applicable, for further details. It is recommended that PD refers to Guidelines in the table below for more information on the requirements and flexibilities provided. This document (in word) shall be submitted to SustainCERT along with other required documents **for preliminary review** as listed below –

- [Cover Letter](#)
- [Terms and Conditions](#)
- [Official Development Assistance declaration](#)
- [Stakeholder Consultation Report](#)
- Project Design Document (PDD) final version (CDM/other standard)
- Validation report submitted to CDM/other standard
- Last Monitoring and Verification report submitted to CDM/other standard

1 Transition pathway	
1.1 Option 1: Is project seeking registration with GS4GG to issue GSCERs while maintaining the CDM registration? (Ref: GHG Product Requirements)	☐ Yes ☒ No
1.2 Option 2: Is project seeking registration with GS4GG to issue GSVERs only and/or conversion of issued CERs to GSVERs ? (Ref: Annex B, GHG Product Requirements) <i>Note – for conversion of issued CERs to GSVERs, the project must be registered with GS4GG.</i>	☒ Yes ☐ No
1.3 Option 3: Is project seeking registration with GS4GG to issue GSVERs only and/or conversion of emission reduction to GSVERs issued by standard other than CDM ? (Ref: Annex B, GHG Product Requirements)	☐ Yes ☒ No
Requirement: <i>All projects submitting request for transition on or after 1/1/2021 must demonstrate compliance with requirements stated in Annex B, GHG Product Requirements.</i> <i>The project following option 1 above;</i> - may seek registration under GS4GG based on provisional CDM EB decision - may seek issuance of GSVERs in exchange of provisional CERs based on CDM EB decision but must transfer issued CERs to the Gold Standard Swiss CDM Registry Account. If there are any implications for issued volume or project eligibility due to CMP decision regarding GWP, additionality or any other decision, the PD must address these issues, as applicable in consultation with SustainCERT/GS. - A/R projects are not eligible for option 1. <i>The project transitioning to GS4GG following option 2 above,</i> - may convert issued CERs to GSVERs - are not required to deregister from CDM but shall not claim emission reductions under both GS4GG and CDM for the same vintage - Eligible LUF project is required to deregister from CDM to issue GSVERs.	

The project transitioning to GS4GG following **option 3** above,

- may convert issued emission reductions unit to GSVERs
- may issue GSVERs
- shall deregister project from other standard before registration with GS4GG

Guidelines:

Project already undergoing design certification for CER labelling can continue with their existing process. [SustainCERT](#) shall be notified of the intention to switch to GSVER stream, at the earliest possible opportunity.

Project already certified for CER labelling can switch to GSVER stream by completing this form and notifying [SustainCERT](#). Such project may leave the PDD section blank as this information has been captured in GS4GG PDD version submitted earlier.

2| Transition approval procedure

2.1 	Option 1 - Is the project undergoing a preliminary review by sustainCERT , validation by VVB and design review by SustainCERT ?	☒ Yes ☐ No
2.2 	Option 2 - Is the project undergoing a combined preliminary review, validation, and design review by SustainCERT ? (restrictions apply, see 5.3 below)	☐ Yes ☒ No
2.3 	Option 3- Is the project undergoing preliminary review by SustainCERT , combined validation & verification by VVB , followed by combined design and performance review by SustainCERT?	☐ Yes ☒ No

Requirement:

The project certification under GS4GG involves following key steps. Refer to Section 5. Project cycle Principles and Requirements for details.

Preliminary review - Preliminary Review is conducted once at the time of first submission to Gold Standard. It involves desk review of the Key Project Information and Draft Project Design Document by SustainCERT.

Design certification (validation + design review) - Design certification involves validation by VVB and design review by SustainCERT. With successful design certification the Project will obtain 'Certified design' status that is equivalent to registration under CDM and other standard.

Performance certification (verification + performance review) - Performance certification involves verification by VVB and performance review by SustainCERT. The positive conclusion of the Performance Review period shall result in Gold Standard 'Certified Project status' and Project can issue GSVERs. The project may opt for combined Design Certification, conducting both the first Verification and Performance Review under GS4GG at the same time.

To minimise disruption and keep the transition review time and costs minimum, the projects are provided with flexibilities as summarised in the table below;

		Option 1	Option 2*	Option 3
Certification outcome	Certification stage	Normal certification pathway	Combined Preliminary review + Validation + Design review	Combined validation + verification followed by combined design + performance review

Listing	Preliminary review	SustainCERT	SustainCERT	SustainCERT
Certified Design = Registration	Validation	VVB	SustainCERT	VVB
	Design review	SustainCERT		SustainCERT
Certified project = Issuance	Verification	VVB	VVB	VVB
	Performance review	SustainCERT	SustainCERT	SustainCERT
Comments		Project shall go through preliminary review by SustainCERT (4 weeks)	Project may combine preliminary review with validation and design review. All these steps can be combined and completed by SustainCERT.	Project shall go through preliminary review by SustainCERT (4 weeks)
		Design review (minimum 4 weeks) is conducted after Validation by VVB and is concluded when all CARs/CLs are successfully closed.	VVB shall complete the verification.	Project Developers may combine Design Certification with first Verification and Performance Review.
		Performance review (minimum 3 weeks) is conducted after Verification by VVB and is concluded when all CARs/CLs are successfully closed.	Performance review (minimum 3 weeks) is conducted after verification by VVB and is concluded when all CARs/CLs are successfully closed	VVB may combine site visits and VVB submits positive Validation and Verification Reports at the same time.
				Concurrent Design Review and Performance Review (minimum 6 weeks) is conducted after submission of validation and verification reports by VVB and is concluded when all CARs/CLs are successfully closed.
For option 1, a validation site visit by VVB is not required as long as the VVB conducted a site visit as part of validation/verification in last three years (from time of first submission for preliminary review) and new/updated information can be audited based on desk review and/or using remote audit approaches. For Option 2, SustainCERT conducts project design elements desk based audit and approve project transition, without VVB's opinion. <u>Note that this option will involve additional review fee levied by SustainCERT. The project developer shall confirm the applicable fee and timelines with SustainCERT (help@sustain-cert.com) before submitting the request for transition.</u> If transition project is applying a new/latest version of the methodology which requires full audit but VVB, option 2 cannot be applied.				
3 Project Eligibility				
3.1 Is the project eligible project type under Gold Standard for the Global Goals?				☒ Yes ☐ No

Requirement: The transitioning project shall be one of the eligible project types for issuance of Gold Standard VERs (Ref: [GHG Product Requirements](#)).

Guidelines: Typical eligible project types are Renewable Energy Supply, End-Use Energy Efficiency Improvement, Waste Handling & Disposal, Land Use and Forests.

- Afforestation/Reforestation project registered with CDM/other standard may transition to GS4GG for issuance of GSVERs only but are not eligible for labelling of issued emission reduction units.
- RE projects shall refer to [Renewable Energy Activity Requirements](#) for eligibility check.
- RE projects for example - · Hydropower · biomass resources · landfill gas and biogas from agro-processing, wastewater and other residues · Waste Heat/Gas recovery · Fossil co-generation · Waste incineration and gasification · Waste handling and disposal are required to demonstrate compliance with the specific eligibility requirements. Refer to Annex – A of [Renewable Energy Activity Requirements](#) for further details.
- Community Services Activities projects for example - Hydropower · biomass resources · landfill gas and biogas from agro-processing, wastewater and other residues · Waste Heat/Gas recovery · Fossil co-generation · Waste incineration and gasification · Waste handling and disposal · Relighting · End-use fossil switching are required to demonstrate compliance with the specific eligibility requirements. Refer to Annex – A of [Community Services Activity Requirements](#) for further details.

4| Compliance with relevant Activity Requirements

4.1 	Does the project conform to the relevant Activity Requirements (CSA/RE / LUF)?	☒ Yes ☐ No
4.2 	Does any specific eligibility criteria/requirement stipulated in Annex A of CSA/RE requirements apply to the project? (see section 2.0 for LUF)	☒ Yes ☐ No
4.3 	Does specific eligibility criteria/requirement stipulated in Annex A of CSA/RE requirements that apply to the project, lead to any change in the registered PDD? If Yes, please provide a full explanation in section A.1.1. below.	☐ Yes ☒ No

Requirement:

(Ref: Section 4.1.1 of [GHG Product Requirements](#))

Projects shall conform to the relevant Activity Requirements and Gold Standard Approved Methodologies, including [eligible CDM Methodologies](#).

RE rule update / RE PoA rule update:

Grid connected Renewable Energy projects seeking to transition from another carbon crediting scheme to GS4GG or labelling of emission reductions under GS4GG are exempted from eligibility requirements listed in para 2.1.3 of the RE Activity Requirements. This exemption is only allowed to projects that started the first crediting period with the original carbon crediting scheme from 01/01/2016 or later but before 24/01/2020. (Ref: Section 2.1.1 and 2.1.2 of [RU 2020 AR –RE V1.2](#))

Specific [Renewable Energy Activity requirements](#) (refer to Annex A): Hydropower, biomass resources, landfill gas and biogas from agro-processing, wastewater and other residues, Waste Heat/Gas recovery, Fossil co-generation, Waste incineration and gasification, Waste handling and disposal.

Specific [Community Service Activity requirements](#) (refer to Annex A): Hydropower, biomass resources, landfill gas and biogas from agro-processing, wastewater and other residues, Waste Heat/Gas recovery, Fossil co-generation, Waste incineration and gasification, Waste handling and disposal, Relighting, End-use fossil switching.

5 Applicability of the methodology/tool version	
5.1 Does the project apply an eligible GS methodology? Refer to list of the eligible methodologies here .	☒ Yes ☐ No
5.2 Does the project apply the version of the methodology and applicable tools applied for CDM/other standard registration or renewal ?	☒ Yes ☐ No
5.3 Does the project apply the latest version of the methodology and applicable tools available at the time of first submission of this form ? If Yes, please provide a full explanation in section B below. And note that the project cannot opt for option 2 mentioned transition approval procedure.	☒ Yes ☐ No
Requirement: (Ref: Annex B of GHG Product Requirements) Transition project shall a. conform to the relevant Activity Requirements and Gold Standard Approved Methodologies, including eligible CDM Methodologies. b. also meet the additional GS4GG methodology eligibility requirements, where applicable. Refer to CDM Methodologies for Gold Standard Eligibility Requirements. Transition project shall apply the version of GS approved CDM methodology or methodology tool for transition to GS4GG as follows; a. version applied at the time of registration/renewal of crediting period with other standard, OR b. version available at the time of first submission (preliminary review) this form.	
6 Demonstration of additionality	
6.1 Are you aware that the transitioning project will be required to demonstrate Ongoing Financial Need as per the relevant GS rules and requirements available at the time of renewal of crediting period? (Refer to para 4.1.51 – 4.1.53 of Principles & Requirements .)	☒ Yes ☐ No
Requirement: - The CDM and JI project are not required to carry out additional assessment for demonstration of additionality over and above what has been done for registration/determination with the CDM unless the project falls into a category that is deemed non-additional in an applicable Gold Standard Activity Requirement. In such cases the relevant Activity Requirement shall take precedence. Ref: Annex B GHG Product Requirements. - Transition projects registered with standards other than CDM are required to undergo additionality revalidation to re-establish the validity of the underlying assumptions applied in the demonstration of additionality at the time of registration with the other standard. - The projects seeking combined transition and renewal of crediting period with GS4GG are not required to demonstrate OFN at the time of transition but must demonstrate OFN at the time of Crediting Period renewal after transitioning to GS4GG.	
7 Sustainable Development Assessment	
7.1 Does the project positively contribute towards minimum three Sustainable Development Goals (SDGs) - SDG13 (mandatory) + two other SDGs?	☒ Yes ☐ No
7.2 Have you identified the monitoring parameters linked with selected SDGs and corresponding SDG targets? For example – the monitoring parameter <u>Amount of GHGs emissions avoided or sequestered</u> is linked with SDG 13. Climate action, SDG target 13.2	☒ Yes ☐ No

Integrate climate change measures into national policies, strategies and planning.	
Fill section B.6. Sustainable Development Goals (SDG) outcomes and B.7 Monitoring plan, below for SDGs monitoring parameters not covered in registered PDD with other standards. Fill Table 1 – Estimated Sustainable Development Contributions below. Requirement: <i>The transitioning project shall demonstrate a clear, direct contribution to sustainable development, defined as making demonstrable, positive impacts on at least three Sustainable Development Goals (SDGs), one of which must be SDG 13 (Ref: Section 4.(c) of Principles and Requirements)</i> Refer to Annex B, GHG Product Requirements for further guidelines for transition projects. Guidelines: <i>Selected SDG impacts must not result from a one-off from design/construction/distribution/ start-up or decommissioning of the project.</i> <i>You may refer to /use the SDG impact Tool (under consultation currently) to identify the relevant monitoring indicator, SDGs and corresponding SDG targets and design monitoring plan for identified indicators.</i>	
8 Start date and duration of the crediting period	
8.1 Has the crediting period of the transitioning project registered with other carbon standard/certification scheme changed and/or extended?	☐ Yes ☒ No
8.2 Is the total duration of the crediting period (i.e. including period that had been issued under the host standard) less than/equal to the maximum crediting period allowed under relevant GS4GG activity requirements?	☒ Yes ☐ No
Complete the section C.2.2 Total length of crediting period below. Requirement: - The crediting period of the transitioning project/PoA/CPA registered with other standards or certification schemes cannot be changed/extended. - Maximum crediting period allowed under GS4GG are as CSA – 15 Yrs, RE – 15 Yrs, LUF 30 – 50 Yrs, AGR – 10 Yrs, if not defined in activity requirement or applicable methodology – 10 Yrs. - The start date of the GS crediting period shall be same as the start date of the CDM crediting period. (Annex B, GHG Product Requirements) - For a transitioning project, PoA/CPA, the total duration of the crediting period, including the period that has been claimed under the host standard, shall not exceed the maximum crediting period allowed under relevant GS4GG activity requirements. If a given project transitioning to GS4GG, was registered under Standard X with - • fixed crediting period (10 years): The total crediting period (Standard X + GS4GG) must remain 10 years. The project can only claim remaining years of its 10-year crediting period after transitioning to GS4GG. • renewable crediting period (7*3 year): The total crediting period (Standard X + GS4GG) must be equal to that allowed under relevant GS4GG activity requirements. The project	

can only claim remaining years of the maximum allowed crediting period after transitioning to GS4GG. For example; the maximum crediting period allowed for renewable energy project is 15 years. A renewable energy project that has already claimed 5 years under Standard X can only claim remaining 10 years of the total 15 years of its allowed crediting period after transitioning to GS4GG

- For a transitioning project, the start date of the Gold Standard Crediting Period starts with crediting period start date with other standard or maximum two years before the date of first submission (submission for preliminary review), whichever occurs later. (Ref: Annex B, [GHG Product Requirements](#))

9| Safeguarding Principles Assessment

9.1 Does the project conform to the Gold Standard Safeguarding Principles and Requirements?	☒ Yes ☐ No
9.2 Is there any risk and/or likely adverse outcomes of the project?	☐ Yes ☒ No
9.3 If answer is yes for Q 9.2, can the project achieve requirements with regards to the relevant principle through design, management or risk mitigation?	☐ Yes ☐ No
9.4 If answer is yes for Q 9.3, have the Mitigation Measures added to the Monitoring Plan (if required)?	☐ Yes ☐ No

Complete the Annex 1 and section D. Summary of Safeguarding Principles below.

Requirement: The transitioning project shall conform to the [Gold Standard Safeguarding Principles and Requirements](#). (Ref: Section 4.1.19 of [GS4GG Principles and Requirements](#))

Guidelines: The detailed Safeguarding Principles and Requirements checklist is available in Annex 1 of this document.

10| Stakeholder Consultation Requirements

10.1 Has the project conducted a Stakeholder Consultation in accordance with the requirements of Gold Standard Stakeholder Consultation & Engagement Requirements ?	☒ Yes ☐ No
The answer to Q 10.1 is "No", if any of the questions below is answered as "No". The project should take the question(s) into account and address the gap when conducting supplementary stakeholder consultation to comply with GS4GG requirements. Please answer the below question with regards to the stakeholder consultation conducted to comply with CDM/other standard requirements?	
10.2 Did you conduct the stakeholder consultation before the project start date?	☐ Yes ☒ No
10.3 Did you discuss identified direct positive and negative impacts of the projects with stakeholders?	☒ Yes ☐ No
10.4 Does the invited stakeholder covers all stakeholder groups (a to g) listed in paragraph 3.1.1. of STAKEHOLDER CONSULTATION AND ENGAGEMENT REQUIREMENTS ?	☒ Yes ☐ No

10.5 Did the invitation methods solicit input from women and marginalised groups?	☒ Yes ☐ No
10.6 Were the stakeholders invited at least 30 days before the stakeholder meeting?	☒ Yes ☐ No
10.7 Did a local language version of the non-technical summary with information required as per paragraph 5.1.1. of STAKEHOLDER CONSULTATION AND ENGAGEMENT REQUIREMENTS , shared with stakeholders?	☒ Yes ☐ No
10.8 Was a physical meeting conducted?	☒ Yes ☐ No
10.9 Was a gender lens applied to assessing comments? (for example, if only men provided comments on household device project, was this taken into consideration when assessing the relevance of the comment?)	☒ Yes ☐ No
10.10 Were any serious, reasonable and proportional concerns raised and taken into account and satisfactorily addressed?	☒ Yes ☐ No
10.11 Were any points that warrant 'Mitigation measures' marked as such and monitoring plan has been designed and included in the PDD?	☒ Yes ☐ No
10.12 Is the mandatory Continuous Input / Grievance Expression Process Book's location clearly stated (and therefore usable)?	☒ Yes ☐ No
10.13 Does PDD include a summary report of the comments received from local stakeholders?	☒ Yes ☐ No

Complete the section E. Summary of Local Stakeholder Consultation below.

Requirement: Ref: Section 4.1.25 of [GS Principles and Requirements](#).

Guidelines: Project that conducted a stakeholder consultation meeting to comply with CDM/other standard requirements, should conduct, at minimum,

- one round of consultation for identified gaps i.e., gaps due to differences in stakeholder consultation requirements of GS4GG and CDM/other standard. For instance, if original consultations only involve one physical meeting, CME/PD should conduct a stakeholder feedback round covering all the identified gaps. The additional stakeholder consultations may involve a physical meeting or stakeholder feedback round, as necessary.

If COVID interim measures are applicable (currently till 30/06/2021), the physical meeting and stakeholder feedback round may be postponed, and a draft SCR shall be mandatorily submitted to cover the consultation activities carried out till date.

KEY PROJECT INFORMATION

GS ID of Project	GS12047
Title of Project	Ecoparque Candeias Landfill Gas Project
Time of First Submission Date	20/12/2022
Date of Design Certification	25/10/2023
Version number of the PDD	4.3
Completion date of version	02/07/2024
Project Developer	Orizon Valorização de Resíduos S.A.
Project Representative	Dalton Canelhas
Project Participants and any communities involved	Orizon Valorização de Resíduos S.A. ⁵
Host Country (ies)	Brazil
Activity Requirements applied	☐ Community Services Activities ☒ Renewable Energy Activities ☐ Land Use and Forestry Activities/Risks & Capacities ☐ N/A
Scale of the project activity	☐ Micro scale ☐ Small Scale ☒ Large Scale
Other Requirements applied	-
Methodology (ies) applied and version number	ACM0001: "Flaring or use of landfill gas" (version 19.0)
Product Requirements applied	☒ GHG Emissions Reduction & Sequestration ☒ Renewable Energy Label ☐ N/A
Project Cycle:	☐ Regular ☒ Retroactive

⁵ While the project activity was previously implemented and registered under the CDM by the project participant and project owner Haztec Tecnologia e Planejamento Ambiental S.A., this company was merged with Orizon Valorização de Resíduos S.A. in year 2020. Orizon Valorização de Resíduos S.A. is the currently owner and operator of the proposed GS project activity.

Table 2 – Estimated Sustainable Development Contributions

Sustainable Development Goals Targeted	SDG Impact (defined in B.6.)	Estimated Annual Average	Units or Products
13 - Climate Action (mandatory)	Amount of GHGs emissions avoided or sequestered	702,389 tCO ₂ e per year	
7 - Affordable and Clean Energy	Total electricity produced: Renewable	211,570	MWh of renewable energy per year
8 - Decent work and Economic Growth	Total number of jobs	19	Jobs

SECTION A. DESCRIPTION OF PROJECT

A.1 Purpose and general description of project

>>

The objective of the “Ecoparque Candeias Landfill Gas Project” is to capture and burn the landfill gas (LFG)⁶ generated by the decay of organic waste from the Ecoparque Candeias landfill (previously termed as CTR Candeiras landfill) located in the municipality of Jaboatão dos Guararapes, in the Recife Metropolitan Area. The project also intends to generate electricity from the combustion of LFG and sale it to the national electricity grid and thus reduce CO₂ emissions by displacing electricity generated from fossil fuels.

The Ecoparque Candeias landfill, previously built and operated by Haztec Tecnologia e Planejamento Ambiental SA (and more recently Orizon Valorização de Resíduos S.A. (Orizon)), is strategically located close to major cities in the Recife Metropolitan Area and is the first sanitary landfill in the State of Pernambuco. The landfill started operations in August 2007 and received all necessary environmental licenses for operations. The landfill was designed to operate over a 21 years-period and will thus be closed by the end of 2027.

The project activity results in greenhouse gas (GHG) emission reduction from the landfill through the ways below:

- Burning LFG in high enclosed flares and/or electricity group generators;
- The amount of electricity generated in the project activity will be exported to the Brazilian national grid, avoiding the dispatch of an equal amount of energy produced by fossil-fuelled thermal plants to that grid. The initiative avoids CO₂ emissions and contributes towards regional and national sustainable development.

⁶ The major landfill gas contents are methane (CH₄) and carbon dioxide (CO₂).

The municipal landfill covers an area of over 170,000 m² and will receive about 24 million tons of solid waste during the period from year 2007 to year 2027. The landfill is currently disposing about 4,000 tons of municipal solid waste (MSW) per day. Landfill gas (LFG) extraction and flaring begun in year 2011, while electricity production started in year 2019 dispatching electricity to the Brazilian interconnected electric system (National Electricity Grid of Brazil).

The project's power generation facility will be comprised of LFG engine generator sets of high-performance standards. The engine-generator sets will be the primary equipment to combust the collected LFG once they are installed. A fraction of the collected LFG could be diverted to flares, which will be used to combust any gas in excess of the fuel demand for the engines, as well as a contingency backup. The flares will be kept in standby for periods when electricity will not be produced or other operational considerations.

The final installed capacity is expected to reach until 28.52 MW upon project completion. However, the installed capacity may vary depending on the availability of the generator equipment in the market at the time of its actual implementation.

Prior to the implementation of the project activity the landfill gas is being released to atmosphere and electricity is being generated in existing and/or new grid-connected power plants, other than the project activity power plant.

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

- Annual average GHG emission reduction: 702,389 tCO₂e
- Total estimated GHG emission reductions: 1,924,547 tCO₂e

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

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

A.1.1. Eligibility of the project under Gold Standard

As per applicable GS rules and definitions, the GS project activity which encompasses flaring of LFG and utilization/generation of electricity from renewable energy source (LFG generated from decomposition of MSW disposed at the Ecoparque Candeias landfill) represents a pre-identified "GHG Emissions Reduction & Sequestration" and "Renewable energy" project type and it meets the eligibility criteria of the GS4GG "Principles and requirements".

The GS project activity is not registered with any other voluntary or compliance schemes other than its registry as a CDM project activity.

While being hosted in Brazil, the GS project activity is not located in a host country, region, locality or state that has an emission reduction cap enforced or has the possibility to trade emissions that include the scope of the proposed project. There is no regional or national GHG emission reduction cap enforced in Brazil. Furthermore, there is no domestic regional or national GHG emission trading scheme implemented in Brazil either.

While the GS project activity represents the only project-based initiative implemented in the municipality of Jaboatão dos Guararapes, in the Recife Metropolitan Area (within the State of Pernambuco) promoting GHG emission reductions due to destruction/utilization of landfill gas (there are no other Gold Standard or other voluntary or compliance standard program of a similar nature implemented or planned to be implemented nearby the GS project activity), there are no potential for double counting of impacts.

The following requirement of the "GS4GG Renewable Energy Activity Requirements" is also applicable to the GS project activity:

"Methane recovery project activities shall be eligible for emission reductions from both methane avoidance (including from the flared biogas fraction) and non-renewable fuel substitution as long as evidence is provided on time for validation to demonstrate that the system was designed in a way to at least make use of

some of the biogas recovered for the delivery of energy services (e.g., electricity, heat)."

Since as per the project design, collected LFG is to be primarily used as gaseous fuel for electricity generation, such requirement is thus fully met.

It is also relevant to note that a Deviation Request was sent/submitted to the GS4GG in June/2022 (for which a response was obtained from the GS4GG on 14/07/2022) inquiring about the eligibility of the project activity for transitioning from the CDM to the GS4GG. In the decision for submitting such Deviation Request, it was considered that the project developer were to demonstrate the project's compliance with applicable GS4GG requirements (as presented above in this Section) and also demonstrate that the project indeed faces serious risk of discontinuation without carbon revenues generation (as presented in Appendix 5).

Finally, as further demonstrated in Section B.4, the GS project activity is regarded as under full compliance with applicable Host Country's legal, environmental, ecological and social regulations.

A.1.2. Legal ownership of products generated by the project and legal rights to alter use of resources required to service the project

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While being the registered owner of all project-related infrastructure of the GS project activity and while having been granted with all applicable permits and authorizations for the operation of both the GS project activity and the Ecoparque Candeias landfill, the project developer Orizon Valorização de Resíduos S.A. has full and uncontested legal ownership of all products that are generated under Gold Standard Certification.

A.2 Location of project

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Host Party:

- Brazil

Region/State/Province:

- Pernambuco

City/Town/Community:

Jaboatão dos Guararapes, in Recife Metropolitan Area

Physical/Geographical location:

The project site is located in the Municipality of Jaboatão dos Guararapes in the Recife Metropolitan Area, Pernambuco State, Northeastern Region of Brazil.

Several poor communities are located in the vicinity of the GS project activity. The Ecoparque Candeias landfill is strategically situated close to three major cities in the state of Pernambuco: Recife, Jaboatão dos Guararapes and Cabo de Santo Agostinho. Due to its central location, the landfill potentially provides services to a metropolitan area of 3.8 million inhabitants. The site, which is located at coordinates Latitude:

- 8.164258; Longitude: -34.985286, is shown in the figure below.



Figure 1 - Location of the Ecoparque Candeias Landfill Gas Project (Source: IBGE)



Figure 2 – Panoramic view of the Ecoparque Candeias Landfill Gas Project

A.3 Technologies and/or measures

>>

Project activity:

The proposed project consists of an LFG collecting system, LFG pre-treatment system, enclosed flaring system, electricity generation system and grid connection system. First, the landfill gas will be collected, then through a network composed of transportation pipes, the landfill gas will reach the pre-treatment system, in which the moisture will be removed. The enclosed flare will be used at the start of the operations (period required to test the volume and quality of the gas prior energy generation) and when the volume of gas exceeds the capacity of the power generation system or when the power generation system is not in operation (e.g., maintenance, breakdown).

Landfill gas collection system:

State-of-the-art gas collection technology includes the items listed below. An example of a transmission line from the gas extraction wells to the power generation / flare complex is shown on Photo 1.

- Vertical wells used to extract gas and leachate;

- Horizontal wells used to extract gas;
- Optimal well spacing for maximum gas collection whilst minimizing costs;
- Wellheads designed for gas measurements;
- Blowers;
- Condensate extraction and storage systems designed at strategic low points throughout the gas system; and
- Pipeline collection system to connect the LFG collected with the electricity generation and flaring systems.



Figure 3 – Manifold in the project activity

The landfill will be covered by clay to prevent biogas to come out through the landfill surface.

The LFG collection efficiency (85%⁷) was considered in the calculations of the emission reductions ex-ante.

⁷ Source: Technical literature (Collection efficiency 0.85 & Load Factor 0.95 - USEPA 1996 Handbook EPALFG.pdf - Item 2.2.2. page 2-8), only collection efficiency technical literature data was used.

Landfill gas pre-treatment system:

Once the landfill gas is collected and transported through pipes, the landfill gas will reach pre-treatment system (demister), in which the moisture of landfill gas will be removed.

Enclosed flaring system:

The enclosed flare selected is designed to operate continuously with automatic temperature control to safely destroy the biogas generated by solid waste.

The flaring system will ensure the combustion of LFG (e.g., maintenance, breakdown or when the volume of gas exceeds the capacity of the power generation system). The flare system includes the items listed below.

- Enclosed flare with controlled combustion system;
- Blower system used to direct gas for flaring;
- Equipment to ensure continuous monitoring of the LFG composition (methane, oxygen, dioxide of carbon and balance), flow and burn temperature; and Security restarts system, in cases the system shuts down.

The flare system will achieve destruction efficiency greater than 99% of total organic compounds and greater than 98% of total non-methane volatile organic compounds (NMVOC) throughout the entire flare operating range, without any burner adjustments or flare modification⁸. For the ex-ante estimates of the emission reductions, and for conservative reasons, 89% (applying 10% discount as defined in Tool "Project Emissions from Flaring") flare efficiency has been considered. The average lifetime of the equipment of the system is between 15 to 20 years⁹.

⁸ Source: Manufacturer (John Zinc) technical specifications.

⁹ Ibid

The landfill gas flaring system will be maintained in accordance with the manufacturer's recommended specifications on schedule and procedures in order to ensure the safety and environmental soundness of the operations. The project personnel involved in the operations and monitoring will receive comprehensive training on equipment, maintenance and monitoring from the equipment supplier.



Figure 4 – LFG Flare Station in the project activity

The main operational characteristics and specifications of the currently installed high temperature enclosed flares are defined as follows:

LFG combustion flaring equipment	Characteristics/specifications
Flare 1	Manufacturer: Biotecnogás s.r.l. Model: 2500HT Min. LFG flaring capacity (for continuous operation): Flow rate of 500 Nm³/h Max. LFG flaring capacity (for continuous operation): Flow rate of 2,500 Nm³/h Min. CH₄ destruction efficiency: 99%

Electricity generation system and grid connection system

Electricity generation plant is composed of 20 generators, each having a capacity of 1.426 MW (or a combined total capacity of 28.52 MW), as below:

Year	Installed capacity (Mwe)	Number of group generators	Net electricity generated in the plant (MWh)
2021 ¹⁰	22.81	16	189,875
2022	25.66	18	213,609
2023	28.52	20	176,219

Note 1: As highlighted in Section A.2, the final equipment that will be chosen (as well as the final installed capacity) may vary depending on the availability of the generation equipment on the market at the time of its actual implementation.

Note 2: Electricity Plant Load Factor assumed as 95% appropriate value calculated based on data provided by the electricity plant owner, where:

¹⁰ Values applicable for years 2018, 2019 and 2020 are not considered since CERs were previously issued for these particular years by the project activity under the CDM. Therefore, no GS VERs will be claimed for this particular years.

Load Factor (%) = Electricity generated in the plant (MWh) / Installed capacity (MW) / 8,760

The lifetime of the equipment is 20 years and it was based on market standard specifications¹¹.



Figure 5 – LFG Engine generation units

Monitoring system:

The process will be controlled by an electrical control system equipped with a Programmable Logical Controller (PLC). All details related to monitoring of GS project is provided in section B.7. of this completed GS4GG Transition Request Form + PDD.

¹¹ The document was made available to DOE in validation visit.

A.4 Scale of the project

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Large scale, using the large-scale Consolidated Methodology ACM0001: "Flaring or use of landfill gas" (Version 19.0).

A.5 Funding sources of project

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There is no public funding involved in the Project Activity.

SECTION B. APPLICATION OF APPROVED GOLD STANDARD METHODOLOGY (IES) AND/OR DEMONSTRATION OF SDG CONTRIBUTIONS

B.1. Reference of approved methodology (ies)

>>

- Large-scale Consolidated Methodology ACM0001: "Flaring or use of landfill gas" (Version 19.0)¹²;
- "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 07.0)¹³ ;
- "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 03.0)¹⁴.
- "Emissions from solid waste disposal sites" (Version 08.0)¹⁵ ;
- "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (Version 03.0)¹⁶;

¹² <https://cdm.unfccc.int/methodologies/DB/JPYB4DYQUXQPZLBDVPHA87479EMY9M>

¹³ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v2.2.pdf/history_view

¹⁴ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf/history_view

¹⁵ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v6.0.1.pdf/history_view

¹⁶ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf/history_view

- "Project emissions from flaring" (Version 03.0)¹⁷;
- "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0)¹⁸;
- "Determining the baseline efficiency of thermal or electric energy generation systems" (Version 02.0)¹⁹;
- "Project and leakage emissions from transportation of freight" (Version 01.1.0)²⁰;
- "Tool to calculate the emission factor for an electricity system" (Version 07.0)²¹;
- "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (Version 03.0.1)²²;
- "Positive lists of technologies" (Version 01.0)²³

B.2. Applicability of methodology (ies)

>>

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

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

The methodology ACM0001: "Flaring or use of landfill gas" is applicable to project activities which:

"...

¹⁷ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v1.pdf/history_view

¹⁸ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v1.pdf/history_view

¹⁹ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v1.pdf/history_view

²⁰ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.pdf/history_view

²¹ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v1.1.pdf/history_view

²² https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v1.pdf/history_view

²³ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-32-v1.pdf/history_view

- a) Install a new LFG capture system in a new or existing SWDS where no LFG capture system was installed prior to the implementation of the project activity; or*
- b) Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that:

 - i) The captured LFG was vented or flared and not used prior to the implementation of the project activity; and*
 - ii) In the case of an existing active LFG capture system for which the amount of LFG can not be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project system: historical data on the amount of LFG capture and flared is available.**
- c) Flare the LFG and/or use the captured LFG in any (combination) of the following ways:

 - i) Generating electricity;*
 - ii) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace; and/or*
 - 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.*

Justification: - Part 1

The methodology **is applicable** because it has been made an investment into an existing LFG capture system to increase the recovery rate (collection efficiency) and change the use of the captured LFG (also electricity generation). The captured LFG was only vented and not used prior to the implementation of the project activity.

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

Moreover, the amount of organic waste will be the same in the project activity as well as in the absence of the project activity.

"...

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

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

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

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

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

This methodology is not applicable:

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

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

..."

Justification: - Part 2

According to Section B.4 and B.5, the methodology is applicable because:

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

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

Justification: - Part 3

The methodology is applicable since the most recent Urban Solid Waste Diagnosis from Institute for Applied Economic Research (IPEA) has been published in 2012. According to Table 18, 99.5% of the Recife area municipal solid waste is disposed in landfills/open dumps and only 0.5% is managed by other methods. Thus, it is possible to state that the recycling percentage in the project activity area is negligible.

The “Combined tool to identify the baseline scenario and demonstrate additionality” is applicable to project activities where:

“...

All potential alternatives 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.*

...”

The project activity encompasses the destruction of a greenhouse gas in one site where one of the identified potential alternative scenarios is no abatement of the greenhouse gas.

Justification:

The tool is **applicable** because the Step 1 of the “Combined tool to identify the baseline scenario and demonstrate additionality” presented in section B.4, demonstrates that all alternative scenarios identified are realistic and credible to the project activity.

The “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” is **not applicable** due to the non-consumption of fossil fuel by the project activity (with fossil fuel being used for purposes other than for electricity generation).

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

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

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

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

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

- c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.

Justification:

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

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

The tool "Project emissions from flaring" is **applicable** to the project activity since the project activity uses enclosed and/or open flares and project participant documents the same in the completed GS4GG Transition Request Form + PDD including the type of flare used in the project activity. Tool is applicable to the flaring of flammable greenhouse gases where:

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

Justification:

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

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

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

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

The “Project and leakage emissions from transportation of freight” is **not applicable** since the project activity does not involve the transportation of freight.

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

The “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” is **applicable** to the project activity since it is required to assess the continued validity of the baseline at the transition from CDM to GS.

The “Positive lists of technologies” is **not applicable** to the project activity since the LFG is used to generate electricity in one or several power plants with a total nameplate capacity that is higher than 10 MW.

B.3. Project boundary

>> [Leave this section blank if there is no change in registered PDD.](#)

Source	GHGs	Included?	Justification/Explanation
--------	------	-----------	---------------------------

Baseline scenario	Source 1	CO ₂
		CH ₄
		N ₂ O
		...
	Source 2	CO ₂
		CH ₄
		N ₂ O
		...
	...	...
		...
		...
		...
Project scenario	Source 1	CO ₂
		CH ₄
		N ₂ O
		...
	Source 2	CO ₂
		CH ₄
		N ₂ O
		...
	...	...
		...
		...
		...

B.4. Establishment and description of baseline scenario

>>

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

It is important to clarify that the baseline scenario for LFG defined for the 1st crediting period under the CDM is maintained valid.

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

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

In order to assess the continued validity of the baseline, changes in the relevant national and/or sectorial regulations between the crediting periods have to be examined at the renewal of the crediting period. If at the start of the project activity, the project activity was not mandated by regulations, but at the time of renewal of the crediting period regulations are in place that enforce the practice or norms or technologies that are used by the project activity, the new regulation (formulated after the registration of the project activity) has to be examined to determine if it applies to existing project or not.

The baseline scenario does not have to be updated for the second crediting period as no new regulations requiring capture and combustion or use of LFG are in place.

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

Prior to the implementation of the project activity the landfill gas is being released to atmosphere and electricity is being generated in existing and/or new grid-connected power plants, other than the project activity power plant.

Thus, the baseline remains the same as defined in the 1st crediting period under the CDM and required regulations.

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

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

At the start of the project activity in 2004, the Brazilian legislation did not require landfills to capture and/or flare and/or use the LFG. After the registration of the project activity in 29/09/2011, the project participant, in order to assess if the current baseline complies with all relevant mandatory national and/or sectorial policies which have come into effect after the submission of the project activity for validation, has verified that the current baseline complies with all applicable laws and regulations.

The baseline scenario for the project activity is identified using step 1 of the 'Combined tool to identify the baseline scenario and demonstrate additionality', as agreed in ACM0001 "Flaring or use of landfill gas".

Step 1.2: Assess the impact of circumstances

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

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

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

Also, in the baseline scenario, electricity is being generated in existing and/or new grid-connected power plants, other than the project activity power plant.

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

Considering the applied methodology at the project activity registration ACM0001 version 11 has changed to consolidated methodology ACM0001 version 19 and all related applicable tools some ex-ante parameters published by IPCC have been updated accordingly.

According to the "Tool to assess the validity of the original/current baseline and to update the baseline at the renewal of a crediting period", where any data and parameter used and not monitored during the crediting period are not valid anymore, they should be updated following the Step 2 as follows:

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

Step 2.1: Update the current baseline

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

Step 2.2: Update the data and parameters

All parameters regarding the grid emission factor calculation have been updated for the current crediting period under the GS ($EF_{grid,OM,y}$ is ex post monitored, $EF_{grid,BM,y}$ is ex-ante monitored and thus $EF_{grid,CM,y}$ is ex post monitored). The baseline scenario for the project activity is identified using step 1 of the 'Combined tool to identify the baseline scenario and demonstrate additionality', as agreed in ACM0001 "Flaring or use of landfill gas". Another parameters have been updated for the current crediting period under the GS , as follows:

- GWP_{CH_4} – Global warming potential of CH_4 is selected as 28 tCO_2e/tCH_4 ;
- TDL_y - Average technical transmission and distribution losses for the electricity (20%).

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

STEP 0: Demonstration that a proposed project activity is the First-of-its-kind.

This step is not applied because the proposed project activity is not the First-of-its-kind. Even with the Post-Registration Changes in the context of CDM registration related to the increment of electricity generation plant installed capacity (From 4.24 MW to 28.52 MW), the baseline remains the same as from the 1st crediting period and not being defined as a new baseline for the current crediting period under the GS.

Outcome of Step 0: The proposed project activity is not the First-of-its-kind.

Step 1: Identification of alternative scenarios

This Step serves to identify all alternative scenarios to the proposed GS project activity(s) which can be the baseline scenario. The project developers will monitor all relevant policies and circumstances at the beginning of each crediting period and adjust the baseline accordingly.

Step 1a: Define alternative scenarios to the proposed CDM project activity

The identified alternatives for the destruction of LFG in the absence of the project activity are:

LFG1	The project activity implemented without being registered as a CDM project activity (i.e. capture and flaring or use of LFG);
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, to address safety and odour concerns, or for other reasons

Thus, the remaining real alternatives for the destruction of LFG are LFG1, LFG2.

The EIA (Environmental Impact Assessment) does not cover recycling, treatment or incineration of organic waste, alternatives LFG3, LFG4 and LFG5 should not be considered.

For electricity generation, the realistic and credible alternatives are:

E1	Electricity generation from LFG, undertaken without being registered as CDM project activity
E3	Electricity generation in existing and/or new grid-connected power plants;

In the absence of project activity, no captive electricity consumption would be necessary. Thus, the alternative scenario E2 should not be considered.

According to the project activity configuration, there will be no heat generation. Therefore, all alternative scenarios addressing these possibilities should not be considered.

Thus, the remaining real alternatives to the project activity are E1 and E3.

The combinations of the project activity compose the following scenarios:

Scenarios		Comments
1	LFG1 + E1	Possible
2	LFG1 + E3	Possible
3	LFG2 + E1	This alternative is not plausible because to generate electricity in the project activity, it is necessary to implement the capture, flaring and use of LFG.
4	LFG2 + E3	Possible

Outcome of Step 1a: Three realistic and credible alternative scenarios to the project activity were identified:

- Scenario 1 (LFG1 + E1);
- Scenario 2 (LFG1 + E3);
- Scenario 4 (LFG2 + E3);

Step 1b: Consistency with mandatory applicable laws and regulations

All alternative scenarios identified in Step 1a comply with all applicable laws and regulations. Brazil's New National Solid Waste Policy (NSWP)²⁴, ratified by the President on 02/08/2010 after 19 years under discussion. The NSWP does not request the LFG capture and/or flare and there is no forecast to approve any regulation or policy in the next years with this requirement. The laws and regulations applicable for the electricity generation component are law 8987/95 and law 9074/95²⁵.

The scenario 4 which is, a continuation of the current situation of the landfill (baseline scenario) represents the business-as-usual practice for the project site as well as for most of the landfills in Brazil.

²⁴ http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm

²⁵ <http://www.aneel.gov.br/area.cfm?idArea=43>

The project participant will monitor all relevant policies and circumstances at the beginning of each crediting period and adjust the baseline accordingly.

Outcome of Step 1b: Three realistic and credible alternative scenarios to the project activity are in compliance with mandatory legislation and regulations. The alternatives scenarios remain the same:

- Scenario 1 (LFG1 + E1);
- Scenario 2 (LFG1 + E3);
- Scenario 4 (LFG2 + E3);

B.5. Demonstration of additionality

>>

The content of this Section (demonstration of additionality of the project activity by using the stepwise approach of the CDM methodological tool “Combined tool to identify the baseline scenario and demonstrate additionality”) is identical to the one presented in the registered PDD for the project activity under the CDM since there is no requirement to re-assess the additionality of the project activity in the context of transitioning from the CDM to the GS4GG²⁶.

Step 0, 1a and 1b are described above in section B.4.

²⁶ Nonetheless, in order to fully address comments raised by the SustainCERT as part of the Design Review phase, details about a complementary financial analysis (which is presented in the spreadsheet titled “*Complementary Financial Analysis DEV277.xls*” (which is being submitted along with this revised PDD)) are also included in Appendix 5 of this PDD, in order to demonstrate that the project indeed faces a risk of discontinuation without carbon revenues from the commercialization of GS VERs to be issued by the project activity.

Step 2: Barrier analysis

This step serves to identify barriers and to assess which alternative scenarios are prevented by these barriers as per the latest approved version of the “Guidelines for objective demonstration and assessment of barriers”. The following Sub-steps are applied:

Sub-step 2a: Identify barriers that would prevent the implementation of alternative scenarios

- Investment barrier: The implementation of the Scenario 2 (collection and destruction of LFG in enclosed flares + electricity generation in existing and/or new grid-connected power plants) requires a very high amount of investment from such project components:
 - Collection system;
 - Biogas transport pipe system;
 - Blower system;
 - Flare system;
 - LFG station (edifications).

In Brazil, flaring LFG in enclosed flares does not generate any revenues and has only expenditures. Therefore, the high investment regarding project components described above is not feasible from the economical point of view.

Outcome of Step 2a: the identified barrier (investment barrier) as described above prevents scenario 2. However, the identified barrier does not prevent the occurrence of the other scenarios (scenarios 1 and 4).

Step 2b: Eliminate alternative scenarios which are prevented by the identified barriers

As the investment in Scenario 2 does not generate any revenues and has only expenditures for the PP, this scenario is not economical/financial attractive.

Outcome of Step 2b: The two realistic and credible alternative scenarios to the project activity are:

- Scenario 1 (LFG1 + E1);
- Scenario 4 (LFG2 + E3);

Step3. Investment analysis

Sub-step3a. Determine appropriate analysis method

As the proposed project activity will generate financial benefits other than CDM related income, Option III is chosen. This option is appropriate because the baseline does not require investment, as per "Guidelines on the assessment of investment analysis", paragraph 19.

Sub-step3b. – Option III. Apply benchmark analysis

The alternative LFG1 (equivalent to P1) (proposed project without CDM revenues) is evaluated by applying a benchmark analysis. The likelihood that this project would be developed without CDM revenues, as opposed to the continuation of business-as-usual activity (LFG2 in combination with P6), is evaluated by comparing its project internal rate of return (IRR) with the benchmark rate of return available to investors in Brazil.

In order to conduct the benchmark analysis, an evaluation of the project's cash-flow and its internal rate of return (IRR) (without CDM financial incentives) is undertaken. The benchmark analysis is undertaken by comparing the project IRR with the more conservative opportunity cost in the Brazilian economy – SELIC Basic Interest Rate set by the Banco Central do Brasil (Central Bank of Brazil) which represents the expected return of a low-risk investment fund in Brazil. Since the SELIC is a nominal interest rate, the Financial Analysis is developed in nominal terms, excluding income taxes. This is a very conservative benchmark, since it does not include any risk adjustment. The nominal SELIC value selected is among the lowest values in the latest years 10.25%. All values of financial parameters are reported below²⁷:

²⁷ All data used in for the financial analysis are the latest available information when preparing the financial analysis in 2010. The targeted start date for the project was then 01/01/2011.

- Investment analysis is conducted over a period of 21 years (until 2030) based on the expected lifetime of the project ^{28,29}
- Inflation rate: 4.5%³⁰
- Sales taxes³¹5. In order to be conservative, it has been included only the Federal sale taxes (PIS and COFINS), excluding other state taxes such as ICMS or municipal taxes:
 - PIS (Profit Participation Contribution): 1.65%
 - COFINS (Social Security Financing Contribution): 7.60%
- Benchmark is equivalent to the SELIC rate: 10.25% (June, 9, 2010)³²
- Exchange rate used for the investment analysis: 3.97 BRL/EUR³³
- Generation capacity: maximum generation capacity is 28.520 MW. Units in service will be the following:
 - 2019: 10 units X 1.426 MW, total 14.260 MW
 - 2020: 12 units X 1.426 MW, total 17.112 MW
 - 2021: 16 units X 1.426 MW, total 22.816 MW
 - 2022: 18 units X 1.426 MW, total 25.668 MW
 - 2023-2030: 20 units X 1.426 MW, total 28.520 MW
- Electricity price: 170.00 R\$/MWh³⁴
- Generation of electricity in 2019 will be 118,672 MWh/year
- Generation of electricity in 2020 will be 142,406 MWh/year
- Generation of electricity in 2021 will be 189,875 MWh/year
- Generation of electricity in 2022 will be 213,609 MWh/year
- And from 2023 to 2030, the generation of electricity will be 237,343 MWh/year.

²⁸ Project defined as biogas capture, generation of electricity and/or gas flaring.

²⁹ Lifetime of equipment, Source: spec ZTOF JZ.pdf

³⁰ Source: Target inflation rate for 2010 fixed by the government (COPOM). Page consulted in October 2010. <http://www.bcb.gov.br/>

³¹ Source: Brazilian Tax office (Ministério da Fazenda)

³² SELIC Target SELIC rate fixed by the government (COPOM) in the 151-meeting held on June 9,2010. Page assessed in October 2010. <http://www.bcb.gov.br/?COPOMJUROS>

³³ Bank of Brazil, February 2nd, 2018.

³⁴ Based on commercial proposal.

- Investment³⁵
 - Pipelines, wellheads and Drill: R\$ 4,422,533
 - Biogas plant (blowers, pre-treatment, flare): R\$ 3,339,000
 - Group motor including engines, construction of the plant, connection, etc:
 - Year 2018: R\$ 8,105,000
 - Year 2019: R\$ 25,879,796
 - Year 2020: R\$ 4,869,867
 - Year 2021: R\$ 9,739,733
 - Year 2022: R\$ 4,869,867
 - Year 2023: R\$ 4,869,867
- Operation and Maintenance³⁶
 - O&M electricity system: 300,000 R\$/year (fixed) and 100 R\$/MWh.
 - O&M LFG system costs: 354,240 R\$/year.
 - Administrative costs: 180,000 R\$/year
 - Insurance costs: 0.177% of investment/y.
- Overhaul (necessary after 60,000 hours of operation)³⁷
 - In 2026, for 10 engines is estimated at: R\$ 9,832,771
 - In 2027, for 10 engines is estimated at: R\$ 2,055,049
 - In 2028, for 10 engines is estimated at: R\$ 4,110,098
 - In 2029, for 10 engines is estimated at: R\$ 2,055,049
 - In 2030, for 10 engines is estimated at: R\$ 2,055,049

Sub-step 3c. Calculation and comparison of financial indicators

Alternative Scenario 1: The scenario 1 is the project activity (capture and flare of LFG and power generation) undertaken without being registered as a CDM project activity.

³⁵ Source: Quotations 2010 Candeias (provided at validation and detailed in the financial analysis Excel spreadsheet).

³⁶ Source: Quotations 2010 Candeias (provided at validation and detailed in the Financial analysis Excel spreadsheet).

³⁷ Source: Quotations 2010 Candeias (provided at validation and detailed in the Financial analysis Excel spreadsheet).

Economic calculation for Landfill gas extraction project at Candeias landfill With income from electricity production																						
All economic values are in nominal terms																						
Taxes																						
Sales taxes																						
PIS	1.65%																					
COFINS	7.60%																					
Inflation rate	4.50%	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cumulative inflation		1.045	1.092	1.141	1.193	1.246	1.302	1.361	1.422	1.486	1.553	1.623	1.696	1.772	1.852	1.935	2.022	2.113	2.208	2.308	2.412	
Gas utilization with electricity production																						
Selling price of electricity	170.0 R\$/MWh																					
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
number of installed Group generators											10	12	16	18	20	20	20	20	20	20	20	20
Electricity price (R\$/MWh)											170.0	177.7	185.6	194.0	202.7	211.9	221.4	231.3	241.8	252.6	264.0	275.9
Electricity produced (MWh)											118.672	142.406	189.875	213.609	237.343	237.343	237.343	237.343	237.343	237.343	237.343	237.343
Income statement (R\$)																						
Gross income from electricity production											20,174,192	25,298,437	35,249,156	41,439,789	48,116,199	50,261,428	52,544,093	54,968,177	57,539,463	59,961,539	62,659,808	65,479,499
Sales taxes																						
PIS											1,866,113	2,340,105	3,260,547	3,831,180	4,450,748	4,651,032	4,860,129	5,079,043	5,307,600	5,546,442	5,796,032	6,056,834
COFINS											332,874	417,424	581,611	683,757	793,817	829,644	866,978	905,992	946,761	989,365	1,033,887	1,080,412
Net Income											18,308,080	22,958,332	31,988,609	37,606,608	43,665,451	45,610,396	47,683,964	49,829,533	52,071,862	54,415,096	56,963,776	59,422,665
Costs																						
Administrative costs		1,680,725	1,817,791	1,945,433	2,048,180	2,155,630	2,269,349	2,393,104	2,478,508	15,233,557	16,113,799	17,234,465	18,441,812	19,746,938	21,149,038	22,649,863	24,249,803	25,949,453	27,749,413	29,649,413	31,649,413	33,749,413
O&M electricity costs		188,100	196,565	205,410	214,653	224,313	234,407	244,955	255,978	267,497	279,534	292,114	305,259	318,995	333,350	348,351	364,027	380,408	397,535	415,415	434,109	453,656
Extraordinary maintenance cost for gas engines										12,567,172	15,194,934	21,062,405	24,718,696	28,661,402	29,951,165	31,298,968	32,707,421	34,179,255	35,713,322	37,319,601	39,000,208	40,769,861
O&M UFG costs		625,994	654,164	683,601	714,363	746,510	780,102	815,207	851,891	2,412,520	3,025,300	4,215,251	4,955,554	5,753,949	6,612,877	7,539,456	8,546,212	9,686,691	10,969,467	12,395,904	13,976,604	15,713,138
Insurance costs		7,941	24,773	26,770	28,617	30,607	32,750	35,061	37,553	40,241	114,279	134,600	171,192	195,591	220,356	230,272	240,634	251,463	262,778	274,603	286,961	299,869
Depreciation		858,690	942,290	1,029,652	1,090,547	1,154,181	1,221,990	1,293,990	1,371,336	348,127	5,539,752	6,530,096	8,495,150	9,487,001	9,411,115	4,155,856	3,099,013	1,064,468	-	-	-	-
EBIT		(1,680,725)	(1,817,791)	(1,945,433)	(2,048,180)	(2,155,630)	(2,409,249)	(1,443,104)	(1,478,508)	3,072,523	(1,195,467)	(245,856)	(1,030,243)	(751,487)	(298,467)	5,366,862	(2,980,544)	7,279,528	6,756,904	9,300,969	9,811,089	10,361,889
Cash Flow Analysis (R\$)																						
EBIT + Depreciation		(822,035)	(875,503)	(915,781)	(957,634)	(1,001,439)	(1,047,200)	(1,095,223)	(1,145,422)	3,420,650	4,344,286	6,284,240	7,455,507	8,735,513	9,112,648	9,522,718	118,469	8,343,996	6,756,904	9,300,969	9,811,089	10,361,889
Investment		4,293,450	8,343,000	436,810	304,473	348,174	337,492	347,404	363,089	379,438	26,276,298	5,284,212	16,172,774	5,322,342	4,869,867	0	0	0	0	0	0	0
UFG collection system		914,450	418,000	436,810	304,473	318,174	312,492	347,404	363,089	379,438	396,503	414,345	432,991	452,475	-	-	-	-	-	-	-	-
Flare		3,339,000																				
UFG Plant			8,105,000																			
Electricity generation plant											25,879,796	4,869,867	9,739,733	4,869,867	4,869,867							
Net Cash Flow of project		-4,293,450	-8,343,000	-4,313,311	-1,220,293	-1,279,807	-3,393,921	-1,394,713	-1,458,312	-1,524,850	32,801,448	8,99,916	3,868,484	2,133,565	3,861,647	9,112,648	9,522,718	118,469	8,343,996	6,756,904	9,300,969	9,811,089
IRR for the total project	1.42%																					

Alternative Scenario 4

Alternative scenario 4 (atmospheric release of the landfill gas) is the continuation of the current practice, which is in compliance with all applicable regulations and policies; and was deemed the most plausible alternative to the project activity. As explained above, the alternative scenario 4 does not generate any revenues, but only expenditures.

Therefore, the IRR = 10.25%.

Sub-step 3d. Sensitivity analysis

The sensitivity analysis was performed varying the electricity tariff (revenues), the capital expenses (CapEx) and operational and maintenance costs (O&M) for the alternative scenarios 1 and 4. All parameters ranging from -10% to +10%, as the result presented below:

Item	Variation	IRR – scenario 1	IRR – scenario 4
	%	(%)	(%)
CapEX	-10.00	2.74	10.25
	10.00	0.19	10.25
Revenues	-10.00	-12.53	10.25
	10.00	7.99	10.25
O&M	-10.00	7.26	10.25

	10.00	-9.19	10.25
Base Case	0.00	1.42	10.25

As presented above, the project IRRs in scenario 1 are always less than benchmark (10.25%) in all sensitivity analyses.

Based on the 2nd investment decision:

Breakeven point

To ensure the additionality of this project activity, the project proponents varied the three identified parameters (CapEx, Revenues and O&M) until each of them reached the benchmark (i.e. IRR = benchmark). The results are presented below for alternative scenario 1 and the spreadsheet was provided to the audit team:

Parameter	Breakeven point
	Alternative Scenario 1
Capex variation until reach the benchmark (%)	-53.20%
Revenue until the benchmark (%)	14.74%
O&M variation until the benchmark (%)	-16.91%

Capital Expenditures (CapEx) – To reach the benchmark, the Capital Expenditures should be reduced in the **scenario alternative 1** in 53.20%. This result is unlikely. Consequently, this scenario is unrealistic.

Revenues – These values should be increased in the **scenario alternative 1** in 14.74%. This scenario is extremely unlikely to happen in the future based on the average electricity auction price results was 140.29 BRL/MWh (lower than 170 BRL/MWh of the electricity price of the project activity) according to historical auction data from Brazilian Electricity Regulatory Agency (ANEEL)³⁸. Therefore, this scenario is unrealistic.

³⁸ <https://www.aneel.gov.br/resultados-de-leiloes> (Regulated Contracting Market - ACR)

O&M – Also, to reach the benchmark, the O&M shall be reduced in the scenario alternative 1 in 16.91%. Thus, the PPs deemed this situation to be unlikely to happen in the future since the O&M always increases. Consequently, this scenario is unrealistic.

Outcome of Step 3

A short list ranking the alternative scenarios of the project activity is presented below according to the best IRR (financial indicator), taking into account the results of the sensitivity analyses.

Alternatives	Results
Scenario 4	Best scenario
Scenario 1	Worst scenario

As a result, the sensitivity analysis was conclusive, and the most financially attractive alternative is scenario 4.

Therefore, it seems reasonable to conclude that alternative scenario 1 is unlikely to be the most financially attractive scenario.

Step 4. Common practice analysis

According to “Guidelines on common practice”, the common practice analysis establishes the following items below:

- **Applicable geographical area:** Brazil is the largest country in South America and the world's fifth largest country in the world. Therefore, the entire host country (Brazil) is considered suitable for this analysis;
- **Measure:** The project activity covers methane destruction;
- **Output:** the service delivers by the project is electricity in the grid (MWh);
- **Technology:** the technology used in the project is electricity generation through biogas combustion in group generators.

The common practice analysis consists of the following steps:

Step 1: Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.

The installed capacity of the project is 28.52 MW. Then, the output range of the project activity is from 14.26 to 42.78 MW.

Step 2: *In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all} . Registered CDM project activities shall not be included in this step.*

The list with all plants is in Annex 3, item 4. The total number of the plants is 228. Then, $N_{all} = 228$.

Step 3: Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number N_{diff} .

The technology of the project activity is electricity generation through biogas. All projects in Brazil which generates electricity through biogas are registered CDM Projects and therefore, there is no project with the same technologies as the project activity.

Then, $N_{diff} = 228$ or $N_{all} = N_{diff}$.

Step 4: Calculate factor $F = 1 - N_{diff}/N_{all}$ representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity.

$$F = 1 - \left(\frac{N_{diff}}{N_{all}} \right)$$

$$F = 1 - (228/228)$$

Therefore, $F = 0$ and $N_{all} - N_{diff} = 0$.

According to Guidelines on common practice: "the proposed project activity is a "common practice" within a sector in the applicable geographical area if the factor F is greater than 0.2 and $N_{all} - N_{diff}$ is greater than 3".

Outcome of common practice analysis.

The project activity is not a common practice because the factor $F = 0$ and the $N_{all} - N_{diff} = 0$.

B.5.1 Prior Consideration

>>

Not applicable.

B.5.2 Ongoing Financial Need

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Not applicable. In accordance with the GS4GG "Guide to completing the PDD", "(..) *This information need only be included at Design Certification Renewal (...)*".

Nonetheless, details about a complementary financial analysis (which is presented in the spreadsheet titled "*Complementary Financial Analysis DEV277.xls*" (which is being submitted along with this revised PDD)) are also included in Appendix 5 of this PDD, in order to demonstrate that the project indeed faces a risk of discontinuation without carbon revenues from the commercialization of GS VERs to be issued by the project activity.

B.6. Sustainable Development Goals (SDG) outcomes

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Relevant Target/Indicator for each of the three SDGs

Sustainable Development Goals Targeted	Most relevant SDG Target	SDG Impact
		Indicator (Proposed or SDG Indicator)
13 Climate Action	13.2: Integrate climate change measures into national policies, strategies and planning	SDG Impact: Reduction in GHGs emissions

(mandator y)		Indicator: Amount of GHG emissions avoided or sequestered
7		SDG Impact: Renewable energy generation
Affordable and Clean Energy	7.2: By 2030, increase substantially the share of renewable energy in the global energy mix	Indicator: Total electricity produced: Renewable
8 Decent work and Economic Growth	8.5 By 2030, achieve full and productive employment for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	SDG Impact: Increased employment opportunities
		Indicator: Total number of jobs

B.6.1 Explanation of methodological choices/approaches for estimating the SDG Impact

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7 Access to affordable, reliable, sustainable and modern energy for all:

High Positive Impact: The project activity is a renewable energy project activity and will displace fossil-generated power. This will increase the share of renewable energy in the energy mix. According to International Energy Agency statistics (IEA, 2020)³⁹, coal and natural gas are still dominant sources of electricity generation, with 60% a share.

³⁹ <https://www.iea.org/fuels-and-technologies/electricity>

8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work:

High Positive Impact: The project will create employment opportunities. These job opportunities will require both highly qualified low qualified people. As a general principle, employment recruitments will be made mostly from the nearby regions and municipalities, especially for the labor-intensive jobs.

13 Climate Action:

High Positive Impact: The Project Activity will result in CO₂ emission reduction by displacing fossil power generation with renewable power generation and avoidance of methane.

The emission reductions resulting from the project activity are calculated according to the latest version of ACM0001 "Flaring or Use of Landfill Gas" and applicable tools. The calculation approaches for baseline emissions, project emissions and emission reductions are explained below:

Baseline emission calculation

The baseline emission was calculated according to the following formula:

$$BE_y = BE_{CH_4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}$$

Where:

BE_y	Baseline emissions in year y (tCO ₂ e/yr)
$BE_{CH_4,y}$	Baseline emissions of methane from the SWDS in year y (tCO ₂ e/yr)
$BE_{EC,y}$	Baseline emissions associated with electricity generation in year y (tCO ₂ /yr)
$BE_{HG,y}$	Baseline emissions associated with heat generation in year y (tCO ₂ /yr)
$BE_{NG,y}$	Baseline emissions associated with natural gas use in year y (tCO ₂ /yr)

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

Therefore, $BE_y = BE_{CH_4,y} + BE_{EC,y}$

Step (A): Baseline emissions of methane from the SWDS ($BE_{CH_4,y}$)

$$BE_{CH_4} = \left((1 - OX_{top_layer}) \times F_{CH_4,PJ,y} - F_{CH,BL,y} \right) \times GWP_{CH_4}$$

Where:

$BE_{CH_4,y}$	Baseline emissions of LFG from the SWDS in year y (tCO ₂ e/yr)
OX_{top_layer}	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)
$F_{CH_4,PJ,y}$	Amount of methane in the LFG which is flared and/or used in the project activity in year y (tCH ₄ /yr)
$F_{CH_4,BL,y}$	Amount of methane in the LFG that would be flared in the baseline in year y (tCH ₄ /yr)
GWP_{CH_4}	Global warming potential of CH ₄ (tCO ₂ e/tCH ₄)

Step A.1: Ex-post determination of $F_{CH_4,PJ,y}$

During the crediting period, the $F_{CH_4,PJ,y}$ will be determined as follows:

$$F_{CH_4,PJ,y} = F_{CH_4,flared,y} + F_{CH_4,EL,y} + F_{CH_4,HG,y} + F_{CH_4,NG,y}$$

Where:

$F_{CH_4,PJ,y}$	Amount of methane in the LFG which is flared and/or used in the project activity in year y (tCH ₄ /yr)
$F_{CH_4,flared,y}$	Amount of methane in the LFG which is destroyed by flaring in year y (tCH ₄ /yr)
$F_{CH_4,EL,y}$	Amount of methane in the LFG which is used for electricity generation in year y (tCH ₄ /yr)
$F_{CH_4,HG,y}$	Amount of methane in the LFG which is used for heat generation in year y (tCH ₄ /yr)
$F_{CH_4,NG,y}$	Amount of methane in the LFG which is sent to the natural gas distribution network and/or dedicated pipeline and/or to the trucks in year y (tCH ₄ /yr)

As the project flares LFG, generate electricity, the $F_{CH_4,HG,y} = 0$ and $F_{CH_4,NG,y} = 0$. Thus, the equation is:

$$F_{CH_4,PJ,y} = F_{CH_4,flared,y} + F_{CH_4,EL,y}$$

$F_{CH_4,EL,y}$ is determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" and monitoring the working hours of the power plant(s), boiler(s), air heater(s), glass melting furnace(s) and kiln(s), so that no emission reduction are claimed for methane destruction during non-working hours. This is taken into account by monitoring the hours that the equipment utilizing the LFG is operating in year y ($Op_{j,h,y}$).

The following requirements apply:

- (a) As per the gaseous stream tool, if the LFG is used for multiple purposes (e.g. flaring or energy generation), and all methane destruction devices are verified to be operational (e.g. by means of flame detectors records, energy generated), a single flow meter may be used to record the flow into multiple destruction devices. The destruction efficiency of the least efficient among the destruction devices shall be used as the destruction efficiency for all destruction devices monitored by this flow meter. If there are any periods for which one or more destruction devices are not operational, paragraph 5 (a) and (b) of the Appendix of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" tool shall be followed;
- (b) CH_4 is the greenhouse gas for which the mass flow should be determined;
- (c) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations (3) or (17) in the tool);
- (d) The mass flow should be calculated on an hourly basis for each hour h in year y ;
- (e) The mass flow calculated for hour h is 0 if the equipment is not working in hour h ($Op_{j,h} = \text{not working}$), the hourly values are then summed to a yearly unit basis.

The amount of methane destroyed by flaring ($F_{CH_4,flared,y}$) will be determined as follows:

$$F_{CH_4, flared, y} = F_{CH_4, sent_flare, y} - \frac{PE_{flare, y}}{GWP_{CH_4}}$$

Where:

$F_{CH_4, flared, y}$	Amount of methane in the LFG which is destroyed by flaring in year y (tCH ₄ /yr)
$F_{CH_4, sent_flare, y}$	Amount of methane in the LFG which is sent to the flare in year y (tCH ₄ /yr)
$PE_{flare, y}$	Project emissions from flaring of the residual gas stream in year y (tCO ₂ e/yr)
GWP_{CH_4}	Global warming potential of CH ₄ (tCO ₂ e/tCH ₄)

$F_{CH_4, sent_flare, y}$ will be determined directly using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, applying the requirements described below. The tool shall be applied to the gaseous stream flowing in the LFG delivery pipeline to each flare.

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

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

And

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

Option A

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

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

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

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

With

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

Where:

- $F_{i,t}$ Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)
- $V_{t,db}$ Volumetric flow of the gaseous stream in time interval t on a dry basis (m³ dry gas/h)
- $v_{i,t,db}$ Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m³ gas i /m³ dry gas)
- $\rho_{i,t}$ Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i /m³ gas i)
- P_t Absolute pressure of the gaseous stream in time interval t (Pa)
- MM_i Molecular mass of greenhouse gas i (kg/kmol)
- R_u Universal ideal gases constant (8,314 Pa.m³ /kmol.K)
- T_t Temperature of the gaseous stream in time interval t (K)

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

Option B

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

$$V_{t,db} = V_{t,wb} / (1 + v_{H_2O,t,db})$$

Where:

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

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

$$v_{H_2O,t,db} = \frac{m_{H_2O,t,db} * MM_{t,db}}{MM_{H_2O}}$$

Where:

$v_{H_2O,t,db}$	Volumetric fraction of H ₂ O in the gaseous stream in time interval t on a dry basis (m ³ H ₂ O/m ³ dry gas)
$m_{H_2O,t,db}$	Absolute humidity in the gaseous stream in time interval t on a dry basis (kg H ₂ O/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_{H_2O}	Molecular mass of H ₂ O (kg H ₂ O/kmol H ₂ O)

The absolute humidity of the gaseous stream ($m_{H_2O,t,db}$) will be determined using Option 2 (simplified calculation without measurement of the moisture content):

Option 2: Simplified calculation without measurement of the moisture content

This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation⁴⁰.

Concerning the project activity, the conservative situation will be to assume that the gaseous stream is saturated, then $m_{H_2O,t,db}$ is assumed to equal the saturation absolute humidity ($m_{H_2O,t,db,sat}$) and calculated using the following equation.

⁴⁰ An assumption that the gaseous stream is saturated is conservative for the situation that the mass flow of greenhouse gas i is underestimated (applicable for calculating baseline emissions). Conversely, an assumption that the gas stream is dry is conservative for the situation that the greenhouse gas i is overestimated (applicable for calculating project emissions).

$$m_{\text{H}_2\text{O},t,\text{db},\text{Sat}} = \frac{p_{\text{H}_2\text{O},t,\text{Sat}} * \text{MM}_{\text{H}_2\text{O}}}{(P_t - p_{\text{H}_2\text{O},t,\text{Sat}}) * \text{MM}_{t,\text{db}}}$$

Where:

$m_{\text{H}_2\text{O},t,\text{db},\text{sat}}$	Saturation absolute humidity in time interval t on a dry basis (kg H ₂ O/kg dry gas)
$p_{\text{H}_2\text{O},t,\text{Sat}}$	Saturation pressure of H ₂ O at temperature T_t in time interval t (Pa)
T_t	Temperature of the gaseous stream in time interval t (K)
P_t	Absolute pressure of the gaseous stream in time interval t (Pa)
$\text{MM}_{\text{H}_2\text{O}}$	Molecular mass of H ₂ O (kg H ₂ O/kmol H ₂ O)
$\text{MM}_{t,\text{db}}$	Molecular mass of the gaseous stream in a time interval t on a dry basis (kg dry gas/kmol dry gas)

Parameter $\text{MM}_{t,\text{db}}$ is estimated using the following equation.

$$\text{MM}_{t,\text{db}} = \sum_k (v_{k,t,\text{db}} * \text{MM}_k)$$

Where:

$\text{MM}_{t,\text{db}}$	Molecular mass of the gaseous stream in time interval t on a dry basis (kg dry gas/kmol dry gas)
$v_{k,t,\text{db}}$	Volumetric fraction of gas k in the gaseous stream in time interval t on a dry basis (m ³ gas k /m ³ dry gas)
MM_k	Molecular mass of gas k (kg/kmol)
k	All gases (except H ₂ O) contained in the gaseous stream (e.g. N ₂ and CH ₄) See available simplification below:

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

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

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

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

STEP 2: Determination of the flare efficiency;

STEP 3: Calculation of project emissions from flaring.

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

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

Parameter	SI Unit	Description
$F_{\text{CH}_4,m}$	kg	Mass flow of methane in the residual gaseous stream in the minute m

The following requirements apply:

- The gaseous stream tool shall be applied to the residual gas;
- The flow of the gaseous stream shall be measured continuously;
- 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 ;

$F_{\text{CH}_4,m}$, which is measured as the mass flow during minute m , shall then be used to determine the mass of methane in kilograms fed to the flare in minute m ($F_{\text{CH}_4,\text{RG},m}$). $F_{\text{CH}_4,m}$ shall be determined on a dry basis.

The option chosen for the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" by the project participant is option A. However, during the project

operational monitoring, if not demonstrated that the temperature of the gaseous stream (T_t) is less than 60°C (dry basis), then the flow measurement should be assumed to be on a wet basis and the option B should be applied instead.

Step 2: Determination of flare efficiency

According to “Project emissions from flaring”, the flare efficiency will be calculated as follows:

Open flare

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

Enclosed flares

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

Option A: Apply a default value for flare efficiency

Option B: Measure the flare efficiency.

The project participant has chosen Option B.

In the present project activity, the flare efficiency for minute m ($\eta_{flare,m}$) will be determined by Option B.2 of the methodological tool “Project emissions from flaring”, where the flare efficiency is measured in each minute or, if option B.2. measurements are not available, Option A of the methodological tool “Project emissions from flaring” will be used. Both options are described below:

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

Option A: Default value

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

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

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

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

Option B: Measured flare efficiency

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

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

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

In applying Option B, the project developers chose to determine $n_{flare,calc,m}$ using [Option B.2](#) where the measurement of flare efficiency are conducted in each minute.

Option B.2: Measurement of flare efficiency in each minute

The flare efficiency ($\eta_{flare,calc,m}$) is determined based on monitoring the methane content in the exhaust gas, the residual gas, and the air used in the combustion process during the minute m in year y , as follows:

$$\eta_{flare,calc,m} = 1 - \frac{F_{CH4,EG,m}}{F_{CH4,RG,m}}$$

Where:

$\eta_{flare,calc,m}$ Flare efficiency in the minute m

$F_{CH_4,EG,m}$	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the minute m (kg)
$F_{CH_4,RG,m}$	Mass flow of methane in the residual gas on a dry basis at reference conditions in the minute m (kg)

$F_{CH_4,EG,t}$ is measured according to an appropriate national or international standard. $F_{CH_4,RG,t}$ is calculated according to Step 1, and consists of the sum of methane flow in the minutes m that make up the time period t .

Step 2.1: Determine the methane mass flow in the exhaust gas on a dry basis

The mass flow of methane in the exhaust gas is determined based on the volumetric flow of the exhaust gas and the measured concentration of methane in the exhaust gas, as follows:

$$F_{CH_4,EG,m} = V_{EG,m} \times fc_{CH_4,EG,m} \times 10^{-6}$$

Where:

$F_{CH_4,EG,m}$	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the minute m (kg)
$V_{EG,m}$	Volumetric flow of the exhaust gas of the flare on a dry basis at reference conditions in minute m (m ³)
$fc_{CH_4,EG,m}$	Concentration of methane in the exhaust gas of the flare on a dry basis at reference conditions in minute m (mg/m ³)

Step 2.2: Determine the volumetric flow of the exhaust gas ($V_{EG,m}$)

Determine the average volume flow of the exhaust gas in minute m based on a stoichiometric calculation of the combustion process. This depends on the chemical composition of the residual gas, the amount of air supplied to combust it and the composition of the exhaust gas. It is calculated as follows:

$$V_{EG,m} = Q_{EG,m} \times M_{RG,m}$$

Where:

$V_{EG,m}$	Volumetric flow of the exhaust gas of the flare on a dry basis at reference conditions in minute m (m ³)
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$Q_{EG,m}$	Volume of the exhaust gas on a dry basis at reference conditions per kilogram of residual gas on a dry basis at reference conditions in minute m (m^3 exhaust gas/kg residual gas)
$M_{RG,m}$	Mass flow of the residual gas on a dry basis at reference conditions in the minute m (kg)

Step 2.3: Determine the mass flow of the residual gas ($M_{RG,m}$)

Project developers may select to monitor the mass flow of the residual gas in minute m directly (see monitored parameter $M_{RG,m}$) or, according to the procedure given in this step, calculate $M_{RG,m}$ based on the volumetric flow and the density of the residual gas. The density of the residual gas is determined based on the volumetric fraction of all components in the gas.

$$M_{RG,m} = \rho_{RG,ref,m} \times V_{RG,m}$$

Where:

$M_{RG,m}$	Mass flow of the residual gas on a dry basis at reference conditions in the minute m (kg)
$\rho_{RG,ref,m}$	Density of the residual gas at reference conditions in minute m (kg/m^3)
$V_{RG,m}$	Volumetric flow of the residual gas on a dry basis at reference conditions in the minute m (m^3)

and

$$\rho_{RG,ref,m} = \frac{P_{ref}}{\frac{R_u}{MM_{RG,m}} \times T_{ref}}$$

$\rho_{RG,ref,m}$	Density of the residual gas at reference conditions in minute m (kg/m^3)
P_{ref}	Atmospheric pressure at reference conditions (Pa)
R_u	Universal ideal gas constant ($Pa \cdot m^3 / kmol \cdot K$)
$MM_{RG,m}$	Molecular mass of the residual gas in minute m ($kg/kmol$)
T_{ref}	Temperature at reference conditions (K)

Use the equation below to calculate $MM_{RG,m}$, when applying this equation, project developers may choose to either a) use the measured volumetric fraction of each component i of the residual gas, or b) as a simplification, measure the volumetric

fraction of methane and consider the difference to 100% as being nitrogen (N₂). The same equation applies, irrespective of which option is selected.

$$MM_{RG,m} = \sum (v_{i,RG,m} \times MM_i)$$

MM _{RG,m}	Molecular mass of the residual gas in minute <i>m</i> (kg/kmol)
MM _i	Molecular mass of residual gas component <i>i</i> (kg/kmol)
V _{i,RG,m}	Volumetric fraction of component <i>i</i> in the residual gas on a dry basis at reference conditions in the hour <i>h</i>
<i>i</i>	Components of the residual gas. If Option (a) is selected to measure the volumetric fraction, then <i>i</i> = CH ₄ , CO, CO ₂ , O ₂ , H ₂ , H ₂ S, NH ₃ , N ₂ or if Option (b) is selected then <i>i</i> = CH ₄ and N ₂

Step 2.4: Determine the volume of the exhaust gas on a dry basis at reference conditions per kilogram of residual gas (Q_{EG,m})

Q_{CO₂,EG,m} shall be determined as follows:

$$Q_{EG,m} = Q_{CO_2,EG,m} + Q_{O_2,EG,m} + Q_{N_2,EG,m}$$

Q _{EG,m}	Volume of the exhaust gas on a dry basis per kg of residual gas on a dry basis at reference conditions in the minute <i>m</i> (m ³ /kg residual gas)
Q _{CO₂,EG,m}	Quantity of CO ₂ volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute <i>m</i> (m ³ /kg residual gas)
Q _{N₂,EG,m}	Quantity of N ₂ volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute <i>m</i> (m ³ /kg residual gas)
Q _{O₂,EG,m}	Quantity of O ₂ volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute <i>m</i> (m ³ /kg residual gas)

with

$$Q_{O_2,EG,m} = n_{O_2,EG,m} \times VM_{ref}$$

Q _{O₂,EG,m}	Quantity of O ₂ volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute <i>m</i> (m ³ /kg residual gas)
n _{O₂,EG,m}	Quantity of O ₂ (moles) in the exhaust gas per kg of residual gas flared on a dry basis at reference conditions in minute <i>m</i> (kmol/kg residual gas)

VM_{ref} Volume of one mole of any ideal gas at reference temperature and pressure ($m^3/kmol$)

$$Q_{N_2,EG,m} = VM_{ref} \times \left\{ \frac{MF_{N,RG,m}}{2 \times AM_N} + \left(\frac{1 - v_{O_2,air}}{v_{O_2,air}} \right) \times [F_{O_2,RG,m} + n_{O_2,EG,m}] \right\}$$

Where:

$Q_{N_2,EG,m}$ Quantity of N_2 (volume) in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m^3/kg residual gas)

VM_{ref} Volume of one mole of any ideal gas at reference temperature and pressure ($m^3/kmol$)

$MF_{N,RG,m}$ Mass fraction of nitrogen in the residual gas in the minute m

AM_N Atomic mass of nitrogen ($kg/kmol$)

$v_{O_2,air}$ Volumetric fraction of O_2 in air (dimensionless)

$F_{O_2,RG,m}$ Stoichiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in minute m ($kmol/kg$ residual gas)

$n_{O_2,EG,m}$ Quantity of O_2 (moles) in the exhaust gas per kg of residual gas flared on a dry basis at reference conditions in minute m ($kmol/kg$ residual gas)

$$Q_{CO_2,EG,m} = \frac{MF_{C,RG,m}}{AM_C} \times VM_{ref}$$

Where:

$Q_{CO_2,EG,m}$ Quantity of O_2 (moles) in the exhaust gas per kg of residual gas flared on a dry basis at reference conditions in minute m ($kmol/kg$ residual gas)

$v_{O_2,EG,m}$ Volumetric fraction of O_2 in the exhaust gas on a dry basis at reference conditions in the minute m $v_{O_2,air}$ = Volumetric fraction of O_2 in the air

$MF_{C,RG,m}$ Mass fraction of carbon in the residual gas in the minute m

AM_C Atomic mass of carbon ($kg/kmol$)

$MF_{N,RG,m}$ Mass fraction of nitrogen in the residual gas in the minute m

AM_N Atomic mass of nitrogen ($kg/kmol$)

$F_{O_2,RG,m}$ Stoichiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in minute m ($kmol/kg$ residual gas)

$$n_{O_2,EG,m} = \frac{v_{O_2,EG,m}}{\left(1 - (v_{O_2,EG,m}/v_{O_2,air})\right)} \times \left[\frac{MF_{C,RG,m}}{AM_C} + \frac{MF_{N,RG,m}}{2 \times AM_N} + \left(\frac{1 - v_{O_2,air}}{v_{O_2,air}} \right) \times F_{O_2,RG,m} \right]$$

Where:

$n_{O_2,EG,m}$	O ₂ (moles) in the exhaust gas per kg of residual gas flared on a dry basis at reference conditions in minute m (kmol/kg residual gas)
$v_{O_2,EG,m}$	Volumetric fraction of O ₂ in the exhaust gas on a dry basis at reference conditions in the minute m
$v_{O_2,air}$	Volumetric fraction of O ₂ in the air
$MF_{C,RG,m}$	Mass fraction of carbon in the residual gas in the minute m
AM_C	Atomic mass of carbon (kg/kmol)
$MF_{N,RG,m}$	Mass fraction of nitrogen in the residual gas in the minute m
AM_N	Atomic mass of nitrogen (kg/kmol)
$F_{O_2,RG,m}$	Stoichiometric quantity of moles of O ₂ required for a complete oxidation of one kg residual gas in minute m (kmol/kg residual gas)

$$F_{O_2,RG,m} = \frac{MF_{C,RG,m}}{AM_C} + \frac{MF_{H,RG,m}}{4AM_H} - \frac{MF_{O,RG,m}}{2AM_O}$$

Where:

$F_{O_2,RG,m}$	Stoichiometric quantity of moles of O ₂ required for a complete oxidation of one kg residual gas in minute m (kmol/kg residual gas)
$MF_{C,RG,m}$	Mass fraction of carbon in the residual gas in the minute m
AM_C	Atomic mass of carbon (kg/kmol)
$MF_{O,RG,m}$	Mass fraction of oxygen in the residual gas in the minute m
AM_O	Atomic mass of oxygen (kg/kmol)
$MF_{H,RG,m}$	Mass fraction of hydrogen in the residual gas in the minute m
AM_H	Atomic mass of hydrogen (kg/kmol)

Determine the mass fractions of carbon, hydrogen, oxygen and nitrogen in the residual gas, using the volumetric fraction of component i in the residual gas and applying the

equation below. In applying this equation, the project developers may choose to either a) use the measured volumetric fraction of each component i of the residual gas, or (b) as a simplification, measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2). The same equation applies, irrespective of which option is selected.

$$MF_{j,RG,m} = \frac{\sum_i V_{i,RG,m} \times AM_j \times NA_{j,i}}{MM_{RG,m}}$$

Where:

$MF_{j,RG,m}$	Mass fraction of element j in the residual gas in the minute m
$V_{i,RG,m}$	Volumetric fraction of component i in the residual gas on a dry basis in the minute m
AM_j	Atomic mass of element j (kg/kmol)
$NA_{j,i}$	Number of atoms of element j in component i
$MM_{RG,m}$	Molecular mass of the residual gas in minute m (kg/kmol)
j	elements C, O, H and N
i	Component of residual gas. If Option (a) is selected to measure the volumetric fraction, then $i = CH_4, CO, CO_2, O_2, H_2, H_2S, NH_3, N_2$ or if Option (b) is selected then $i = CH_4$ and N_2

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 ($F_{CH_4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

$$PE_{flare,y} = GWP_{CH_4} \times \sum_{m=1}^{525600} F_{CH_4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3}$$

Where:

$PE_{flare,y}$	Project emissions from flaring of the residual gas in year y (tCO ₂ e)
GWP_{CH_4}	Global warming potential of methane valid for the commitment period (tCO ₂ e/tCH ₄)
$F_{CH_4,RG,m}$	Mass flow of methane in the residual gas in the minute m (kg)
$\eta_{flare,m}$	Flare efficiency in minute m

Table 3 – Parameters used in the Tool “Project emissions from flaring”

Parameter	Description	Value	Unit
P_{ref}	Atmospheric pressure at reference conditions	101,325	Pa
R_u	Universal ideal gas constant	0.008314472	Pa.m ³ /kmol.K
T_{ref}	Temperature at reference conditions	273.15	K
GWP_{CH_4}	Global warming potential of methane valid for the commitment period	28 ⁴¹	tCO ₂ /tCH ₄
$\rho_{CH_4,n}$	Density of methane at reference conditions	0.716	Kg/m ³

Step A.1.1: Ex-ante estimation of $F_{CH_4,PJ,y}$:

An ex-ante estimate of $F_{CH_4,PJ,y}$ is required to estimate baseline emission of methane from the SWDS in order to estimate the emission reductions of the proposed project activity in the completed GS4GG Transition request form + PDD. It is determined as follows:

$$F_{CH_4,PJ,y} = \eta_{PJ} \times BE_{CH_4,SWDS,y} / GWP_{CH_4}$$

Where:

$F_{CH_4,PJ,y}$	Amount of methane in the LFG which is flared and/or used in the project activity in year y (tCH ₄ /yr)
$BE_{CH_4,SWDS,y}$	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y (tCO ₂ e/yr)
η_{PJ}	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH_4}	Global warming potential of CH ₄ (tCO ₂ e/tCH ₄)

⁴¹ Default value used, according to IPCC Fifth Assessment Report (AR5). Available online:

<https://www.ipcc.ch/assessment-report/ar5/>

$BE_{CH_4,SWDS,y}$ is determined using the methodological tool “Emissions from solid waste disposal sites”. The calculation of $BE_{CH_4,SWDS,y}$, applying application A, according the tool is:

$$BE_{CH_4,SWDS,y} = \phi_y \cdot (1 - f_y) \cdot GWP_{CH_4} \cdot (1 - OX) \cdot \frac{16}{12} \cdot F \cdot DOC_{f,y} \cdot MCF_y \cdot \sum_{x=1}^y \sum_j W_{j,x} \cdot DOC_j \cdot e^{-k_j(y-x)} \cdot (1 - e^{-k_j})$$

Where:

$BE_{CH_4,SWDS,y}$	Baseline, project or leakage methane emissions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y (tCO ₂ e/yr)
x	Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period ($x = 1$) to year y ($x = y$).
y	Year of the crediting period for which methane emissions are calculated (Y is a consecutive period of 12 months)
$DOC_{f,y}$	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)
$W_{j,x}$	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t)
ϕ_y	Model correction factor to account for model uncertainties for year y
f_y	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
GWP_{CH_4}	Global Warming Potential of methane
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	Fraction of methane in the SWDS gas (volume fraction)
MCF_y	Methane correction factor for year y
DOC_j	Fraction of degradable organic carbon in the waste type j (weight fraction)
k_j	Decay rate for the waste type j (1 / yr)
j	Type of residual waste or types of waste in the MSW

According to ACM0001 methodology, the parameter f_y in the methodological tool “Emissions from solid waste disposal sites” shall be assigned a value of 0 (zero) because the amount of LFG that would have been captured and destroyed is already accounted for in equation 2 of this methodology. Also, according to ACM0001 methodology, the

parameter x begins with the year that the SWDS started receiving wastes (2010). For this reason, the parameter f_y and x will not be monitored.

Step A.2: Determination of $F_{CH_4,BL,y}$

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

In this situation:

$$F_{CH_4,BL,y} = F_{CH_4,BL,sys,y}$$

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:

$$F_{CH_4,BL,sys,y} = 20\% \times F_{CH_4,PJ,y}; \text{ or}$$

$$F_{CH_4,BL,y} = 20\% \times F_{CH_4,PJ,y}$$

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

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

Where:

$BE_{EC,y}$	Baseline emissions from electricity generation in year y (tCO ₂ /yr)
$EC_{BL,k,y} = EG_{PJ,y}$	Net amount of electricity generated using LFG in year y (MWh/yr)
$EF_{EL,k,y}$ ⁴²	Emission factor for electricity generation for source k in year y (tCO ₂ /MWh)

⁴² According to the "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion", $EF_{EL,k,y} = EF_{grid,CM,y}$.

$TDL_{k,y}$ Average technical transmission and distribution losses for providing electricity to source k in year y .

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

Emission Factor calculation

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

Step 1. Identify the relevant electric power system

For the purpose of determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g., the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

The Brazilian DNA published an official delineation of the project electricity system in Brazil, considering a national interconnected system.⁴³

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

Option I: Only grid power plants are included in the calculation.

The Brazilian DNA is responsible for calculating the emission factors and it is not included in calculation the off-grid power plants.

⁴³ According to Brazilian DNA Resolution n.8 published on 26/05/2008.

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.

The Brazilian DNA is responsible for calculating the OM emission factor in Brazil. It uses the method c) Dispatch data analysis OM.

For the dispatch data analysis OM, it is necessary to use the year in which the project activity displaces grid electricity and to update the emission factor annually during monitoring.

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

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

The emission factor is calculated as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_h EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}}$$

Where:

$EF_{grid,OM-DD,y}$	Dispatch data analysis operating margin CO ₂ emission factor in year y (tCO ₂ /MWh)
$EG_{PJ,h}$	Electricity displaced by the project activity in hour h of year y (MWh)
$EF_{EL,DD,h}$	CO ₂ emission factor for power units in the top of the dispatch order in hour h in year y (tCO ₂ /MWh)
$EG_{PJ,y}$	Total electricity displaced by the project activity in year y (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

The $EF_{grid,OM,2022}$ is displayed on the Brazilian DNA website, for the year 2022 $EF_{grid,OM,2022} = 0.4068 \text{ tCO}_2/\text{MWh}$

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

The Brazilian DNA is responsible for calculating the BM emission factor in Brazil.

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

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

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

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

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

Where:

$EF_{grid,BM,y}$	Build margin CO ₂ emission factor in year y (tCO ₂ /MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	CO ₂ emission factor of power unit m in year y (tCO ₂ /MWh)
m	Power units included in the build margin
y	Most recent historical year for which electricity generation data is available

The $EF_{grid,BM}$ is displayed on the Brazilian DNA website, for the year 2022.

$$EF_{grid,BM,2022} = 0.0270 \text{ tCO}_2/\text{MWh}$$

Step 6. Calculate the combined margin emissions factor

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

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

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

$$EF_{2018} = (0.4068 \times 0.25) + (0.0270 \times 0.75) = 0.1220 \text{ tCO}_2/\text{MWh}^{44}$$

The build margin CO₂ emission factors will be ex-ante.

The operating margin CO₂ emission factors will be ex-post.

⁴⁴ The source of the data is from Brazilian DNA. The link is <https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao>, accessed on 18/05/2023.

Therefore, the combined margin CO₂ emission factor will be ex-post.

Project emissions:

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

Where:

PE_y	Project emissions in year y (tCO ₂ /yr)
$PE_{EC,y}$	Emissions from consumption of electricity due to the project activity in year y (tCO ₂ /yr)
$PE_{FC,y}$	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation in year y (tCO ₂ /yr)
$PE_{DT,y}$	Emissions from the distribution of compressed/liquefied LFG using trucks in year y (tCO ₂ /yr)
$PE_{SP,y}$	Emissions from the supply of LFG to consumers through a dedicated pipeline in year y (tCO ₂ /yr)

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

Since there is no supply of LFG to consumers through a dedicated pipeline, $PE_{SP,y} = 0$

Since there is no consumption of fossil fuels due to the project activity, for purposes other than electricity generation, $PE_{FC,y} = 0$.

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

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

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

Thus,

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

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

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

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

Thus, the project emission is calculated as following:

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

Where:

EC _{PJ1,y}	Quantity of electricity consumed from the grid by the project activity during the year y (MWh);
EF _{grid,CM,y}	Emission factor for the grid in year y (tCO ₂ /MWh);
TDL _y	Average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

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

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

$$PE_{EC2,y} = EC_{PJ2,y} \times EF_{diesel_generator,y} \times (1 + TDL_y)$$

Where:

$EC_{PJ2,y}$	Quantity of electricity consumed from diesel generator by the project activity during the year y (MWh);
$EF_{\text{diesel_generator},y}$	Emission factor for the diesel generator in year y (tCO ₂ /MWh);
TDL_y	Average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

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

There is no project emission from consumption of heat.

Therefore, $PE_{FC,y} = 0$

Leakage:

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

Emission Reduction

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y	Emission reductions in year y (tCO ₂ e/yr)
BE_y	Baseline emissions in year y (tCO ₂ e/yr)
PE_y	Project emissions in year y (tCO ₂ e/yr)

B.6.2 Data and parameters fixed ex ante

SDG13

Data/parameter	OX_{top_layer}
Unit	Dimensionless
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Consistent with how oxidation is accounted for in the methodological tool "Emissions from solid waste disposal sites"
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	Default value used, according to ACM0001 (version 19.0)
Purpose of data	Calculation of baseline emissions
Additional comment	Applicable to Step A

Data/parameter	GWP_{CH4}
Unit	tCO ₂ / tCH ₄
Description	Global Warming Potential of CH ₄
Source of data	Default value used, according to IPCC Fifth Assessment Report (AR5) ⁴⁵
Value(s) applied	28 tCO ₂ e/tCH ₄

⁴⁵Available online: <https://www.ipcc.ch/assessment-report/ar5/>

Choice of data or Measurement methods and procedures	The applied values are in accordance with the currently applicable guidelines from the GS for the selection and application of the global warming potential.
Purpose of data	Calculation of baseline emissions.
Additional comment	Not applicable.

Data/parameter	η_{PJ}
Unit	Dimensionless
Description	Efficiency of the LFG capture system installed in the project activity
Source of data	Collection efficiency 0.85 & Load Factor 0.95 - USEPA 1996 Handbook EPA-LFG.pdf - Item 2.2.2. page 2-8. Only collection efficiency technical literature data was used.
Value(s) applied	85%
Choice of data or Measurement methods and procedures	Based on Collection efficiency 0.85 & Load Factor 0.95 - USEPA 1996 Handbook EPA-LFG.pdf- Item 2.2.2. page 2-8. Only collection efficiency technical literature data was used.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/parameter	R_u
Unit	Pa.m ³ /kmol.K
Description	Universal ideal gas constant
Source of data	Methodological tool "Project emissions from flaring" (version 03.0)

Value(s) applied	8,314
Choice of data or Measurement methods and procedures	Default value used, according to Methodological tool "Project emissions from flaring" (version 03.0), table 1: Constants used in equations
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/parameter	MM _k								
Unit	Kg/kmol								
Description	Molecular mass of gas <i>k</i>								
Source of data	"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)								
Value(s) applied	<table><tr><th>Compound</th><th>Structure</th><th>Molecular mass (kg/kmol)</th></tr><tr><td>Nitrogen</td><td>N₂</td><td>28.01</td></tr></table>			Compound	Structure	Molecular mass (kg/kmol)	Nitrogen	N ₂	28.01
Compound	Structure	Molecular mass (kg/kmol)							
Nitrogen	N ₂	28.01							
Choice of data or Measurement methods and procedures	According to "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)								
Purpose of data	Calculation of baseline emissions								
Additional comment	-								

Data/parameter	MM _i								
Unit	Kg/kmol								
Description	Molecular mass of greenhouse gas <i>i</i>								
Source of data	"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)								
Value(s) applied	<table><tr><th>Compound</th><th>Structure</th><th>Molecular mass (kg/kmol)</th></tr><tr><td>Methane</td><td>CH₄</td><td>16.04</td></tr></table>			Compound	Structure	Molecular mass (kg/kmol)	Methane	CH ₄	16.04
Compound	Structure	Molecular mass (kg/kmol)							
Methane	CH ₄	16.04							

Choice of data or Measurement methods and procedures	According to "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/parameter	P_{ref}
Unit	Pa
Description	Atmospheric pressure at reference conditions
Source of data	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	Default value extracted from Tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/parameter	T_{ref}
Unit	K
Description	Temperature at reference conditions
Source of data	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	Default value extracted from Tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)

Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/parameter	MM_{H2O}
Unit	Kg/kmol
Description	Molecular mass of water
Source of data	"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	According to "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/parameter	Φ_{default}
Unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	Tool "Emissions from solid waste disposal sites" (version 08.0)
Value(s) applied	0.75
Choice of data or Measurement methods and procedures	According to "Emissions from solid waste disposal sites" (version 08.0), the Application A was used because the landfill is an existing solid waste disposal site and in the project activity the methane emissions are being mitigated by capturing and flaring the methane (ACM0001).

Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/parameter	OX
Unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	According to "Emissions from solid waste disposal sites" (version 08.0), the Application A was used because the landfill is an existing solid waste disposal site and in the project activity the methane emissions are being mitigated by capturing and flaring the methane (ACM0001).
Purpose of data	Calculation of baseline emissions
Additional comment	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO ₂ . The oxidation factor represents the proportion of methane that is oxidized to CO ₂ . This should be distinguished from the methane correction factor (MCF) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer of SWDS.

Data/parameter	F
Unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)

Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Default value used according to "Emissions from solid waste disposal sites" (version 08.0)
Purpose of data	Calculation of baseline emissions
Additional comment	Upon biodegradation, organic material is converted to a mixture of methane and carbon dioxide

Data/parameter	DOC_{f,default}
Unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	The default value was used for type Application A). according to "Emissions from solid waste disposal sites" (version 08.0)
Purpose of data	Calculation of baseline emissions
Additional comment	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. This default value can be used for Application A.

Data/parameter	MCF_{default}
Unit	-
Description	Methane Correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories

Value(s) applied	1.0
Choice of data or Measurement methods and procedures	The project activity is an anaerobic managed solid waste disposal site with controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and is include: (i) cover material; (ii) mechanical compacting and (iii) leveling of the waste;
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/parameter	DOC_j															
Unit	-															
Description	Fraction of degradable organic carbon in the waste type j (weight fraction)															
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 5, Tables 2.4 and 2.5)															
Value(s) applied	<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>		Waste type j	DOC _j (% wet waste)	Wood and wood products	43	Pulp, paper and cardboard (other than sludge)	40	Food, food waste, beverages and tobacco (other than sludge)	15	Textiles	24	Garden, yard and park waste	20	Glass, plastic, metal, other inert waste	0
Waste type j	DOC _j (% wet waste)															
Wood and wood products	43															
Pulp, paper and cardboard (other than sludge)	40															
Food, food waste, beverages and tobacco (other than sludge)	15															
Textiles	24															
Garden, yard and park waste	20															
Glass, plastic, metal, other inert waste	0															

Choice of data or Measurement methods and procedures	IPCC default value for municipal solid waste (MSW) disposal site is applied.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/parameter	k _j																
Unit	-																
Description	Decay rate for the waste type <i>j</i>																
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 5, Tables 2.4 and 2.5)																
Value(s) applied	<table><tr><th colspan="2">Waste type</th><th>k_j</th></tr><tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge) and textiles</td><td>0.07</td></tr><tr><td>Wood, wood products and straw</td><td>0.035</td></tr><tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.17</td></tr><tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.40</td></tr></table>			Waste type		k _j	Slowly degrading	Pulp, paper, cardboard (other than sludge) and textiles	0.07	Wood, wood products and straw	0.035	Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.17	Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.40
Waste type		k _j															
Slowly degrading	Pulp, paper, cardboard (other than sludge) and textiles	0.07															
	Wood, wood products and straw	0.035															
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.17															
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.40															
Choice of data or Measurement methods and procedures	IPCC default value for anaerobic managed solid waste disposal site is applied.																
Purpose of data	Calculation of baseline emissions																
Additional comment	-																

Data/parameter	Waste composition
Unit	%

Description	Waste composition														
Source of data	Values are selected as per applicable guidance of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, Chapter 2, table 2.4, Waste Composition - by Country and regional averages														
Value(s) applied	<table border="1"> <thead> <tr> <th colspan="2">Composition of Waste</th></tr> </thead> <tbody> <tr> <td>A) Wood and wood products</td><td>0%</td></tr> <tr> <td>B) Pulp, paper and cardboard (other than sludge)</td><td>17.60%</td></tr> <tr> <td>C) Food, food waste, beverages and tobacco (other than sludge)</td><td>53.50%</td></tr> <tr> <td>D) Textiles</td><td>0%</td></tr> <tr> <td>E) Garden, yard and park waste</td><td>0%</td></tr> <tr> <td>F) Glass, plastic, metal, other inert waste</td><td>28.9%</td></tr> </tbody> </table>	Composition of Waste		A) Wood and wood products	0%	B) Pulp, paper and cardboard (other than sludge)	17.60%	C) Food, food waste, beverages and tobacco (other than sludge)	53.50%	D) Textiles	0%	E) Garden, yard and park waste	0%	F) Glass, plastic, metal, other inert waste	28.9%
Composition of Waste															
A) Wood and wood products	0%														
B) Pulp, paper and cardboard (other than sludge)	17.60%														
C) Food, food waste, beverages and tobacco (other than sludge)	53.50%														
D) Textiles	0%														
E) Garden, yard and park waste	0%														
F) Glass, plastic, metal, other inert waste	28.9%														
Choice of data or Measurement methods and procedures	-														
Purpose of data	Calculation of baseline emissions														
Additional comment	-														

Data/parameter	SPEC_{flare}
Unit	Temperature - °C Flow rate - Nm ³ /h Maintenance schedule - number of days
Description	Manufacturer's flare specifications for temperature, flow rate and maintenance schedule
Source of data	Flare Manufacturer

Value(s) applied	Flare model	2500 HT
	Minimum flare temperature	850 °C
	Maximum flare temperature	1,200 °C
	Minimum and maximum inlet flow rate	Minimum flow: 500 Nm ³ /h --- Maximum flow: 2,500 Nm ³ /h
	Maximum duration in days between maintenance events	365 days
Choice of data or Measurement methods and procedures	As established by the methodological tool “Project emissions from flaring” (version 03.0), 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 current GS 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 each individual high temperature enclosed flare; and (c) Duration in days of time periods between maintenance events for each individual high temperature enclosed flare.	
Purpose of data	Calculation of baseline emissions	
Additional comment	-	

Data/parameter	EF _{grid,BM,y}
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Unit	tCO ₂ /MWh
Description	Build margin emission factor of the Brazilian grid
Source of data	Calculations based on parameters described above.
Value(s) applied	0.0270
Choice of data or Measurement methods and procedures	The build margin emission factor has been defined by the Brazilian DNA for the year 2022.
Purpose of data	Calculation of project emissions and baseline emissions (due to the displacement of an equivalent amount of electricity generated by the project's electricity generation infrastructure which would otherwise be generated by grid-connected power plants within the National Electricity Grid of Brazil).
Additional comment	All data and parameters to determine the grid electricity emission factor, as required by the "Tool to calculate the emission factor for an electricity system" (version 07.0), were included in the monitoring plan.

B.6.3 Ex ante estimation of SDG Impact

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Electricity from renewable sources (SDG 7)

The amount of electricity to be generated by the project activity is ex-ante estimated based on the combined installed capacity of the 20 engine-generator sets of the project activity (211,570 MWh/year (average value)). For the ex-post calculation of emission reductions achieved by the project activity, the amount of electricity to be generated will be monitored by using an appropriate electricity meter.

Regarding the baseline scenario for SDG 7 (same situation prior to the implementation of the project activity), no LFG would be used for generating electricity since there would be no electricity generation infrastructure at the Ecoparque Candeias landfill in the absence of the project activity. Thus, it is directly assumed that, in the baseline scenario, the parameter $EC_{BL,y}$ (net amount of electricity generated by using LFG) is equal to 0.

Number of jobs generated (SDG 8)

While the initial crediting period for the project activity under the GS4GG encompasses the period from 01/01/2021 to 28/09/2023, the estimated number of jobs created by the project activity (17 jobs in 2021, 22 jobs in 2022 and 20 jobs in 2023) is based on the actual number of employees of the project during the years of 2021, 2022 and 2023. Monitoring details about the jobs created by the project activity will be presented in the Monitoring Reports.

Regarding the baseline scenario for SDG 8 (same situation prior to the implementation of the project activity), no jobs would be created since there would be infrastructure for promoting forced collection nor flaring and/or utilization of LFG generated at the Ecoparque Candeias landfill in the absence of the project activity. Thus, it is directly assumed that, in the baseline scenario, the parameter "Total number of jobs" is equal to 0.

Emission reductions (SDG 13)

Baseline emission calculation

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

Ex-ante estimation of $F_{CH_4,PJ,y}$

The assumptions used to calculate $F_{CH_4,PJ,y}$ are:

- Methane content in LFG = 50% (default value);
- LFG collection efficiency = 85%: (Based on Collection efficiency 0.85 & Load Factor 0.95-- USEPA 1996 Handbook EPA-LFG.pdf-- Item 2.2.2. page 2-8. Only collection efficiency technical literature data was used.);
- Density of methane = 0.716 kg/m³ (as per tool "Project emissions from flaring").

The landfill gas collection and utilization system will capture only a portion of the generated landfill gas. Thus, an estimate of 85% LFG collection was applied to the estimate of LFG produced, under assumption that generated LFG is composed of 50% methane.

The ex-ante estimation of the $F_{CH_4,PJ,y}$ is presented below:

$$F_{CH_4,PJ,y} = \eta_{PJ} \times \frac{BE_{CH_4,SWDS,y}}{GWP_{CH_4}}$$

Where:

$F_{CH_4,PJ,y}$	Amount of methane in the LFG which is flared and/or used in the project activity in year y (tCH ₄ /yr)
$BE_{CH_4,SWDS,y}$	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y (tCO ₂ e/yr)
η_{PJ}	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH_4}	Global warming potential of CH ₄ (tCO ₂ e/tCH ₄)

The table below illustrates the ex-ante estimation of $F_{CH_4,PJ,y}$ by the project activity during the crediting period.

Table 4 – Ex-ante estimation of $F_{CH_4,PJ,y}$

Year	$F_{CH_4,PJ,y}$ (tCH ₄ /yr)
2021 ⁴⁶	33,685
2022	34,698
01/01/2023 to 28/09/2023	25,484

Determination of $F_{CH_4,BL,y}$

$$F_{CH_4,BL,y} = 20\% \times F_{CH_4,PJ,y}$$

⁴⁶ Values applicable for years 2018, 2019 and 2020 are not considered since CERs were previously issued for these particular years by the project activity under the CDM. Therefore, no GS VEs will be claimed for this particular years.

Table 5 – Ex-ante estimation of $F_{CH_4,BL,y}$

Year	$F_{CH_4,BL,y}$ (tCH ₄ /yr)
2021	6,737
2022	6,940
01/01/2023 to 28/09/2023	5,097

Step (A): Baseline emissions of methane from the SWDS ($BE_{CH_4,y}$)

The equation of the $BE_{CH_4,y}$ is:

$$BE_{CH_4} = \left((1 - OX_{top_layer}) \times F_{CH_4,PJ,y} - F_{CH_4,BL,y} \right) \times GWP_{CH_4}$$

Where the $OX_{top_layer} = 0.1$ (default value) and $F_{CH_4,PJ,y}$ and $F_{CH_4,BL,y}$ are calculated above.

The results are presented below:

Table 6 – Baseline emissions of methane from the SWDS ($BE_{CH_4,y}$)

Year	$BE_{CH_4,y}$ (tCO ₂ /year)
2021	660,217
2022	680,073
01/01/2023 to 28/09/2023	499,479

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

The ex-ante calculation is:

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

As explained above, the $EF_{grid,CM,y} = 0.1220$ tCO₂/MWh

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

Year	$EC_{BL,k,y}$ (MWh/yr)	$BE_{EC,y}$ (tCO ₂ /yr)
2021	189,875	27,789
2022	213,609	31,262

01/01/2023 to 28/09/2023	176,219	25,790
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The equation of the baseline emission calculation is:

$$BE_y = BE_{CH_4,y} + BE_{EC,y}$$

The result is:

Table 8 – baseline emission calculation

Year	$BE_{CH_4,y}$ (tCO ₂ /yr)	$BE_{EC,y}$ (tCO ₂ /yr)	BE_y (tCO ₂ /yr)
2021	660,217	27,789	688,005
2022	680,073	31,262	711,335
01/01/2023 to 28/09/2023	499,479	25,790	525,269

1. Project emission

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

Where:

PE_y Project emissions in year y (tCO₂/yr)

$PE_{EC,y}$ Emissions from consumption of electricity due to the project activity in year y (tCO₂/yr)

$PE_{FC,y}$ Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation in year y (tCO₂/yr)

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

Thus,

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

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

The project emission from consumption of electricity is:

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

Where:

PE_{EC1,y} – Project emission from the grid

In the option A1 of the “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”, states that a value of the combined margin emission factor ($EF_{grid,CM,y}$) may be used as the emission factor ($EF_{Elj/k/l,y}$) Therefore a value of 0.1220 tCO₂/MWh will be used.

Finally, for the ex-ante estimation of emission reductions , the average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site (TDL_y) is selected as the applicable default value of 20% 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) Table below summarizes the project emissions resulting from electrical consumption in the plant.

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

Year	Electricity consumption from the grid (MWh/year)	PE _{el,grid} (tCO ₂ /yr)
2021	152	23
2022	152	23
01/01/2023 to 28/09/2023	113	17

It is important to note, it is considered that in standard operation the electricity of LFG plant will be supplied by of the LFG electricity power plant.

PE_{EC2,y} - Project emission from diesel generator(s)

It is considered no consumption of diesel by the diesel generator since the electricity will be generated through LFG in order to supply the LFG plant internal needs. The emission factor from the diesel generator(s) is 1.3 tCO₂/MWh. The following table represents the project emissions from the use of the standby generator over the crediting period. Table below presents the project emissions associated with fossil fuel combustion at the project site.

Table 10 – Project emissions from diesel generator

Year	PE _{el,diesel} (MWh/year)	PE _{el,diesel} (tCO ₂ /yr)
2021	0	0
2022	0	0
01/01/2023 to 28/09/2023	0	0

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

For ex-ante calculation, this factor was considered zero because there is no project emission from consumption of heat.

$$PE_{FC,y} = 0$$

2. Leakage

No leakage effects need to be accounted under methodology ACM0001.

3. Emission reduction

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y Emission reductions in year y (tCO₂e/yr)

BE_y Baseline emissions in year y (tCO₂e/yr)

PE_y Project emissions in year y (tCO₂e/yr)

Year	BE _y (tCO ₂)	PE _y (tCO ₂)	ER _y (tCO ₂)
2021	688,005	23	687,982
2022	711,335	23	711,312
01/01/2023 to 28/09/2023	525,269	17	525,252

B.6.4 Summary of ex ante estimates of each SDG Impact

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SDG 13

Year	Baseline estimate (tonnes of CO ₂ e)	Project estimate (tonnes of CO ₂ e)	Net benefit (tonnes of CO ₂ e)
2021	688,005	23	687,982
2022	711,335	23	711,312
01/01/2023 to 28/09/2023	525,269	17	525,252
Total	1,924,610	63	1,924,547
Total number of crediting years	2.74 years		
Annual average over the crediting period	702,412	23	702,389

SDG 7

Year	Baseline estimate (MWh)	Project estimate (MWh)	Net benefit (MWh)
2021	189,875	0	189,875
2022	213,609	0	213,609
01/01/2023 to 28/09/2023	176,219	0	176,219
Total	579,703	0	579,703
Total number of crediting years	2.74 years		
Annual average over the crediting period	211,570	0	211,570

SDG 8

Year	Baseline estimate (number of jobs per year)	Project estimate (number of jobs per year)	Net benefit (number of jobs per year)
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2021	17	0	17
2022	22	0	22
01/01/2023 to 28/09/2023	20	0	20
Total	19	0	19
Total number of crediting years	2.74 years		
Annual average over the crediting period	19	0	19

B.7. Monitoring plan

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B.7.1 Data and parameters to be monitored

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SDG 13

Data / Parameter	Management of SWDS
Unit	-
Description	Management of SWDS
Source of data	Use different sources of data: - Original design of the landfill; - Technical specifications for the management of the SWDS; - Local or national regulations
Value(s) applied	-
Measurement methods and procedures	Project developers should refer to the original design of the landfill to ensure that any practice to increase

	methane generation have been occurring prior to the implementation of the project activity. Any change in the management of the SWDS after the implementation of the project activity should be justified by referring to technical or regulatory specifications.
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	-

Data / Parameter	$V_{t,db}$
Unit	m ³ /h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data	Measurements by the project developers by using flow meter(s)
Value(s) applied	n/a
Measurement methods and procedures	The volumetric flow rate of the residual gas which is sent to each individual flare, LFG engines in the hour h will be measured by the installed flow meters with digital recordable electronic signal, according to the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0), the measurement option in the project activity will be:

	- Option (A) dry basis: when the temperature of gaseous stream is lower than 60°C (333.15 K) at the flow measurement point; - Option (B) wet basis: when the temperature of gaseous stream is higher than 60° C (333.15 K) at the flow measurement point;
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. The calibration frequency of this monitoring equipment should be in accordance with manufacturer's specifications.
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	This parameter will be monitored only in case Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied for the determination of $FCH_{4,flared,y}$ and $FCH_{4,EL,y}$.

Data / Parameter	$V_{t,wb}$
Unit	m ³ /h
Description	Volumetric flow of the gaseous stream in time interval t on a wet basis
Source of data	Measurements by project developers by using a flow meter
Value(s) applied	n/a
Measurement methods and procedures	The volumetric flow rate of the residual gas which is sent to each individual flare, LFG engines in the hour h will be

	measured by the installed flow meters with digital recordable electronic signal, according to the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0), the measurement option in the project activity will be: • Option (A) dry basis: when the temperature of gaseous stream is lower than 60°C (333.15 K) at the flow measurement point; • Option (B) wet basis: when the temperature of gaseous stream is higher than 60° C (333.15 K) at the flow measurement point;
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. The calibration frequency of this monitoring equipment should be in accordance with manufacturer's specifications.
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	This parameter will be monitored only in case Options B or C of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied for the determination of $FCH_{4,flared,y}$ and $FCH_{4,EL,y}$.

Data / Parameter	$V_{RG,m}$
Unit	m ³
Description	Volumetric flow of the residual gas on a dry basis at reference conditions in the minute m
Source of data	Measurements by project developers using flow meter

Value(s) applied	-
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital)
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	Flow meters are to be periodically calibrated according to the manufacturer's recommendation
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	Monitoring of this parameter is applicable in case of enclosed flares and continuous monitoring of the flare efficiency and if project participant selects to calculate $V_{RG,m}$ instead of monitoring directly. Monitoring of this parameter may also be necessary for confirming that the manufacturer's specifications for flow rate/heat flux are met. In this case the flow rate should be measured in a m^3/h basis

Data / Parameter	$V_{i,t,db}$
Unit	m^3 gas i/m^3 dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Source of data	Measurements by project developers by using gas analyzer
Value(s) applied	Approximately 50%

Measurement methods and procedures	Continuous gas analyzer operating on a dry basis. Volumetric flow measurement should always refer to the actual pressure and temperature.
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N ₂) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	This parameter will be monitored only in case Option A of the tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied for the determination of $FCH_{4,flared,y}$ and $FCH_{4,EL,y}$.

Data / Parameter	$V_{i,t,wb}$
Unit	m ³ gas i/m ³ wet gas
Description	Volumetric fraction of greenhouse gas <i>i</i> in a time interval <i>t</i> on a wet basis
Source of data	Measurements by project developers using gas analyzer
Value(s) applied	Approximately 50%
Measurement methods and procedures	Continuous gas analyzer operating on a wet basis. Volumetric flow measurement should always refer to the actual pressure and temperature.

Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g., N ₂) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	This parameter will be monitored only in case Options B or C of the tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied for the determination of $FCH_{4,flared,y}$ and $FCH_{4,EL,y}$.

Data / Parameter	V_{O2,EG,m}
Unit	-
Description	Volumetric fraction of O ₂ in the exhaust gas on a dry basis at reference conditions in the minute <i>m</i>
Source of data	Measurements by project developers by using a continuous gas analyzer
Value(s) applied	-
Measurement methods and procedures	Extractive sampling analyzers with water and particulates removal devices or in situ analyzers for wet basis determination. The point of measurement (sampling point) shall be in the upper section of the flare (80% of total flare height). Sampling shall be conducted with

	appropriate sampling probes adequate to high temperatures level (e.g., inconel probes)
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	Analyzers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard gas
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	Monitoring of this parameter is only applicable in case of enclosed flares and continuous monitoring of the flare efficiency

Data / Parameter	$V_{i,RG,m}$
Unit	-
Description	Volumetric fraction of component i in the residual gas on a dry basis in the minute m
Source of data	Measurements by project developers by using a continuous gas analyzer
Value(s) applied	-
Measurement methods and procedures	Measurement may be made on either dry or wet basis. If value is made on a wet basis, then it shall be converted to dry basis for reporting
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.

QA/QC procedures	Analyzers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	As a simplified approach, project developers may only measure the content CH ₄ , CO and CO ₂ of the residual gas and consider the remaining part as N ₂ . Monitoring of this parameter is only applicable in case of enclosed flares and continuous monitoring of the flare efficiency

Data / Parameter	M_{RG,m}
Unit	Kg
Description	Mass flow of the residual gas on a dry basis at reference conditions in the minute <i>m</i>
Source of data	-
Value(s) applied	-
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital)
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;

Additional comment	Monitoring of this parameter is applicable in case of enclosed flares and continuous monitoring of the flare efficiency and if project participant selects to monitor $M_{RG,m}$ directly, instead of calculating. Monitoring of this parameter may also be necessary for confirming that the manufacturer's specifications for flow rate/heat flux are met. In this case the flow rate should be measured in a kg/h basis
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Data / Parameter	$f_{CH_4,EG,m}$
Unit	mg/m ³
Description	Concentration of methane in the exhaust gas of the flare on a dry basis at reference conditions in the minute m
Source of data	Measurements by project developers by using a continuous gas analyzer
Value(s) applied	-
Measurement methods and procedures	Extractive sampling analyzers with water and particulates removal devices or in situ analyzer for wet basis determination. The point of measurement (sampling point) shall be in the upper section of the flare in order that the sampling is of the gas after consumption has taken place (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperatures level (e.g., inconel probes)
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	Analyzers must be periodically calibrated according to manufacturer's recommendation. A zero check and a

	typical value check should be performed by comparison with a standard gas
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	Monitoring of this parameter is only applicable in case of enclosed flares and continuous monitoring of the flare efficiency. Measurement instruments may read ppmv or % values. To convert from ppmv to mg/m ³ simply multiply by 0.716. 1% equals 10 000 ppmv.

Data / Parameter	T_t
Unit	K
Description	Temperature of the gaseous stream in time interval t
Source of data	Measurements by Project participant using a temperature meter
Value(s) applied	n/a
Measurement methods and procedures	Thermo resistance with digital recordable electronic signal will be used. The accuracy and uncertainty of the monitoring instrument will be in accordance with manufacturer specifications.
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. The calibration frequency of this monitoring equipment should be according to the manufacturer's specifications

Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60°C is adopted, this parameter must be monitored continuously to assure the applicability condition is met.

Data / Parameter	P_t
Unit	Pa
Description	Pressure of the gaseous stream in time interval <i>t</i>
Source of data	Measurements by Project participant using a pressure meter
Value(s) applied	n/a
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) will be used. Examples include pressure transducers, etc. The accuracy and uncertainty of the monitoring instrument will be in accordance with manufacturer specifications.
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers

	(either capacitive or resistive) must be calibrated according to manufacturer recommendation. In case the pressure meter is not a capacitive or resistive pressure transducer, the calibration frequency of this monitoring equipment should be according to the manufacturer's specifications.
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency).

Data / Parameter	$EC_{PJ1,y} = EG_{EC1,y}$								
Unit	MWh/y								
Description	Quantity of electricity consumed from the grid by the project activity during the year y ;								
Source of data	Measurement from project developers								
Value(s) applied	<table border="1"> <thead> <tr> <th>Year</th><th>$EC_{PJ1,y}$ (MWh/year)</th></tr> </thead> <tbody> <tr> <td>2021</td><td>152</td></tr> <tr> <td>2022</td><td>152</td></tr> <tr> <td>01/01/2023 to 28/09/2023</td><td>113</td></tr> </tbody> </table>	Year	$EC_{PJ1,y}$ (MWh/year)	2021	152	2022	152	01/01/2023 to 28/09/2023	113
Year	$EC_{PJ1,y}$ (MWh/year)								
2021	152								
2022	152								
01/01/2023 to 28/09/2023	113								

Measurement methods and procedures	Continuously measured by electricity meters for the grid electricity consumption as per the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0) and methodology ACM0001 (version 19.0).
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	The calibration frequency of this monitoring equipment should be according to the manufacturer's specifications. Measurement records will be cross-checked against available electricity receipts/invoices issued by the local electricity distribution company.
Purpose of data	Required to calculate baseline and project emissions.
Additional comment	The data will be archived throughout the crediting period and two years thereafter.

Data / Parameter	$EC_{PJ2,y} = EG_{EC2,y}$					
Unit	MWh/y					
Description	Quantity of electricity consumed from diesel generator by the project activity during the year y					
Source of data	Measurement from project developers					
Value(s) applied	<table><tr><th>Year</th><th>$EC_{PJ2,y}$ (MWh/year)</th></tr><tr><td>2021</td><td>0</td></tr></table>		Year	$EC_{PJ2,y}$ (MWh/year)	2021	0
Year	$EC_{PJ2,y}$ (MWh/year)					
2021	0					

	<table> <tr> <td>2022</td><td>0</td></tr> <tr> <td>01/01/2023 to 28/09/2023</td><td>0</td></tr> </table>	2022	0	01/01/2023 to 28/09/2023	0
2022	0				
01/01/2023 to 28/09/2023	0				
Measurement methods and procedures	Continuously measured by electricity meters for the diesel generators as per "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0) and ACM0001 (version 19.0).				
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.				
QA/QC procedures	The calibration frequency of this monitoring equipment should be according to the manufacturer's specifications.				
Purpose of data	Required to calculate baseline and project emissions.				
Additional comment	The data will be archived throughout the crediting period and two years thereafter.				

Data / Parameter	$P_{H_2O,t,Sat}$
Unit	Pa
Description	Saturation pressure of H ₂ O at temperature T _t in time interval <i>t</i>
Source of data	Provided by project developers
Value(s) applied	101,325
Measurement methods and procedures	This parameter is solely a function of the gaseous stream temperature T _t and can be found at reference [1] for a total pressure equal to 101,325 Pa

Monitoring frequency	-
QA/QC procedures	-
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	[1] Fundamentals of Classical Thermodynamics; Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4 ^o Edition 1994, John Wiley & Sons, Inc.

Data / Parameter	$T_{EG,m}$
Unit	°C
Description	Temperature in the exhaust gas of the enclosed flare in minute m
Source of data	Measurements by project developers
Value(s) applied	-
Measurement methods and procedures	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 850 °C indicates that a significant amount of gases are still being burnt and that the flare is operating. Data will be recorded continuously and values will be averaged hourly or at a shorter time interval
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	According to manufacturer's recommendations.
Purpose of data	(b) Calculation of project emissions or actual net GHG removals by sinks;
Additional comment	This parameter is only applicable for enclosed flares.

Data / Parameter	Flame_m
Unit	Flame on or Flame off
Description	Flame detection of flare in the minute <i>m</i>
Source of data	Project Participant
Value(s) applied	-
Measurement methods and procedures	Measurements by project developers using a continuous Ultra Violet flame detector
Monitoring frequency	Continuously recorded and aggregated in a minute basis. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off
QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations
Purpose of data	Calculation of baseline and project emissions when the flame is on ⁴⁷ .
Additional comment	-

Data / Parameter	Maintenance_y
Unit	Calendar dates
Description	Maintenance events completed in year <i>y</i>

⁴⁷ When the flame is off, neither baseline nor project emissions occur since the LFG is not combusted and instead released to the atmosphere.

Source of data	Project developers
Value(s) applied	-
Measurement methods and procedures	Record the date that maintenance events were completed in year y . Records of maintenance logs must include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced, or needing to be replaced, source of replacement parts, serial numbers and calibration certificates.
Monitoring frequency	Maintenance services in the flare are performed every year by specialized technical service team under conformance with maintenance requirements for the flare (as established by equipment manufacturer) and as required by the ex-ante determined parameter $SPEC_{flare}$.
QA/QC procedures	Records must be kept in a maintenance log for two years beyond the life of the flare
Purpose of data	Calculation of baseline and project emissions when the flame is on ⁴⁸ .
Additional comment	Monitoring of this parameter is required for the case of flares. 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 ($SPEC_{flare}$).

⁴⁸ When the maintenance is being carried out, neither baseline nor project emissions occurs since the LFG is not combusted and released to the atmosphere.

Data / Parameter	Status of biogas destruction device
Unit	-
Description	Operational status of biogas destruction devices
Source of data	Provided by project developers
Value(s) applied	n/a
Measurement methods and procedures	Monitoring and documenting may be undertaken by recording the energy production from methane captured or the operation of the flare by means of a flame detector to demonstrate the actual destruction of methane, unless a different method is specified in the underlying methodology/tool. Emission reductions will not accrue for periods in which the destruction device is not operational.
Monitoring frequency	Continuous
QA/QC procedures	-
Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	For Flame detector devices refer to the methodological tool "Project emissions from flaring" (version 03.0)

Data / Parameter	$O_{pj,h}$
Unit	-
Description	Operation of the equipment that consumes the LFG
Source of data	Measurements by Project participant using a device integrated with the operational software at the landfill gas plant.

Value(s) applied	n/a
Measurement methods and procedures	For each equipment unit j using the LFG monitor that the plant is operating in hour h by the monitoring any one or more of the following three parameters: (a) Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer's specifications of the burning equipment. Document and justify the location and minimum threshold in the GS4GG Transition Request Form + PDD (b) Flame. Flame detection system is used to ensure that the equipment is in operation; I Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnaces. This option is not applicable to brick kilns. $O_{pj,h}=0$ when: (a) One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); (b) Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); I No products are generated in the hour h. Otherwise, $O_{pj,h}=1$
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	The calibration of this equipment is not applicable since it is a device integrated with the operational software at the landfill gas plant.

Purpose of data	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment	For enclosed flares is possible to analyses the temperature in the exhaust gas.

Data / Parameter	TDL_y
Unit	-
Description	Average technical transmission and distribution losses in the grid in year <i>y</i> for the voltage level at which electricity is obtained from the grid at the project site.
Source of data	Use of recent, accurate and reliable data available within the host country or selection of applicable default value (20%) 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 GS 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	Required to calculate baseline and project emissions.
Additional comment	-

Data / Parameter	EF_{grid,CM,y}
Unit	tCO ₂ /MWh
Description	CO ₂ emission factor of the Brazilian grid electricity during the year y
Source of data	Calculations based on parameters described above.
Value(s) applied	0.1220
Measurement methods and procedures	The emission factor is calculated ex-post, as the weighted average of the dispatch data analysis OM (Operating Margin) and the BM (Build margin), as described in B.6.3.
Monitoring frequency	Annual
QA/QC procedures	Apply procedures in the "Tool to calculate the emission factor for an electricity system" (version 07.0).
Purpose of data	Required to calculate baseline and project emissions.
Additional comment	All data and parameters to determine the grid electricity emission factor, as required by the "Tool to calculate the emission factor for an electricity system" (version 07.0), were included in the monitoring plan.

Data / Parameter	EF_{grid,OM,y}
Unit	tCO ₂ /MWh
Description	Operating margin emission factor of the Brazilian grid
Source of data	Calculations based on parameters described above.

Value(s) applied	0.4068
Measurement methods and procedures	The operating margin emission factor is calculated ex-post
Monitoring frequency	Annual
QA/QC procedures	Apply procedures in the "Tool to calculate the emission factor for an electricity system" (version 07.0)
Purpose of data	Required to calculate baseline and project emissions.
Additional comment	All data and parameters to determine the grid electricity emission factor, as required by the "Tool to calculate the emission factor for an electricity system" (version 07.0), were included in the monitoring plan.

SDG 7 and SDG 13

Data / Parameter	$EG_{PJ,y} = EC_{BL,k,y}$								
Unit	MWh								
Description	Amount of electricity generated using LFG by the project activity in year y This parameter is also presented as the SDG 7 Indicator "Total electricity produced: Renewable"								
Source of data	Electricity meter								
Value(s) applied	<table border="1"> <thead> <tr> <th>Year</th><th>$EC_{PJ,y}$ (MWh/year)</th></tr> </thead> <tbody> <tr> <td>2021</td><td>189,875</td></tr> <tr> <td>2022</td><td>213,609</td></tr> <tr> <td>01/01/2023 to 28/09/2023</td><td>176,219</td></tr> </tbody> </table>	Year	$EC_{PJ,y}$ (MWh/year)	2021	189,875	2022	213,609	01/01/2023 to 28/09/2023	176,219
Year	$EC_{PJ,y}$ (MWh/year)								
2021	189,875								
2022	213,609								
01/01/2023 to 28/09/2023	176,219								

Measurement methods and procedures	Monitor net electricity generation using LFG by the project activity
Monitoring frequency	Continuous measurements are recorded and reported with an every-minute frequency.
QA/QC procedures	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company. Measurement records will be cross-checked against available electricity receipts/invoices issued by the local electricity distribution company.
Purpose of data	Required to calculate baseline and project emissions.
Additional comment	This parameter is required for calculating baseline emissions associated with electricity generation ($BE_{EC,y}$) using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)

SDG 8

Data / Parameter	Total number of jobs
Unit	-
Description	Number of employees related to the operation of the project activity
Source of data	Employment records
Value(s) applied	17 jobs in 2021 22 jobs in 2022 20 jobs in 2023

Measurement methods and procedures	In accordance with records of employees related to the operation of the project activity.
Monitoring frequency	Annual.
QA/QC procedures	-
Purpose of data	-
Additional comment	-

B.7.2 Sampling plan

>>

Not applicable.

B.7.3 Other elements of monitoring plan

>>

The monitoring plan will be done according to the methodology ACM0001 (version 19.0), the applicable tools, as well as per both CDM project standard and GS4GG related documents. Details are available in section B.7.1 above. The monitoring equipment locations are presented in the picture below:

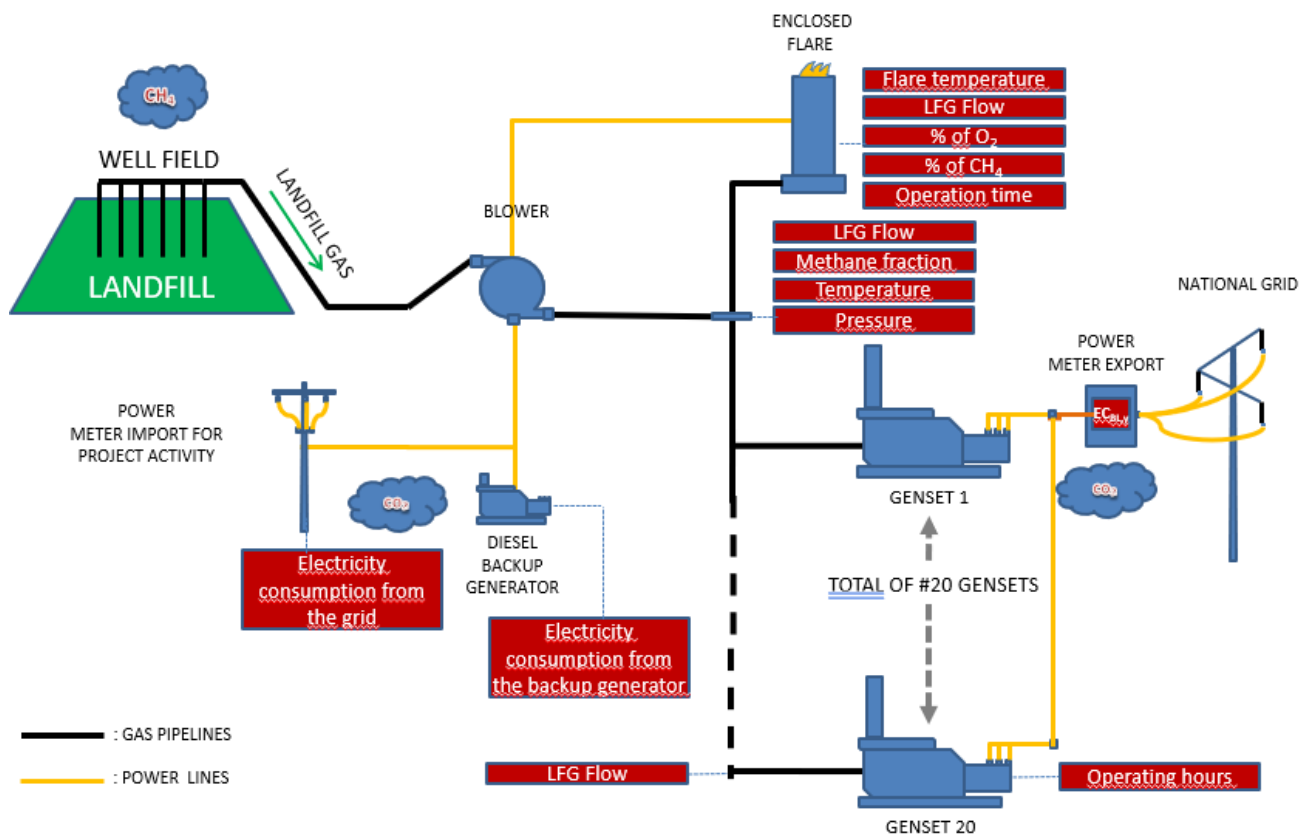


Figure 5 - Monitoring equipment locations

All continuously measured parameters (LFG flow, CH₄ concentration, flare temperature, flare operating hours, engine operating hours, and engine electrical output) will be recorded electronically via a datalogger, located within the Site boundary which will have the capability to aggregate and print the collected data at the frequencies as specified above. It will be the responsibility of the Site Operator to provide all requested data logs which will be stored over the duration of the reporting period at the Site office. The data logs will be summarized into emission reduction calculations prior to each verification. This task will be completed by the project owner and reported directly to the DOE. These logs will be available at the request of the DOE in order to prove the operational integrity of the Project.

1. Introduction and Objectives

The two primary purposes of the monitoring plan are:

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

The operational data that is collected will be used to support the periodic verification report that will be required for VER auditing. The monitoring plan discussed herein is designed to meet or exceed GS4GG and UNFCCC requirements (approved monitoring methodology ACM0001 (version 19.0)).

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

2. Training of monitoring personnel

Before commencement of the O&M phase, project owner will conduct a training and quality control program to ensure that good management practices are carried out and implemented by all project operating personnel in terms of record-keeping, equipment calibration, overall maintenance, and procedures for corrective action. An operations manual will be developed for the operating personnel. The procedures for filing data and calculations to be performed by the LFG utilization operator will be included in a daily log to be placed in the main control room.

3. Monitoring Work Program

The LFG monitoring program is a relatively simple, straight forward program designed to collect system operating data required to safely operate the system

and for the verification of VERs. This data will be collected in real time and will provide a continuous record that is easy to monitor, review, and validate.

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

- Flow measurement;
- Gas quality measurements;
- Uncombusted methane in case of enclosed flares and flame detection in case of open flares;
- Electricity Consumption;
- Project electricity output;
- Regulatory requirements;
- Data records; and
- Data assessment and reporting.

3.1. Flow Measurement

According to ACM0001 (version 19.0), flow meters are installed during Phase 1 (flaring) on the piping, straight before the flares.

During phase 2 (electricity generation) implementation, in order to follow ACM0001 (version 19.0), flow meters are installed:

- Flow meter is installed in the piping before the power plant to measure the LFG flow utilized for electricity generation
- Flow meter is either installed in each flare

The flow of LFG collected by the system and subsequently utilized or flared is measured via individual devices suitable for measuring the velocity and volumetric flow of a gas. One common example is an annubar. The flow measurements are taken within the piping itself, and the flow sensors are

connected to transmitters that are capable of collecting and sending continuous data to a recording device such as a datalogger.

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

The accuracy of a flow meter is dependent on the design of the equipment, and the specific type of sensor used. The equipment selected for the site utilizes a continuous monitoring system as defined in ACM0001 (version 19.0), which measures and aggregates flow data approximately once every minute.

3.2. Gas Quality

The two parameters that are most pertinent to the validation of GS VERs, as well as the safe and efficient operation of the system are the concentration of methane and oxygen in the gas stream delivered for utilization or diverted to flaring. These two parameters are measured via a common sample line that is ran to the main collection system piping, and measured in real time by two separate sensors, one for methane and the other for oxygen, installed as per ACM0001 (version 19.0).

Regular calibration of the equipment is especially important, as the accuracy of the methane and oxygen sensors is greatest within the expected range of the gas stream to be measured. The equipment selected for the site aggregates gas compositions approximately once every minute.

3.3. Uncombusted Methane

For enclosed flares, the efficiency will be measured per the methodological tool "Project emissions from flaring" (version 03.0).

3.4. Electrical Consumption

The consumed electricity by the project activity will be continuously measured by electricity meters for the grid and/or diesel generators. The respective data will be electronically recorded.

Monthly electrical bills charged to the project will be monitored and considered as the actual energy consumption for the project.

3.5. Project Electricity Output

The generated electricity used for the landfill internal consumption (i.e. administration offices, truck garage, recycling plant, leachate pumps), excluding the LFG Facility electricity consumption by the project activity will be continuously measured by an electricity meter and respective data will be electronically recorded.

3.6. Regulatory Requirements

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

4. Data records and storage

Data collected from each of the parameter sensors is transmitted directly to an electronic database from which the GS VER volume calculations may be carried out, as described in section 2.1 above. A hard copy backup or reports of the data may be printed as required or recorded in Portable Document Format (PDF). Backup of the electronic data is conducted frequently, as described above.

Data monitored and required for verification and issuance are kept and archived for at least two years after the end of the final crediting period or the last issuance of GS VERs, whichever occurs later.

4.1. Data Assessment and Reporting

Assessment of the flow and composition data described above coupled with the operating hours of the engines/flare and engines/flare destruction efficiencies are used to determine the quantity of GS VERs to be generated. For electricity generation offsets, the appropriate emission factors will be applied.

The destruction efficiency of the enclosed flares is a function of the internal combustion temperature and resident holding time, which are generally measured by the flare system controller and recorded for auditing purposes. Extensive technical documentation is available that documents the destructive efficiency of the enclosed drum flares that will be used, subject to the flow rate and combustion temperature verification. Destruction efficiency will also be assessed periodically through measurement of uncombusted methane emissions.

Flow data is normalized to standard temperature, pressure, and composition for reporting purposes. The data will be compiled and assessed to produce the required quantification and validation. The periodic monitoring report will contain the data required for the verification of the GS VERs, and additionally may contain operational data from the collection system and flaring system described below to illustrate that the system is well maintained and operating at peak efficiency. Records of regular maintenance performed will also be a component of the annual report.

5. Related monitoring and project performance review

The project owner will conduct additional operational monitoring of the LFG collection system to check the project performance and ensure that the system is being operated both correctly and efficiently. Periodic adjustments to the horizontal trenches and to the extraction wells/drains will be required to optimize the capture and collection systems effectiveness. LFG collection field adjustments

will be made based upon a review of the trench and well performance history considered within the context of the overall LFG collection field operation in order to maximize the collection of methane balanced against minimization of any oxygen in the system that could introduce unsafe operating conditions. Monitoring at each trench and extraction well will consist of the following parameters: valve position, individual well/trench flow, individual well/trench vacuum, and composition of the gas collected, i.e., methane, carbon dioxide, and oxygen, using a portable measuring device.

6. Emergency procedures

As a precautionary measure, the system is plugged to a battery-based uninterruptible power supply (UPS) to avoid data loss due to power failures. As a backup is produced and stored off-site from the main recording system, no more than 2 to 3 minutes of data at a time would ever be lost due to a system malfunction.

All data is collected and registered in data log in supervisory system. In addition, there will be developed an Emergency Plan including other types of emergencies such as fire and work accidents.

7. Calibration

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

Also, for calibration, GS project standard for project activities (version 2), paragraph 79 (d) will be used. Thus, the project developers shall apply the following unless the applied methodologies, the applied standardized baselines or the other applied methodological regulatory documents state otherwise:

(d) The calibration of measuring equipment shall be carried out by an accredited

SECTION C. DURATION AND CREDITING PERIOD

C.1. Duration of project

C.1.1 Start date of project

>>

Project starting date: 29/09/2011

C.1.2 Expected operational lifetime of project

>>

21 years and 0 months

C.2. Crediting period of project

C.2.1 Start date of crediting period

>>

The 2 crediting periods for the project activity under the CDM were defined as follows:

1st CP: from 29/09/2011 to 28/09/2018

2nd CP: from 29/09/2018 to 28/09/2025

Under the GS4GG, the project activity will have the following crediting periods:

2nd CP: from 01/01/2021 to 28/09/2023

3rd CP: from 29/09/2023 to 28/09/2026

C.2.2 Total length of crediting period

>>

From 01/01/2021 to 28/09/2023.

SECTION D. SUMMARY OF SAFEGUARDING PRINCIPLES AND GENDER SENSITIVE ASSESSMENT

D.1 Safeguarding Principles that will be monitored

A completed Safeguarding Principles Assessment is in [Appendix 1](#), ongoing monitoring is summarised below.

Principles	Mitigation Measures added to the Monitoring Plan
Principle 6.1 Labour Rights	Refer to the monitoring parameter "Total number of jobs" in Section B.7.1.

D.2. Assessment that project complies with GS4GG Gender Sensitive requirements

Question 1 - Explain how the project reflects the key issues and requirements of Gender Sensitive design and implementation as outlined in the Gender Policy.	As an LFG collection and utilization, the project does not adversely impact women or men. All the key gender issues and requirements of GS4GG are respected, as well as Brazilian laws, principles and guidelines which deal with gender equality. The project provides employment opportunities equally for men and women.
Question 2 - Explain how the project aligns with existing country policies, strategies and best practices.	The project complies with the requirements of gender equality, as it is under the jurisdiction of Brazilian legislation. Article 5 of the Brazilian Constitution ⁴⁹ declares women equal to men in all legal respects, explicitly stating that "men and women have equal rights and duties under the terms of this Constitution."

⁴⁹ https://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm

	The law Nº 7.35350 of 1985 established the National Council on Women's Rights, which advocated successfully on behalf of including gender conscious legislation in the updated constitution of 1988. Moreover, the Consolidation of Labour Laws (CLT)⁵¹, which regulates labour relations in Brazil, prohibits gender-based wage discrimination (Article 461, §1º) and ensures equal rights for men and women in the workplace.
Question 3 - Is an Expert required for the Gender Safeguarding Principles & Requirements?	No. The project is an LFG collection and utilization initiative, and it does not discriminate among gender nor reduce access to or control of resources for women. The Project beneficiaries in terms of employment and social upliftment of the area are common for both the gender and it does not involve any kind of discrimination in any form.
Question 4 - Is an Expert required to assist with Gender issues at the Stakeholder Consultation?	A Stakeholder's consultation was held in the year 2022 by following the applicable requirements for Gold Standard Projects valid at the time. Since the project complies with all the requirements of "Principle 2 – Gender Equality and Women's Rights" from the currently valid version of the GS4GG

⁵⁰ http://www.planalto.gov.br/ccivil_03/leis/1980-1988/L7353.htm

⁵¹ https://www.planalto.gov.br/ccivil_03/decreto-lei/del5452.htm

"Safeguarding Principles and Requirements", no Expert is required to assist with Gender issues at the Stakeholder Consultation.

SECTION E. SUMMARY OF LOCAL STAKEHOLDER CONSULTATION

Below is a summary of the 2 step GS4GG Consultation for monitoring purposes. Please refer to the separate Stakeholder Consultation Report for a complete report on the initial consultation and stakeholder feedback round.

E.1 Summary of stakeholder mitigation measures

>>

The project developer sent e-mail invitations for the identified stakeholders⁵² on 25/08/2022 and 26/08/2022. On the e-mails, there was an invitation to visit the project activity and to send any comments or questions to the project developer. After the submission of the invitations, no comments were received from any of the stakeholders and the feedback round was deemed closed after 2 months.

The performed Local Stakeholder Consultation (LSC) audience/meeting took place at a meeting room located at the Ecoparque Candeias landfill on 30/09/2022. After the meeting, a grievance book was made available to all interested stakeholders at the central office of the Ecoparque Candeias landfill. Comments made in such grievance book by stakeholders will be reviewed and addressed by the project's operational staff, under the supervision of the project coordinator (Mr. Paulo Laguardia).

⁵² While currently there is no organization or people representing waste scavengers which were informally working at the Muribeca dumpsite more than 16 years ago (when this dumpsite was closed), the project developer assumed that there were no scavengers to be invited to the conducted LSC meeting. However, it is crucial to note that representatives of the society and multiple stakeholders (which may represent such individuals whatever is their occupation or profession nowadays) were indeed invited to the performed LSC.

Further details about people invited and attendants of the meeting are presented in the Stakeholder Consultation Report (which is being submitted along with this revised version of the GS4GG Transition request form + PDD).

During the conducted meeting, it was also explained to the attendants about the Feedback Round which would last for 2 months (starting on 01/10/2022 and ending on 01/12/2022). The project's webpage under the GS website (which included the initial version of the PDD for the transition from the CDM to the GS4GG) was also included in the presentation shown during the physical meeting (which was later sent to the attendants via email).

As part of the renewal of crediting for the project activity under the GS4GG (which will occur soon after the transition to the GS4GG is approved), a new feedback round will be promoted by making updated project documentation electronically available to stakeholders, inviting them and to give any feedback via the open channels of communication and also by informing stakeholders that they are welcome to visit the project activity (in a schedule to be agreed between the two parties).

E.2 Final continuous input / grievance mechanism

Method	Include all details of Chosen Method (s) so that they may be understood and, where relevant, used by readers.
Continuous Input / Grievance Expression Process Book (mandatory)	The process/comments book has been located in the main office at the entrance of the Ecoparque Candeias landfill as the stakeholders' chosen place. The process/comments book is checked on a weekly basis by the responsible personnel to verify if any new comments have been raised by stakeholders (so far, no comments have been raised). Any comments received will be addressed by the project developer by following the available written procedure for addressing stakeholder's grievances.
GS Contact (mandatory)	help@goldstandard.org

Other	Orizon Valorização de Resíduos S.A. Brazil Av. das Nações Unidas, Torre Oeste, Cidade Monções +55 (11) 5103 5300 +55 (21) 5103 5301 dalton.canelhas@orizonvr.com.br www.orizonvr.com.br
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APPENDIX 1 - SAFEGUARDING PRINCIPLES ASSESSMENT

>> Fill this section

Complete the Assessment below and copy all Mitigation Measures for each Principle into [SECTION D](#) above. Please refer to the instructions in the [Guide to Completing](#) this Form.

Assessment Questions/ Requirements	Justification of Relevance (Yes/potentially/no)	How Project will achieve Requirements through design, management or risk mitigation.	Mitigation Measures added to the Monitoring Plan (if required)
Principle 1. Human Rights			
1. The Project Developer and the Project shall respect internationally proclaimed human rights and shall not be complicit in violence or human rights abuses of	No	1. The project respects internationally proclaimed human rights. Brazil has its own legislation ⁵³ in place prohibiting the violation of the human rights principle and it actively enforces the	Not applicable

⁵³ https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2014/lei/l12986.htm

any kind as defined in the Universal Declaration of Human Rights 2. The Project shall not discriminate with regards to participation and inclusion		compliance of such principle. Brazil has ratified two UN human rights treaties: - the International Covenant on Civil and Political Rights⁵⁴ - the International Covenant on Economic, Social, and Cultural Rights⁵⁵. 2. The project does not discriminate with regards to participation and inclusion. The project is in conformance with national and international rules of equality and does not	
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⁵⁴ https://treaties.un.org/Pages/ViewDetails.aspx?chapter=4&clang=_en&mtdsg_no=IV-4&src=IND

⁵⁵ https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=IV-3&chapter=4&clang=_en

		involve nor is complicitly in any form of discrimination.	
Principle 2. Gender Equality			
1. The Project shall not directly or indirectly lead to/contribute to adverse impacts on gender equality and/or the situation of women 2. Projects shall apply the principles of non-discrimination, equal treatment, and equal pay for equal work 3. The Project shall refer to the country's national gender strategy or equivalent national commitment to aid in assessing gender risks	No	1. The project does not decrease women 's access to or control of resources. The project developers do not discriminate on gender and support gender equality. 2 - The project offers equal opportunities for women and men to contribute both in volunteer and working positions. The project does not involve and is not complicit in any form of discrimination based on gender, race, religion, sexual orientation or any	Not applicable

4. (where required) Summary of opinions and recommendations of an Expert Stakeholder(s)		other basis. The National Council on Women's Rights, formed in 1975, advocated successfully on behalf of including gender conscious legislation in the updated constitution of 1988. 3 - The project complies with the requirements of gender equality, as it is under the jurisdiction of Brazilian legislation. Article 5 of the Brazilian Constitution⁵⁶ declares women equal to men in all legal respects, explicitly stating that "men and women	
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⁵⁶ https://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm

		have equal rights and duties under the terms of this Constitution.” The law Nº 7.353⁵⁷ of 1985 established the National Council on Women’s Rights, which advocated successfully on behalf of including gender conscious legislation in the updated constitution of 1988. Moreover, the Consolidation of Labour Laws (CLT)⁵⁸, which regulates labour relations in Brazil, prohibits gender-based wage discrimination (Article 461, §1º) and ensures equal	
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⁵⁷ http://www.planalto.gov.br/ccivil_03/leis/1980-1988/L7353.htm

⁵⁸ https://www.planalto.gov.br/ccivil_03/decreto-lei/del5452.htm

		rights for men and women in the workplace.	
		4 – Not required for the project activity.	
Principle 3. Community Health, Safety and Working Conditions			
1. The Project shall avoid community exposure to increased health risks and shall not adversely affect the health of the workers and the community	No	There are no perceived health risks to the local communities due to the project activity. The project developers are committed to apply safe and healthy working conditions for all employees during all phases of the project.	Not applicable.
Principle 4.1 Sites of Cultural and Historical Heritage			
Does the Project Area include sites, structures, or objects with historical, cultural, artistic, traditional or religious	No	No cultural heritage was observed on the project site prior to the implementation of the landfill (as confirmed in	Not applicable

values or intangible forms of culture?		the EIA Report) or the project.	
>>			
Principle 4.2 Forced Eviction and Displacement			
Does the Project require or cause the physical or economic relocation of peoples (temporary or permanent, full or partial)?	No	The project activity is within the area of an existing landfill, which obtained prior approval from the local environmental authority for its implementation. As demonstrated in the EIA Report, the construction of the landfill (and subsequently of the project) did not require or cause the physical or economic relocation of people (temporary or permanent, full or partial).	Not applicable
>>			
Principle 4.3 Land Tenure and Other Rights			

a. Does the Project require any change, or have any uncertainties related to land tenure arrangements and/or access rights, usage rights or land ownership? b. For Projects involving land use tenure, are there any uncertainties with regards to land tenure, access rights, usage rights or land ownership?	No	The project does not require any change, or have any uncertainties related to land tenure arrangements and/or access rights, usage rights or land ownership.	Not applicable
>>			
Principle 4.4 - Indigenous people			
Are indigenous peoples present in or within the area of influence of the Project and/or is the Project located on land/territory claimed by indigenous peoples?	No	There are no indigenous people or group identified within the area of influence of the Project, as confirmed in the EIA Report for the Ecoparque Candeias landfill.	Not applicable

>>			
Principle 5. Corruption			
1. The Project shall not involve, be complicit in or inadvertently contribute to or reinforce corruption or corrupt Projects	No	The project does not involve and is not complicit in any kind of corruption.	Not applicable.
Principle 6.1 Labour Rights			
1. The Project Developer shall ensure that all employment is in compliance with national labour occupational health and safety laws and with the principles and standards embodied in the ILO fundamental conventions	Potentially	1 – The project developers are committed to apply safe and healthy working conditions for all employees during all phases of the project. All employees of the project are protected by the Brazilian Federal set of labour regulations denominated Consolidation of Labour Laws	Refer to parameter “Total number of jobs”.

2. Workers shall be able to establish and join labour organisations 3. Working agreements with all individual workers shall be documented and implemented and include: a) Working hours (must not exceed 48 hours per week on a regular basis), AND b) Duties and tasks, AND c) Remuneration (must include provision for		(CLT)⁵⁹, which represents the regulatory framework that regulates labour relations in Brazil, and the principles and standards embodied in the International Labour Organization (ILO) fundamental conventions. Law compliance is subject to governments inspection and ruling. 2 - The rights to establish and join labour organizations or unions are protected by brazilian Labour Laws. The project fully respects the employees' rights in	
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⁵⁹ https://www.planalto.gov.br/ccivil_03/decreto-lei/del5452.htm

payment of overtime), AND d) Modalities on health insurance, AND e) Modalities on termination of the contract with provision for voluntary resignation by employee, AND f) Provision for annual leave of not less than 10 days per year, not including sick and casual leave. 4. No child labour is allowed (Exceptions for children working on their families' property requires an Expert Stakeholder opinion)		accordance with all labour related laws endorsed in Brazil. 3 - Working agreements between the company and individual workers are documented and implemented, including working hours, duties and tasks, remuneration, modalities on health insurance, modalities on termination of contract, provision for annual leave, etc., always under conformance with applicable regulations and best practice The employment model applied is locally, nationally and culturally appropriate. 4. Brazil has published laws for the protection of	
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5. The Project Developer shall ensure the use of appropriate equipment, training of workers, documentation and reporting of accidents and incidents, and emergency preparedness and response measures		children⁶⁰, which also includes employment regulations. The project requires skilled employees and it does not employ and is not complicit in any form of child labour. 5. The project is operated in accordance with the applied working procedures and safety regulation rules and best practice. The project organizes employee training with topics on technical, environmental/safety code, and operational/maintenance procedures. Thus, the project developers ensure the use of	
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⁶⁰ https://www.planalto.gov.br/ccivil_03/leis/l8069.htm

		appropriate equipment, training of workers, documentation and reporting of accidents and incidents, and emergency preparedness and response measures.	
Principle 6.2 Negative Economic Consequences			
1. Does the project cause negative economic consequences during and after project implementation?	No	The Project does not cause negative economic consequences.	Not applicable.
>>			
Principle 7.1 Emissions			
Will the Project increase greenhouse gas emissions over the Baseline Scenario?	No	The project will reduce greenhouse gas emissions as it avoids methane from being freely emitted into the atmosphere and it also	Not applicable
>>			

		displaces equivalent amount of electricity that would be otherwise generated from fossil fuel fired power plants.	
Principle 7.2 Energy Supply			
Will the Project use energy from a local grid or power supply (i.e., not connected to a national or regional grid) or fuel resource (such as wood, biomass) that provides for other local users?	No	The Project will supply electricity to the national electricity grid of Brazil. It may consume grid-sourced electricity whenever the power plant is temporarily out of operation. It therefore does not use energy source from a local grid or power supply or fuel resource that provides for other local users.	Not applicable
>>			
Principle 8.1 Impact on Natural Water Patterns/Flows			

Will the Project affect the natural or pre-existing pattern of watercourses, ground-water and/or the watershed(s) such as high seasonal flow variability, flooding potential, lack of aquatic connectivity or water scarcity?	No	The Project will not affect the natural or pre-existing pattern of watercourses, groundwater and/or the watershed(s) such as high seasonal flow variability, flooding potential, lack of aquatic connectivity or water scarcity. Nonetheless, the parameters and conditions established in the operational license for the Ecoparque Candeias landfill (which include treatment of leachate generated at the landfill) are regularly inspected by the local environmental authority.	Not applicable
>>			
Principle 8.2 Erosion and/or Water Body Instability			
a. Could the Project directly or indirectly cause additional erosion and/or water body	No	The impact of the project on erosion and/or in the water body is negligible. As also	Not applicable

instability or disrupt the natural pattern of erosion? b. Is the Project's area of influence susceptible to excessive erosion and/or water body instability?		demonstrated in the EIA Report for the construction of the landfill, the project's area of influence isn't susceptible to excessive erosion and/or water body instability.	
>>			
Principle 9.1 Landscape Modification and Soil			
Does the Project involve the use of land and soil for production of crops or other products?	No	The project is an LFG recovery and utilization project and it does not involve the use of land and soil for production of crops or other products.	Not applicable
>>			
Principle 9.2 Vulnerability to Natural Disaster			
Will the Project be susceptible to or lead to increased vulnerability to wind, earthquakes, subsidence, landslides, erosion, flooding,	No	The Project is not susceptible to and does not lead to increased vulnerability to extreme climatic conditions.	Not applicable.

drought or other extreme climatic conditions?			
>>			
Principle 9.3 Genetic Resources			
Could the Project be negatively impacted by or involve genetically modified organisms or GMOs (e.g., contamination, collection and/or harvesting, commercial development, or take place in facilities or farms that include GMOs in their processes and production)?	No	The project activity is an LFG utilization project with no involvement genetically modified organisms or GMOs.	Not applicable.
>>			
Principle 9.4 Release of pollutants			
Could the Project potentially result in the release of pollutants to the environment?	No	As a LFG recovery and destruction/utilization project, it actually reduces emissions of pollutants to the atmosphere.	Not applicable
>>			

Principle 9.5 Hazardous and Non-hazardous Waste			
Will the Project involve the manufacture, trade, release, and/ or use of hazardous and non-hazardous chemicals and/or materials?	No	The project does not involve the manufacture, trade, release, and/or use of hazardous and non-hazardous chemicals and/or materials.	Not applicable
>>			
Principle 9.6 Pesticides & Fertilisers			
Will the Project involve the application of pesticides and/or fertilisers?	No	The Project does not involve the application of pesticides and/or fertilizers	Not applicable.
>>			
Principle 9.7 Harvesting of Forests			
Will the Project involve the harvesting of forests?	No	Project does not involve the harvesting of forests	Not applicable.
>>			
Principle 9.8 Food			
Does the Project modify the quantity or nutritional quality	No	The Project does not modify the quantity or nutritional	Not applicable.

of food available such as through crop regime alteration or export or economic incentives?		quality of food available such as through crop regime alteration or export or economic incentives.	
>>			
Principle 9.9 Animal husbandry			
Will the Project involve animal husbandry?	No	The Project does not involve animal husbandry.	Not applicable.
>>			
Principle 9.10 High Conservation Value Areas and Critical Habitats			
Does the Project physically affect or alter largely intact or High Conservation Value (HCV) ecosystems, critical habitats, landscapes, key biodiversity areas or sites identified?	No	As demonstrated in the EIA Report for the construction of the Ecoparque Candeias landfill, this landfill (and consequently the project) does not physically affect or alter largely intact or High Conservation Value (HCV) ecosystems, critical habitats,	Not applicable
>>			

		landscapes, key biodiversity areas or sites identified.	
Principle 9.11 Endangered Species			
a. Are there any endangered species identified as potentially being present within the Project boundary (including those that may route through the area)? b. Does the Project potentially impact other areas where endangered species may be present through transboundary affects?	No	As demonstrated in the EIA Report for the construction of the Ecoparque Candeias landfill, there are no endangered species identified as potentially being present within the project boundary (including those that may route through the area of the landfill), and the project would not potentially impact other areas where endangered species may be present through transboundary affects.	Not applicable
>>			

APPENDIX 2- CONTACT INFORMATION OF PROJECT PARTICIPANTS

>> Fill this section

Organization name	Orizon Valorização de Resíduos S.A.
Registration number with relevant authority	
Street/P.O. Box	Av. das Nações Unidas, Torre Oeste, Cidade Monções
Building	No: 12.901 – 8th Floor
City	São Paulo
State/Region	SP
Postcode	04578-000
Country	Brazil
Telephone	+55 (11) 5103 5300
E-mail	dalton.canelhas@orizonvr.com.br
Website	www.orizonvr.com.br
Contact person	Dalton Canelhas
Title	
Salutation	Mr.
Last name	Canelhas
Middle name	
First name	Dalton
Department	
Mobile	
Direct tel.	
Personal e-mail	dalton.canelhas@orizonvr.com.br

APPENDIX 3- LUF ADDITIONAL INFORMATION

>> Fill this section, if applicable

Not applicable as the proposed GS project activity is not a Land-use & Forest Activity (LUF) project.

APPENDIX 4-SUMMARY OF APPROVED DESIGN CHANGES

Please refer to [Design Change Requirements](#) for more information on procedures governing Design Changes.

APPENDIX 5 – DEMONSTRATION OF RISK OF DISCONTINUATION OF THE PROJECT ACTIVITY WITHOUT CARBON REVENUES

As per applicable GS4GG rules and procedures, a project activity requesting transition to the GS4GG which has a crediting period starting before 01/01/2016 under other GHG program/standard (such as the case of the project activity) is required to demonstrate the following as an eligibility requirement:

- *"(...) that the project faces a serious risk of discontinuation without carbon revenue, and*
- *how the project has been operational in the absence of carbon revenue, if carbon credits have not been issued to the project in recent years"*

In order to demonstrate that the project activity faces a serious risk of discontinuation without future carbon revenues, a complementary financial analysis (presented in the additional spreadsheet termed "*Complementary Financial Analysis DEV277.xls*") was performed with the aim of effectively and transparently demonstrating the instrumental role of future GS4GG carbon revenues (due to the commercialization of GS VERs to be issued for the periods from 01/01/2021 to 28/09/2023 and from 29/09/2023 to 28/09/2026) for having the project activity reaching its overall financial/economic sustainability (even considering the already received carbon revenues from the commercialization of CDM CERs), by taking into consideration the following as input data:

- Total incurred historical annual capital expenditures (CAPEX) by the project activity (along its gradual/phased occurred implementation schedule).
- Total incurred historical annual costs for the operation and maintenance (OPEX) of the infrastructure encompassed by the project activity (along its occurred gradual/phased implementation schedule). including provisions of capital for covering future costs associated to the required major overhauling work in each one of the installed engine-generator sets after 60,000 hours of accumulated

operation⁶¹.

- All CDM carbon revenues previously earned as a result of the operation of the project activity (based on historical records considering the quantities and prices valid for each vintage year for which CDM CERs were issued)
- All electricity generation related revenues earned so far as a result of the operation of the project activity (based on historical records considering records of electricity amount and electricity prices up to year 2022)
- Forecasted future revenues due to the commercialization of electricity to be generated by the project activity during the period from year 2023 to year 2028 based on forecasts for both electricity commercialization prices and electricity generation valid/applicable for each year under 2 scenarios for electricity prices (using (i) annual price 6-year projections from year 2023 to 2028 derived by chartered energy market specialist PSR, Inc⁶² (price series which somehow reflect trend of decrease in electricity prices for the future) + assuming values for year 2028 as also valid for the period 2029 - 2031 and (ii) assuming the market price for commercialization of generated electricity previously forecasted for year 2023 as also being valid/applicable for all years for the period 2024 – 2031).
- Forecasted future annual OPEX of infrastructure encompassed by the project activity (including capital provisions for the required and expensive major overhauling in the engine-generator sets of the project's electricity generation after 60,000 hours of operations)

The performed complementary financial analysis (that considers figures, technical

⁶¹ The annual OPEX figures presented in the complementary financial analysis include annual provision for the required costs associated with the required performance of major overhauling in the engine-generator sets of the project's electricity generation infrastructure. The previously completed CDM Validation Report for the project activity (dated year 2011) refers to such required overhauling work as follows:

- *"The project lifetime is also consistent with the lifetime and service period of the engines, which have a total lifetime of 120,000 hours, i.e. 15 years (with an overhaul after 7.5 years)"*
- *"Overhaul of first set of engines: The first set of engines reaches the end of its 60,000 hour useful operating life (...). In order for the engines to continue being used for another 60,000 hours they must be overhauled (...). ERM CVS has validated the costs of this overhaul against a quotation from the equipment manufacturer, GE Energy, for the overhaul costs (...). These costs are also considered reasonable based on ERM CVS's local, technical and financial expertise."*

⁶² Operating in more than 70 countries, PSR, Inc is a global provider of energy consulting services, computational modeling and energy innovation; and actively contributes to research and development of optimization and data analytics solutions. More information about PSR, Inc is available online: https://www.psr-inc.com/en/who_we_are/

market and contractual conditions which could not be previously known or forecasted at the time of the decision making process to implement the project activity under the CDM (at the time of the occurred project design initial conceptualization and occurred CDM consideration)) represents a complementary assessment to the previously performed assessment and demonstration of additionality of the project activity in year 2011 (which is presented in Section B.5) and is intended to support the demonstration of the role of GS carbon revenues for the project activity (that would otherwise face a serious risk of discontinuation in the absence of carbon revenues).

Regarding the demonstration of how the project has been kept under operational status regardless of the lack of carbon revenues in recent years, the following aspects are required to be considered:

- It is instrumental to note that Orizon Valorização de Resíduos S.A. has dealt with temporary lack of carbon revenues not only for the project activity in question, but also for other of its project activities promoting LFG collection and destruction/utilized.
- Orizon Valorização de Resíduos S.A. is a well-managed and well-structured public listed company (code "ORVR3" in the Brazilian BOVESPA stock exchange) and has a professional business council where long term decisions are taken based on long-term strategical and operational planning for the company. The project activity has been operated by making use not only of its own positive cash flows, but also through utilization of other capital sources (capital from the project owner and project developer, capital from 3rd parties (short-term debt, medium term debt and long-term debt) as part of its day-to-day operation and long-term strategical planning.

In this particular context, long-term-perspective view and planning are to be seen as a requirement for a company with multiple operations nationwide and with more than 2,000 direct employees such as the case of Orizon Valorização de Resíduos S.A.

- Since the early years of the carbon market under the CDM, the company's management team and its major shareholders believed that past and future carbon revenues played and will keep on playing a crucial role for the sustainable implementation and operation of LFG collection and destruction/utilization initiatives in Brazil.

- In line with the most recent and credible market trends and forecasts with optimistic views for the global carbon market, the decision-making team of Orizon Valorização de Resíduos S.A. is of the opinion that future stream of GS VERs to be issued by the project activity under GS4GG will indeed represent a singular and important revenue source for the project activity, thus contributing to its sustainable and continuous operation. That represents an important driver to maintain the project activity (and other project-based initiatives implemented and/or under implementation by the group) under operational status regardless of the yet persistent non-occurrence of carbon revenues (since year 2020/21 in the particular case of the project activity) and regardless of long-term trend of relative decrease of the commercialization prices for electricity generated by renewable energy sources).
- All operations of Orizon Valorização de Resíduos S.A. (including the project activity and the landfill where it is implemented) follow a clearly defined Corporate Social Responsibility (CSR) strategy with its business model integrating social and environmental concerns in all business operations and interactions with their stakeholders instead of only considering economic profits. Under this context, innovation in its operation with a long-term focus on better management of residues through the application of environmentally and climate friendly approaches and techniques (always identifying related risks and opportunities) became incorporated as part of the corporate governance of assets and operations.

Revision History

Version	Date	Remarks
1.0	10 July 2017	Initial adoption