

TEMPLATE

Key Project Information & project Design Document (PDD)

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RELATED SUPPORT

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KEY PROJECT INFORMATION

GS ID of Project	GS12047
Title of Project	Ecoparque Candeias Landfill Gas Project
Time of First Submission Date	20/12/2024
Date of Design Certification	15/10/2023
Version number of the PDD	5.1
Completion date of version	22/01/2025
Project Developer	Orizon Valorização de Resíduos S.A.
Project Representative	Dalton Canelhas
Project Participants and any communities involved	Orizon Valorização de Resíduos S.A. ¹
Host Country (ies)	Brazil
Activity Requirements applied	☐ Community Service Activity ☒ Renewable Energy ☐ Land-Use and Forests Activity Requirements/Risks & Capacities ☐ N/A
Scale of the project activity	☒ GHG Emissions Reduction & Sequestration ☒ Renewable Energy Label ☐ N/A
Other Requirements applied	☐ Regular ☒ Retroactive
Methodology (ies) applied and version number	ACM0001: "Flaring or use of landfill gas" (version 19.0)
Product Requirements applied	☒ GHG Emissions Reduction & Sequestration

¹ While the project activity was previously implemented and registered under the CDM by its former project participant and project owner named Haztec Tecnologia e Planejamento Ambiental S.A. (CDM registration date 29/09/2011) with the title "CTR Candeias Landfill Gas Project", this company was later 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 GS project activity.

	☐ Renewable Energy Label
	☐ N/A
Project Cycle:	☐ Regular
	☒ Retroactive

Land-use & Forest Key Project Information²

Not applicable.

Table 1 – 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	796,161	tCO ₂ e per year
7 - Affordable and Clean Energy	Total electricity produced: Renewable	224,852 ³	MWh of renewable energy per year
8 - Decent work and Economic Growth	Total number of jobs	21	Jobs

² Please refer to Appendix 3 for detailed information on LUF projects

³ The estimated amount of electricity to be generated by the GS project activity per year encompassed by its last crediting period under GS4GG is based in calculations which more realistically takes into account the average load and capacity factors for the project's installed electricity generation infrastructure (when compared to the approach used for related estimate in the previous crediting periods both under CDM and under GS4GG). Due to that, the estimated amount of electricity to be generated by the GS project activity per year is higher in this GS4GG PDD valid for the last crediting period of the GS project activity under GS4GG than the value assumed in the GS4GG PDD valid for its previous crediting period (176,219 MWh) when considering the project's electricity generation infrastructure under its final implementation (with 20 engine-generator sets being installed).

SECTION A. DESCRIPTION OF PROJECT

A.1 Purpose and general description of project

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The Gold Standard (GS) project activity "Ecoparque Candeias Landfill Gas Project" (hereafter referred to as the "GS project activity") encompasses the promotion of destruction and utilization of landfill gas (LFG) (rich in methane) through collection LFG and its destruction in high a temperature enclosed flare and utilization as gaseous fuel in set of engine-generator sets of an electricity generation infrastructure (with final total combined nameplate installed capacity of 28.520 MW (20 engine-generator sets of individual nameplate installed capacity 1.426 MW) at the Ecoparque Candeias landfill site. This well-managed landfill is currently owned and operated by the project participant Orizon Valorização de Resíduos S.A.

The Ecoparque Candeias landfill, previously built and operated by Haztec Tecnologia e Planejamento Ambiental S.A. (and haas been operated by Orizon Valorização de Resíduos S.A. during the latest 6 years). The landfill is strategically located close to major cities within the Recife Metropolitan Area and it is the first well-designed and well-managed landfill in the State of Pernambuco. The landfill started its municipal solid waste (MSW) permanent disposal operations in August/2007 and was granted with all necessary environmental licenses/permits for its operations. The Ecoparque Candeias landfill was designed to operate over a 21 year-period and it is therefore forecasted to be closed by the end of year 2027 with MSW streams being received from the following municipalities located in the State of Pernambuco:

- São Lourenço da Mata
- Cabo de Santo Agostinho
- Jaboatão dos Guararapes
- Moreno
- Recife

The GS project activity promotes real and permanent greenhouse gas (GHG) emission reductions as follows:

- Combustion of LFG in high temperature enclosed flares and/or engine-generator sets promotes permanent and real mitigation of methane emissions into the atmosphere

- Generation of electricity through utilization of LFG (renewable energy source) with generated electricity being exported through the National Electricity Grid of Brazil promotes displacement of equivalent amount of electricity that would be otherwise generated in existent grid-connected electricity generation sources (including fossil fuel fired power plants) and addition of new electricity generation sources therefore resulting in permanent and real carbon dioxide (CO₂) emission reductions.

The Ecoparque Candeias landfill covers an area of over 170,000 m² and is expected to receive about 24 million ton of MSW solid waste during the period from the year 2007 to the year 2027. About 3,300 ton of MSW are disposed per day at the Ecoparque Candeias landfill. While destruction of collected LFG in high temperature enclosed flare as part of the GS project activity was initiated in year 2011, utilization of collected LFG as gaseous fuel for electricity generation was initiated in year 2019. The project's electricity generation infrastructure encompasses the installation and operation of electricity generation infrastructure with engine-generator sets of high-performance standards. The engine-generator sets are the primary equipment to combust collected LFG.

By promoting effective and efficient collection and destruction/utilization of LFG at the Ecoparque Candeias landfill, the GS project activity has promoted real, permanent and measurable GHG emission reductions. It is assumed that, in the absence of the GS project activity (baseline scenario), LFG (rich in methane) would otherwise be directly emitted into the atmosphere through the pre-project passive conventional LFG venting/combustion drains and through the surface of the landfill, with small share of LFG being assumed as combusted under inefficient and non-continuous way in such passive conventional LFG venting/combustion drains, with no LFG being therefore utilized as gaseous fuel for electricity generation.

The pre-project scenario represents LFG generated at the Ecoparque Candeias landfill being freely directly emitted into the atmosphere through the surface of the landfill and through pre-project conventional LFG venting/combustion drains.

The installed nameplate electricity generation capacity for the project's electricity generation infrastructure is 28.52 MW.

GHG emission reductions to be achieved by the GS project activity:

By promoting permanent and real mitigations of CH₄ and CO₂, the GS project activity is expected to promote total combined GHG emission reductions of 2,388,482 tCO₂e during its last crediting period under GS4GG encompassing a 3-year period. This value is equivalent to average annual GHG emission reductions of 796,161 tCO₂e/year.

A.1.1. Eligibility of the project under Gold Standard

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As per applicable GS rules and definitions, the GS project activity is categorized as “*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 GS project activity. 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 through destruction/utilization of LFG (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 regulatory document “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.

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 infrastructure for the GS project activity and while being granted with all applicable licenses/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 is located under the following coordinates

- Latitude: - 8.164258
- Longitude: -34.985286



Figure 1 - Location of the Ecoparque Candeias Landfill Gas Project within Brazil
 Source: Google Earth application (2024)



Figure 2 - Location of the Ecoparque Candeias Landfill Gas Project within the state of Pernambuco
 Source: Google Earth application (2024)

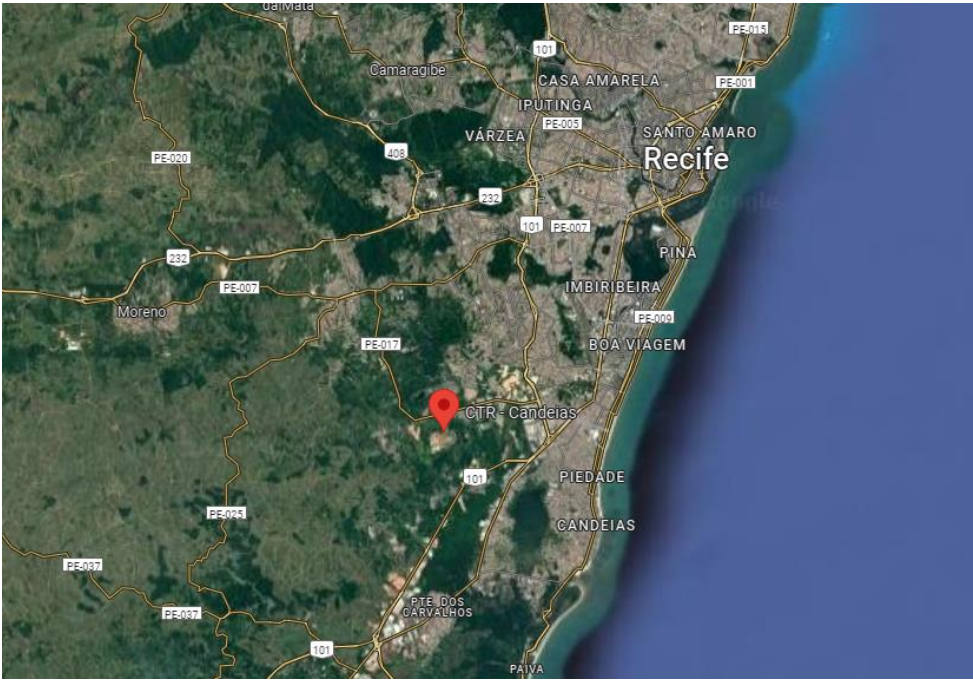


Figure 3 - Location of the Ecoparque Candeias Landfill Gas Project within the city of Jaboatão dos Guararapes
 Source: Google application (2024)



Figure 4 – Panoramic view of the Ecoparque Candeias Landfill Gas Project

A.3 Technologies and/or measures

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Pre-project situation at the Ecoparque Candeias landfill:

MSW disposal at the Ecoparque Candeias landfill has regularly occurred since year 2007. The pre-project-implementation situation (situation prior to the implementation of the GS project activity) at the Ecoparque Candeias landfill represents the non-existence of appropriate equipment/infrastructure and/or practice dedicated to promote effective LFG management (LFG collection and continuous destruction/utilization) at this particular landfill site. As part of the previously performed validation for the project, the above summarized pre-project situation was demonstrated to represent the baseline scenario for the project activity, with a set of conventional and to some extent rudimentary conventional passive LFG venting/combustion drains being used in the landfill's permanent MSW disposal area in order to allow sporadic/eventual passive combustion of LFG (in order to avoid significant accumulation of LFG in the inner section of the landfill (and thus reducing the risk of fire and explosions (safety concerns)) and also address odour concerns). It is assumed that in the baseline scenario (absence of the GS project activity) appropriate infrastructure for promoting effective and efficient LFG collection and destruction would remain non-existent at the Ecoparque Candeias landfill throughout its lifetime.

The baseline scenario for emissions of methane (CH₄) at the Ecoparque Candeias landfill thus represents the continuation of the pre-project-implementation practice (generated LFG being vented (directly emitted into the atmosphere) with small share LFG partially destroyed to address safety and odour issues through existent rudimentary and conventional LFG venting drains), therefore identical to the scenario existing prior to the implementation of the GS project activity (pre-project-implementation scenario).

The baseline scenario for electricity generation remains the continuation of the previously identified pre-project practice (no generation of electricity on site using LFG and/or any other fossil or renewable fuel/energy source). The baseline scenario for electricity generation is therefore identical to the pre-project scenario.

The previously conceived overall design, operation and management plan of the Ecoparque Candeias landfill is not expected to be compromised or changed as a result of the occurred implementation of the GS project activity. While no practice to increase

methane generation has ever occurred at the Ecoparque Candeias landfill, none of such practice (to increase methane generation) has occurred (and/or is expected to occur) after the occurred implementation of the GS project activity either. As required by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), the occurrence or planning of any kind of change in the management of the Ecoparque Candeias landfill during the time period encompassed by operation of the GS project activity is to be reported and is to be justified by referring to applicable technical or regulatory specifications.

Technology and measures encompassed by the project design:

Employed technology encompasses appropriate LFG collection, LFG flaring and electricity generation infrastructure fueled by LFG at the Ecoparque Candeias landfill. Infrastructure implemented as part of the GS project activity encompasses the following:

- LFG collection system composed by set of LFG collection wells installed across the landfill site
- LFG transportation pipeline network
- 1 high temperature enclosed flare
- Electricity generation infrastructure with 20 engine-generator sets (with individual nameplate installed capacity of about 1.426 MW each) and with total combined installed capacity of 28.52 MW.

The implementation and operation of the GS project activity have allowed and will allow methane contained in the LFG to be efficiently destroyed/utilized through controlled combustion, thus avoiding emissions of methane into the atmosphere and, due to that, promoting real and permanent GHG emission reductions.

The project is equipped with all needed monitoring system to ensure that all required monitoring related measurements are performed under full conformance with requirements established by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0) and applicable CDM methodological tools.

Related monitoring activities are to include continuous measurement of (i) LFG flow to the project's flare, (ii) LFG flow to the project's engine-generator sets, continuous monitoring of methane content/fraction in collected LFG, continuous monitoring of

operational conditions/status of the flare and each engine-generator set combusting LFG (project's methane destruction/combustion devices).

The net amount of electricity generated by the GS project activity is also measured. Finally, measurements and monitoring required for the determination of project emissions (due to the consumption of electricity by the project activity) are also performed in conformance with the applied CDM baseline and monitoring methodology ACM0001 (version 19.0) and applicable CDM methodological tools.

In summary, the project technology is environmentally safe and sound.

LFG collection system:

State-of-the-art LFG collection technology of the GS project activity includes the items listed below:

- Vertical LFG collection wells used to extract LFG (currently there are about 150 LFG collection wells installed as part of the project activity)
- Wellheads designed for gas measurements.
- Condensate extraction and storage systems designed at strategic low points throughout the LFG collection system.

LFG flaring equipment:

The GS project activity encompasses the following characteristics/technology that aim to promote efficient and controlled combustion of collected LFG through flaring:

- Combustion of LFG under controlled, safe and efficient (with very low CH₄ fugitive emissions) conditions are guaranteed by the utilization of high temperature enclosed flares.
- Use of best practice safety devices for the flare (such as flame detector and slam shut valve(s)).
- Continuous measurement of temperature of the exhaust gas of the flare (with continuous monitoring of the flare status (with every minute recording of the status signal of flame detector) being available.

- Continuous measurement of methane content in the exhaust gas of the flare (to determine project emissions from flaring)

While the applied CDM baseline and monitoring methodology ACM0001 (version 19.0) and applicable CDM methodological tool requires ex-post monitoring whether flaring equipment combusting LFG has operated under compliance with operational requirements and/or recommendations as set by the flare manufacturer as a requisite for claiming related emission reductions, the main operational characteristics and specifications of the high temperature enclosed flare currently installed as part of the project activity are thus summarized below:

LFG combustion flaring equipment	Characteristics/specifications
Flare 1	- Manufacturer: Biotechnogás srl - Model: BTG 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 - Required min. temperature of the exhaust gas of the flare (to ensure LFG destruction under high CH₄ destruction efficiency): 850 °C - Required max. temperature of the exhaust gas of the flare (to ensure LFG destruction under high CH₄ destruction efficiency): 1,200 °C - Required frequency for inspection service (incl. inspection in the conditions of the flare's isolation ceramics revetment material): every 7 days

Electricity generation infrastructure:

The project's electricity generation infrastructure (which started its continuous operation on 30/07/2019 under its gradual/phased implementation schedule) currently encompasses 20 engine-generator sets which allow combustion of LFG and displacement of electricity generated by fossil fuel electricity generation sources and fossil fuel, therefore promoting additional real and permanent GHG emission reductions (CH₄ and CO₂ emission reductions).

The identical 20 engine-generator sets installed as part of the project's electricity generation infrastructure are manufactured by GE Jenbacher GmbH & Co OHG, are fueled uniquely by LFG and have individual nameplate power generation capacity of about 1.426 MW. These engine-generator sets are assembled under a container-based modular power generation package set design. Each container includes ancillary equipment (cooling fan, coolant radiator, control & safety systems, etc.). The project's electricity generation infrastructure has a total combined nameplate installed capacity of 28.52 MW.



Figure 4. Picture of the engine-generator sets installed as part of the electricity generation infrastructure of the GS project activity

Consumption of electricity by the GS project activity:

As per the project design, the electricity demand for the GS project activity is met by (i) consumption of grid-sourced electricity or (ii) by electricity sourced by the project's electricity generation infrastructure or (iii) electricity supplied by a captive off-grid generator powered by diesel.

No change in the design and operational conditions of the Ecoparque Candeias landfill:

Design and operational aspects of the Ecoparque Candeias landfill have not changed and are not expected to be changed during the operational lifetime of the GS project activity. The Ecoparque Candeias landfill is expected to still being operated with the application of the same and previously applied MSW landfilling technics and procedures.

The Ecoparque Candeias landfill was previously designed and has been operated under conformance with its related design, construction, operational and management specifications and requirements (as detailed and specified in the currently valid environmental permit/license applicable for this particular landfill site). Applied design and operational pattern represents the best available practices for landfill construction and operation in Brazil.

The whole management and operation plan of the Ecoparque Candeias landfill has been approved and has been regularly monitored by the competent environmental authority of the municipality of Ecoparque Candeias with all required environmental permits being granted.

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

A.4 Scale of the project

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Large scale.

A.5 Funding sources of project

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There is no public funding involved in the GS project activity.

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

B.1. Reference of approved methodology (ies)

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- Large-scale CDM baseline and monitoring methodology ACM0001 - "Flaring or use of landfill gas" (version 19.0)⁴
- CDM methodological tools:
 - "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0)⁵
 - "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion" (version 03.0)⁶
 - "Emissions from solid waste disposal sites" (version 08.1)⁷
 - "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)⁸
 - "Project emissions from flaring" (version 04.0)⁹
 - "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)¹⁰
 - "Determining the baseline efficiency of thermal or electric energy generation systems" (version 03.0)¹¹
 - "Tool to calculate the emission factor for an electricity system" (version 07.0)¹²

⁴ <https://cdm.unfccc.int/methodologies/DB/JPYB4DYQUXQPZLBDVPHA87479EMY9M>

⁵ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v2.2.pdf/history_view

⁶ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf/history_view

⁷ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v8.1.pdf/history_view

⁸ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf/history_view

⁹ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v4.0.pdf/history_view

¹⁰ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v1.pdf/history_view

¹¹ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v3.0.pdf/history_view

¹² https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v1.1.pdf/history_view

- "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)¹³

B.2. Applicability of methodology (ies)

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This GS4GG PDD for the design certification renewal under the GS4GG is completed by applying the CDM baseline and monitoring methodology ACM0001 (version 19.0).

Meeting of the applicability conditions of ACM0001 (version 19.0) are demonstrated below:

Applicability conditions of ACM0001 (version 19.0):

"(...)

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

Not applicable. Prior to the occurred implementation of the GS project activity, there was a conventional LFG capture system (i.e. set of pre-project passive LFG venting/combustion drains) in place at the Ecoparque Candeias landfill.

"(...)

- (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; (...)"

The project design encompasses the installation of a new active (forced) LFG capture system (+ all infrastructure promoting destruction and utilization of

¹³ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v1.pdf/history_view

collected LFG) in an existing SWDS partially replacing a previously existent conventional passive LFG capture system ((i.e. set of pre-project passive LFG venting/combustion drains). The active (forced) LFG capture system installed as part of the GS project activity encompasses entirely new equipment (e.g. LFG collection wells, LFG transporting pipeline, centrifugal blowers, etc.). By assuming that the GS project activity replaces the previously existent pre-project passive LFG venting and combustion system, in the particular context of the demonstration of meeting of applicability criteria for ACM0001 (version 19.0), it is assumed that condition (b) (i) is applicable.

"(...)

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

Not applicable. There was no active LFG capture system installed/in place at the Ecoparque Candeias landfill prior to the implementation of the GS project activity.

"(...)

- (c) Flare the LFG and/or use the captured LFG in any (combination) of the following ways:
- (i) Generating electricity; (...)"

The project design encompasses flaring and utilization (as gaseous fuel for electricity generation) of collected LFG. In this sense, condition (c) (i) is thus met.

- " (ii) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace; (...)"

Not applicable. The project activity does not encompass utilization of collected LFG for any type of heat generation.

- "(iii) Supplying the LFG to consumers through a natural gas distribution network; (...)"

Not applicable. The GS project activity does not encompass supply of collected LFG to consumers through natural gas distribution network or through any other supply option.

"(iv) Supplying compressed/liquefied LFG to consumers using trucks; (..)"

Not applicable. The GS project activity does not encompass supply of compressed/liquified LFG to consumers by using trucks or through any other supply option.

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

Not applicable. The GS project activity does not encompass supply of LFG to consumers through dedicated pipeline or through any other supply option.

"(...)"

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

As a result of the occurred implementation and start of operation of the GS project activity, no quantitative, qualitative, procedural or regulatory change has occurred and/or is expected to occur in terms of related MSW management activities and policies valid for the Ecoparque Candeias landfill (or eventually applicable in any other potential waste treatment or disposal facility that would eventually be under the area of influence of this landfill (that would be promoted or triggered by the GS project activity)) in comparison with the situation under the baseline scenario. This situation is expected to remain valid throughout the project's last crediting period under GS4GG.

By taking into consideration the nature of the GS project activity and aspects related to recycling of organic fraction of MSW in the region of landfill and in the rest of Brazil, the occurred implementation and start of operation of the GS project activity *per se* has not promoted or triggered (and it is not expected to promote or trigger) any quantitative change in solid waste disposal activities undertaken at the Ecoparque Candeias landfill. Furthermore, no quantitative or qualitative changes in terms of solid waste management practices were promoted

or triggered (or are expected to be promoted or triggered) in any other existent or potential waste disposal or waste treatment facility (located or to be located in the region of influence of the Ecoparque Candeias landfill) as a direct outcome or consequence of the operation of the GS project activity.

Therefore, the mere occurred gradual/phased implementation of the GS project activity and its operation have not promoted or triggered (and they are not expected to promote or trigger) any reduction (or prevention) in the amount of organic type of MSW (or any other type of solid waste) that would eventually be recycled or re-utilized in the region of influence of the Ecoparque Candeias landfill.

As demonstrated in the applicable construction, design and operational requirements valid for the Ecoparque Candeias landfill, this well-managed landfill site has not included and is not expected to include any activity or initiative promoting recycling or utilization of organic fraction of waste disposed at this landfill as a result of the occurred implementation and start of operation of the GS project activity.

Moreover, it is thus clearly not expected that the occurred implementation and start of operation of the GS project activity would eventually reduce organic waste recycling activities in the landfill.

As a matter of fact, recycling and utilization of organic fraction of MSW is still not being a common practice in the whole country of Brazil.

In this sense, the implementation of the GS project activity does not represent any perverse incentive or driver for the promotion of any supposed quantitative or qualitative reduction or prevention of waste recycling related activities (or initiatives for any type of organic fraction of solid waste or solid residues) that would occur in the region of influence of the Ecoparque Candeias landfill in the absence of the GS project activity.

As per the Brazilian Federal Law 12.305/10 (passed in year 2010), solid waste recycling is defined as a process of transformation of solid waste material and residues through promotion of changes in their physical, chemical or biological properties in order to allow and promote use/utilization of such materials as raw material or even as new products. Although solid waste recycling is being regarded in the national sector directives for waste management as a priority goal in the whole country, solid waste recycling initiatives in Brazil are still being

quite limited (especially in the case of organic fraction of MSW) mainly due to economic restrictions.

As outlined in the publication "*Panorama dos Resíduos Sólidos no Brasil – 2024*"¹⁴, solid waste recycling initiatives in Brazil have encompassed mainly the following by-products/waste types with higher economic value:

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

The "*Panorama dos Resíduos Sólidos no Brasil*" is a publication annually published by the Associação Brasileira de Resíduos e Meio Ambiente – ABREMA (translated into English language as "Brazilian Association for Municipal Solid Waste and Environment") and has represented one of the most credible annual outlook and statistics source for the solid waste management in the country. The most recent Greenhouse Gases Emissions National Inventory¹⁵ also confirms that non-conventional MSW treatment alternatives (such as composting of organic fraction of MSW and waste incineration) are not meaningful practices in Brazil (including the region where the GS project activity is implemented).

In fact, in year 2012 the Brazilian Ministry of City Infrastructure (through its National Secretary of Sanitation) has published the year 2017 edition of a very comprehensive and detailed sectoral analysis/diagnostic about the whole MSW sector in Brazil: the publication "*Diagnóstico do Manejo de Resíduos Sólidos Urbanos – 2017*"¹⁶. Like the Report "*Panorama dos Resíduos Sólidos no Brasil – 2024*", this Government official publication also includes relevant and detailed

¹⁴ Tittle translated into English language as "*Outlook of Solid Waste Sector in Brazil – year 2024*" and available online at: <https://www.abrema.org.br/panorama/>

¹⁵ Published by the Brazilian Ministry of Technology and Science in 2010 and available online at: http://www.mct.gov.br/upd_blob/0213/213909.pdf

¹⁶ Translated into English language as "*Diagnostics of Urban Solid Waste Management - 2017*" and available online at: <http://www.snis.gov.br/diagnostico-residuos-solidos/diagnostico-rs-2017>

statistics for MSW management for the main municipalities, States and regions in Brazil. Available statistics include prevailing practices in terms of waste management practices (collection, disposal and re-use/recycle).

In the particular case of the region under potential influence of the Ecoparque Candeias landfill (municipality of Jaboatão dos Guararapes, Recife and other municipalities from which generated MSW is disposed at the landfill), all solid waste materials (organic or inert) to be eventually/potentially recycled (very small share of collected MSW) are normally previously sorted, under very limited percentiles, in the waste generation sources (prior to be mixed with other types of MSW to be disposed in landfills or waste dump sites in the region).

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

Under the category “*organic MSW fraction*”, only clean (not contaminated) and previously appropriately sorted pulp/paper/cardboard waste materials have been regarded as recyclable material as per both available statistics and available recycling practices.

Besides some particular inert waste materials with attractive commercial value (e.g., aluminum packaging material (e.g. aluminum cans), some types of clean plastic material and some types of glass), no other waste materials have been normally collected from stream of MSW to be disposed in landfills in order to be eventually recycled in the region where the GS project activity is implemented and/or even transported to be recycled in other region. This has also been the typical waste recycling scenario in other regions of Brazil.

Thus, with or without the occurred implementation and start of operation of the GS project activity, no incremental organic fraction of solid waste stream that

has been directed to this particular landfill would be expected to be collected and directed to any type of recycling facility (e.g. composting facility) after or prior its disposal at the landfill site.

This situation is expected to remain the practice in the future. In fact, as established by related construction and design documents for the Ecoparque Candeias landfill, no waste pickers or waste sorting teams have ever operated in the landfill area. No composting plant for organic waste (or any other type of alternative management for MSW organic content) was ever implemented or is expected to be implemented in the area in the future either.

All of the above-summarized facts and aspects confirm that no relevant sorting and collection of recyclable organic material from MSW already disposed in the Ecoparque Candeias landfill are expected to occur regardless of the implementation of the GS project activity (under both baseline and project scenarios). Therefore, incremental recycling or alternative use/utilization of organic fraction from waste already disposed in the Ecoparque Candeias landfill are not expected to occur either (regardless of the occurred implementation and start of operation of the GS project activity).

In summary, based on information and data included in the “*Diagnóstico do Manejo de Resíduos Sólidos Urbanos – 2017*”; information and data available in the “*Panorama dos Resíduos Sólidos no Brasil – 2024*” and also based on common practice for waste collection, currently existing very limited and not relevant recycling initiatives in the region of the GS project activity and even in other regions in Brazil, and by also taking into account the particular situation at the region of the project site, the following assertions are valid for potential of recycling of organic fraction of MSW in the region of influence of the Ecoparque Candeias landfill:

- The current MSW management practice in Brazil (and its trend for the future) represents disposal of collected MSW in existing and new landfills (and still existing open dump sites). This practice currently represents almost all undertaken management for all stream of MSW which is actually collected (in mass basis); with very reduced share of collected MSW in Brazil being currently treated under non-conventional methods such as

waste incineration and/or combustion (co-processing)¹⁷ (0.03%) and composting (0.4%) (in mass basis as per data of year 2023 (data organized and published in year 2024)).

- It is important to note that in all regions in Brazil with existing MSW disposal activities using landfilling techniques (in existing landfill or existing dump sites) significant quality improvements in terms of MSW disposal services and techniques are still being required especially for cases where solid waste is disposed in existing not-well-managed landfill or dump sites. Such required improvements include construction of better-designed landfills, use of more appropriated technics for waste compacting and covering, etc. In this particular sense, the Ecoparque Candeias landfill represents a very well-designed and very well-managed landfill site. The main barrier for improving MSW management in Brazil is still being lack of capital and investment capacity from municipalities to face high associated costs for implementing environmentally friendly MSW management operations. Under the region of influence of the Ecoparque Candeias landfill, the very largest organic fraction of solid waste material that is collected as MSW has been historically disposed by applying landfilling techniques.
- In all geographical regions in Brazil, relative very low share of previously sorted pulp/paper/cardboard (clean and not contaminated) waste materials have been used as recycling material in the region. Materials under such conditions are termed in the available statistics as “dry recyclable material” and are normally not mixed with MSW stream to be sent to landfills or dump sites. It is important to note that the initiatives and businesses involving recycling of previously sorted dry pulp/paper/cardboard materials (clean and not contaminated materials) have their particular dynamics and characteristics and with not so detailed statistics in some cases. However, under no circumstance such activities

¹⁷ Co-processing is a waste management method that uses combustion to transform waste products into fuel and raw materials. This helps conserve energy and resources elsewhere in material production, reducing industrial reliance on raw and virgin materials that are currently depleting at an unsustainable rate.

are to be affected or even influenced by change, improvements or aspects related to MSW disposal activities employing good landfilling technics (for example: in most of the well managed landfills in Brazil, the landfill is implemented in a closed and controlled area without waste pickers collecting waste from the landfill as a way or living). By taking into consideration the dynamics of initiatives promoting recycling of paper material, it is correct to assume that, differently than for MSW disposal activities; policies, planning and practices related to MSW collection and sorting could indeed under a certain limit play a role such initiatives.

- By merely promoting efficient collection and destruction/utilization of LFG in a well-managed landfill (where LFG is generated due to anaerobic degradation of organic fraction of MSW which is to be disposed in the landfill under the framework of contracts for MSW disposal signed with the municipality of Jaboatão dos Guararapes, Recife and other municipalities in the region), the occurred implementation and start of operation of the GS project activity *per se* clearly have not represented and are not expected to represent any driver or incentive for promoting any change in the MSW management situation in the region/city where it is implemented (including solid waste recycling practices or initiatives for organic content of MSW to be disposed in landfills or dump sites).

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

- It is clear that promotion or even disincentive of recycling of organic fraction of MSW are not waste policy aspects that would be under any influence or willingness of the project developer Orizon Valorização de Resíduos S.A. (as owner and operator of the Ecoparque Candeias landfill). Aspects and actions related to promotion of any increase or even reduction

of recycling of organic fraction of waste (and/or recycling of any other type of solid waste material) in the region where the GS project activity is to be implemented, are to be seen as dependent in a last instance on public service policies (including policies, laws, regulations and programs) to be set by competent governmental authorities (under a regional and national level) and by practitioners of recycling. In Brazil, the administrations of municipalities are responsible for addressing all MSW management services. Furthermore, there are federal directives and laws to be considered by Municipalities for the implementation and operation of their local waste management policies. This is the case in the geographical region of the project site. Solid waste collection and disposal services are normally performed by the municipality and/or are performed by private companies hired and paid by one or more municipalities (under contractual commercial agreements for provision of public service on behalf of such municipality (ies)) for the provision of MSW collection and/or MSW disposal services by completely following directives and requirements established by the municipalities in signed contracts. In this context, both under the baseline and project scenarios (with or without the implementation of the GS project activity), the project developer Orizon Valorização de Resíduos S.A. is not under a position to design or plan the implementation of any initiative promoting recycling or use of organic waste (e.g. operation of a solid waste composting plant) at the municipality of Jaboatão dos Guararapes or at other location in the region.

- The implementation and operation of the project-based initiative promoting collection of LFG and its destruction/utilization in high temperature flare and set of engine-generator sets at the Ecoparque Candeias landfill *per se* have not triggered and would not trigger any change in the regional policies and practices for MSW management in the region or outside its region of influence either.

As further discussed in Section B.6.1, so far, there is still no legal restriction neither requirement for LFG gas collection and its destruction using high temperature enclosed flares, engine-generator sets and/or in any other combustion device in Brazil. Moreover, there is still no legal restriction nor requirement for passive venting of LFG nor its combustion in conventional LFG

destruction systems either. There is no applicable regulation/law that deals with LFG management in Brazil. Therefore, the occurred implementation (and operation) of more appropriate and environmentally safe management of LFG at the Ecoparque Candeias landfill (as part of the GS project activity) does not represent a driver or incentive to promote incremental disposal of organic waste stream at this landfill thus displacing or preventing such waste stream from being treated under an existent or potential (hypothetical) MSW recycling/utilization facility (e.g. a hypothetical waste composting plant) instead.

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

Moreover, ACM0001 (version 19.0) is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is as follows:

"(...)

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

As further demonstrated in Section B.4, the baseline scenario for methane emissions at the Ecoparque Candeias landfill remains being the release of LFG from the SWDS directly into the atmosphere and through pre-project passive LFG venting drains (with small share of generated LFG being combusted under uncontrolled and inefficient manner). The application of the procedure to identify the baseline scenario thus falls into (a).

"(...)

- (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;(...)"

Since the project design encompasses utilization of LFG as gaseous fuel for electricity generation, (b-i) is thus also applicable.

"(...)

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

Not applicable. The project design does not encompass utilization of LFG for heat generation.

"(...)

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

Not applicable. The project design does not encompass supply of LFG end users.

"(...)

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

Since the Ecoparque Candeias landfill does not represent a Greenfield SWDS, (d) is not applicable.

Finally, ACM0001 (version 19.0) is not applicable in the following cases:

"(...)

- (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; (...)"

Not applicable. The only GHG emission reductions to be claimed by the GS project activity are due to 9i) destruction of LFG (rich in methane) through combustion (in high temperature enclosed flare) and (ii) utilization of LFG as gaseous fuel for electricity generation in the project's electricity generation infrastructure (thus displacing electricity that would be otherwise generated in existent electricity generation facilities connected to the grid and/or addition of new power generation sources). Moreover, no other approved GHG quantification methodology is used in combination with ACM0001 (version 19.0) in the context of the GS project activity.

"(...)

- (b) *If the management of the SWDS in the project activity is deliberately changed in order to increase methane generation compared to the situation prior to the implementation of the project activity."*

Not applicable. After the implementation of the GS project activity, the landfill operator has continued with MSW disposal activities at the Ecoparque Candeias landfill as per its normal and previously planned/defined operational conditions and practices (as per practices, technics and routines defined prior to the implementation of the GS project activity).

Meeting of applicability conditions and criteria for the applied CDM methodological tools are also analyzed as summarized below:

Demonstration of meeting of applicability conditions of the CDM methodological tool "Project emissions from flaring" (version 04.0):

"This tool provides procedures to calculate project emissions from flaring of a residual gas. The tool is applicable to enclosed or open flares and project participants should document in the CDM-PDD the type of flare used in the project activity."

This tool is applicable to the flaring of flammable greenhouse gases where:

- (a) *Methane is the component with the highest concentration in the flammable residual gas; (...)"*

As part of the GS project activity, collected LFG (whose component with the highest concentration is methane (CH₄)) is combusted in high temperature enclosed flare. ACM0001 (version 19.0) requires that, as part of the determination of baseline emissions, project emissions from flaring are to be determined. Condition (a) is thus applicable.

"(...)

(b) The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas)."

LFG is a flammable gas generated from the anaerobic decomposition of organic waste material disposed in the Ecoparque Candeias landfill. LFG is thus a gas from a biogenic source. Condition (b) is thus applicable.

"The tool is not applicable to the use of auxiliary fuels and therefore the residual gas must have sufficient flammable gas present to sustain combustion. For the case of an enclosed flare, there shall be operating specifications provided by the manufacturer of the flare."

Not applicable. No auxiliary fuel is required to make the flammability of LFG sufficient to be combusted in the project's flare.

Demonstration of meeting of applicability conditions of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0):

"If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption:

(a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer; (...)"

Not applicable. The electricity demand of the GS project activity has been met through a combination of sources, including supply of grid-sourced electricity, the project's own electricity generation infrastructure, and an off-grid diesel-powered generator installed as part of the GS project activity.

"(...)

This tool can be referred to in methodologies to provide procedures to monitor 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;
- (c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.

Scenario I is applied since electricity generated by the GS project activity will be supplied to the grid.

"This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO₂ emissions."

Not applicable since there was no captive renewable power generation technologies installed in the baseline scenario (absence of the GS project activity).

"(...)

- (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; (...)"

Not applicable. There is a backup captive off-grid electricity generator (fueled by diesel) installed as part of the GS project activity.

"(...)

- (c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid."

Not applicable. The electricity demand of the GS project activity has been met through a combination of sources, including supply of grid-sourced electricity, the project's own electricity generation infrastructure, and an off-grid diesel-powered generator installed as part of the GS project activity. Therefore, Scenario C is applicable.

Demonstration of meeting of applicability conditions of the CDM methodological tool "Tool to calculate the emissions factor for an electricity system" (version 07.0):

"This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects)."

Project emissions due to the consumption of electricity by the GS project activity and baseline emissions for electricity generation are both determined by applying applicable guidance of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (of which ACM0001 (version 19.0) refers to).

The CDM methodological tool "Tool to calculate the emission factor for an electric system" is referred to in the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" for the purpose of calculating both project emissions and baseline emissions in case where a GS project activity consumes electricity from the grid and exports generated electricity through the grid respectively.

The CO₂ emission factor for the electricity grid which sources electricity to the GS project activity (and through which electricity generated by the GS project activity is exported to) is determined as the combined margin CO₂ emission factor.¹⁸

"In the case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country."

The electricity grid (to which the project activity is connected) is not located partially or totally in an Annex I country.

Demonstration of meeting of applicability conditions of the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0):

"Typical applications of this tool are methodologies where the flow and composition of residual or flared gases or exhaust gases are measured for the determination of baseline or project emissions, which is the case of the present project activity."

As established by ACM0001 (version 19.0), this CDM methodological tool is applied as per the methodology for determining the mass flow of CH₄ which is sent to the project's methane destruction devices (flare and engine-generator sets). The applicability condition of the CDM methodological tool is thus met.

"Methodologies where CO₂ is the particular and only gas of interest should continue to adopt material balances as the means of flow determination and may not adopt this tool as material balances are the cost-effective way of monitoring flow of CO₂."

¹⁸ The CDM Designated National Authority (CDM DNA) of Brazil has regularly calculated and reported values for the CO₂ emission factor of the National Electricity Grid of Brazil. Such values are reported as being determined/calculated through application of the CDM methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0 (and previous versions)).

This condition is not applicable since methane (CH_4) is the main gas of interest in the particular case of the GS project activity and also in accordance with ACM0001 (version 19.0).

"The underlying methodology should specify:

(a) The gaseous stream the tool should be applied to; (...)"

As per ACM0001 (version 19.0) and in the particular case of the GS project activity, the gaseous streams the CDM methodological tool should be applied to are the "Amount of methane in the LFG which is sent to the flare" ($F_{\text{CH}_4, \text{sent_flare}}$) and the "Amount of methane in the LFG which is used for electricity generation" ($F_{\text{CH}_4, \text{EL}, y}$).

(b) For which greenhouse gases the mass flow should be determined to;

In accordance with ACM0001 (version 19.0), the greenhouse gas the mass flow should be determined to is methane (CH_4).

"(...)

(c) In which time intervals the flow of the gaseous stream should be measured; (...)"

As per ACM0001 (version 19.0), the mass flow should be calculated on an hourly basis for each hour h . Nonetheless, since there are requirements from ACM0001 which potentially require calculations to be performed under a higher frequency (e.g. under every minute basis for monitoring of operational status (on/off) of the flare and engine-generator sets), the flow of methane is thus determined on an every-minute basis.

"(...)

(d) Situations where the simplification offered for calculating the molecular mass of the gaseous stream (equations (3) or (17)) is not valid (such as the gaseous stream is predominantly composed of a gas other than N_2)."

ACM0001 (version 19.0) does not specify any situations where the simplification presented in the tool is not valid.

Demonstration of meeting of applicability conditions of the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1):

"The tool can be used to determine emissions for the following types of applications:

- (a) Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g., "ACM0001: Flaring or use of landfill gas"). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex-ante estimation of emissions in the project design document (CDM-PDD). The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS); (...)"

The GS project activity mitigates methane emissions from a landfill site as one of its GHG abatement measures. Application A in the CDM methodological tool is thus selected and applied in the context of calculations of ex-ante estimates of emission reductions to be achieved by the GS project activity as established by ACM0001 (version 19.0).

"(...)

- (b) Application B: The CDM project activity avoids or involves the disposal of waste at a SWDS. An example of this application of the tool is ACM0022, in which municipal solid waste (MSW) is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS. The methane is generated from waste disposed or avoided from disposal during the crediting period. In these cases, the tool can be applied for both ex-ante and ex post estimation of emissions. These project activities may apply the simplified approach detailed in 0 when calculating baseline emissions."

Not applicable. The GS project activity does not avoid nor affect the disposal of waste at the Ecoparque Candeias landfill through application of alternative waste treatment option.

Demonstration of meeting of applicability conditions of the CDM methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0):

"The tool is applicable to all types of proposed project activities. However, in some cases, methodologies referring to this tool may require adjustments or additional explanations as per the guidance in the respective methodologies. This could include, inter alia, a listing of relevant alternative scenarios that should be considered in Step 1, any relevant types of barriers other than those presented in this tool and guidance on how common practice should be established".

Applicable since ACM0001 (version 19.0) requires the application of the CDM methodological tool for the identification of baseline scenario and demonstration of additionality.

Demonstration of meeting of applicability conditions of the CDM methodological tool
"Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (version 03.0.1):

"This tool provides a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period, as required by paragraph 49 (a) of the modalities and procedures of the clean development mechanism.

The tool consists of two steps. The first step provides an approach to evaluate whether the current baseline is still valid for the next crediting period. The second step provides an approach to update the baseline in case that the current baseline is not valid anymore for the next crediting period".

Applicable to the GS project activity since it is required to assess the continued validity of the baseline at the renewal of a crediting period as per ACM0001 (version 19.0) and applicable guidance for renewal of crediting period (design certification renewal) of GS project activities.

B.3. Project boundary

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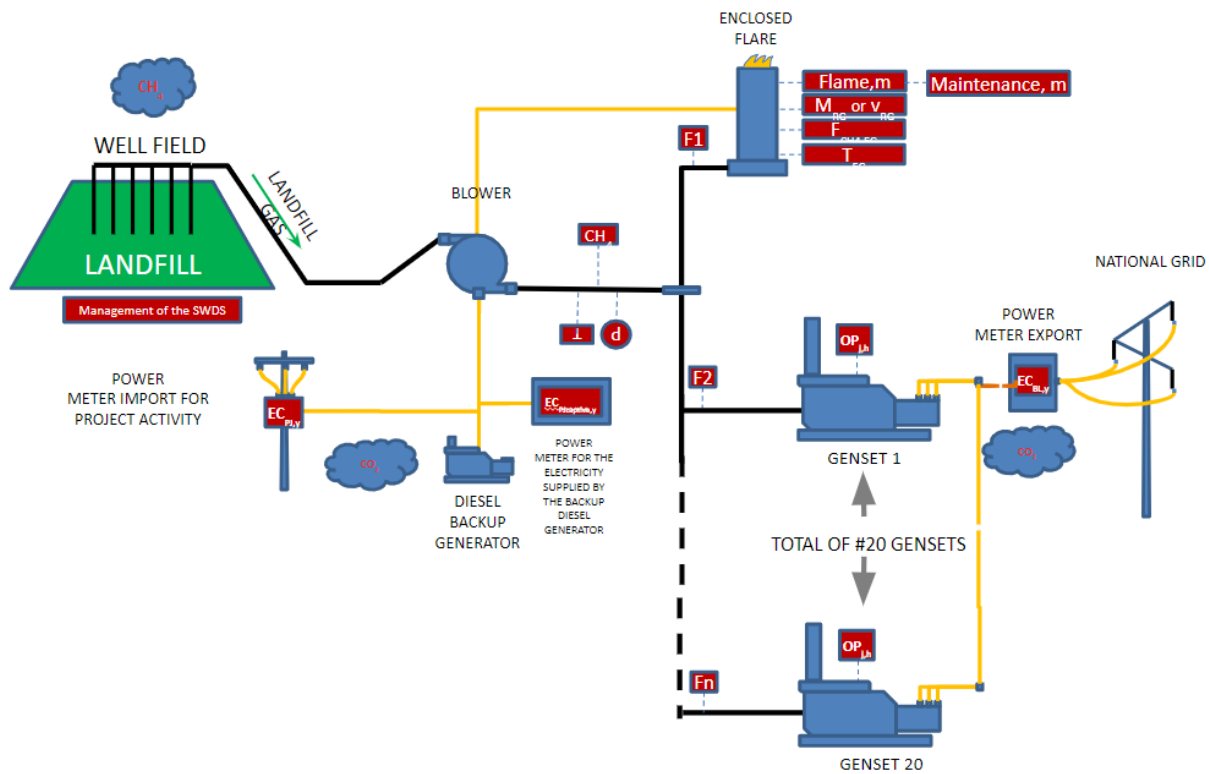
As required by ACM0001 (version 19.0) and applicable GS4GG and CDM guidance and requirements, the boundary for the GS project activity includes the landfill site where LFG is captured and destroyed/utilized (Ecoparque Candeias landfill). The electricity grid

to which the GS project activity is connected to (National Electricity Grid of Brazil) is also considered for the definition of project boundary. Under conformance with applicable guidance from ACM0001 (version 19.0), the table below provides a summary of greenhouse gases (GHG) and sources included and excluded from the project boundary:

Source	GHGs	Included?	Justification/Explanation
Baseline scenario	Emissions from decomposition of waste at the SWDS site.	CO ₂ No	CO ₂ emissions from decomposition of organic waste are not accounted since the CO ₂ is also released under the GS project activity.
		CH ₄ Yes	The major source of GHG emissions in the baseline
		N ₂ O No	N ₂ O emissions are very small when compared to CH ₄ emissions from SWDS (in tCO ₂ e). This is conservative.
	Emissions from electricity generation	CO ₂ Yes	Major emission source.
		CH ₄ No	Excluded for simplification. This emission source is assumed to be very small.
		N ₂ O No	Excluded for simplification. This emission source is assumed to be very small.
Project scenario	Emissions from consumption of grid-sourced electricity by the GS project activity	CO ₂ Yes	May be an important/material emission source.
		CH ₄ No	Excluded for simplification. This emission source is assumed to be very small.
		N ₂ O No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from flaring ¹⁹	CO ₂ No	Excluded for simplification. Emissions are negligible.
		CH ₄ Yes	May be an important emission source.
		N ₂ O No	Excluded for simplification. Emissions are negligible.

¹⁹ It is relevant to note that, as per the applied methodological approach from ACM0001 (version 19.0), the parameter "project emissions from flaring" (PE_{flare,y}) is accounted for the determination of baseline emissions (and not used for the determination of project emissions despite of being termed as "project emissions" from flaring).

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



MONITORING DEVICES AND SIMBOLOGY

F1 : FLARE FLOW METER	CH_A : LFG METHANE ANALYSER
F2 : GENERATOR 1 FLOW METER	EC_{PL,Y} : ELECTRICITY CONSUMPTION POWER METER
Fn : GENERATOR n FLOW METER	EC_{BL,Y} : GENERATED ELECTRICITY POWER METER
P : PRESSURE METERS*	EC_{CAPPLANT,Y} : CAPTIVE POWER PLANT ELECTRICITY POWER METER
T : TEMPERATURE METER	OP_{lh} : OPERATION HOURS OF THE EQUIPMENT THAT CONSUMES THE LFG
— : GAS PIPELINES	
— : POWER LINES	
	Flame,m M_{EC} or V_{EC} F_{FLAME} T_{EC} Maintenance,m : FLARE OPERATION PARAMETERS

B.4. Establishment and description of baseline scenario

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This Section includes the application of the stepwise approach of the latest version of methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" (version 03.1) in order to confirm the validity of the previously identified baseline scenario for the GS project activity as a requirement for its renewal of crediting period (design certification renewal).

Application of the stepwise approach of the CDM methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period":

As per applicable guidance of the CDM project cycle procedure for project activities (CDM-PCP-PA) and under conformance with GS4GG related guidelines and requirements, the stepwise approach of the CDM methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" (hereinafter referred to as "baseline validity tool") is to be applied in order to confirm the validity of the previously determined baseline scenario of the GS project activity.

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

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

Prior to the occurred implementation of the GS project activity, its registration under the CDM and its later transition into GS4GG, as assessed in related validation assessments, there was indeed no legal obligation or requirement to have LFG generated at the Ecoparque Candeias landfill being captured and destroyed/utilized (by using active (forced) collection systems and high temperature enclosed flare, engine-generator sets and/or any other methane destruction devices). The same condition is also applicable for any other existing

(under operation or not) landfill in Brazil at these times. This situation currently remains prevailing.

Currently, there are still no legal requirements for LFG gas collection and its destruction/utilization using active high temperature enclosed flare and/or any other combustion device in Solid Waste Disposals Sites (SWDS's) in Brazil (from open waste dumpsites to well-managed landfills). Moreover, there are still no legal restrictions, neither legal requirement for passive venting of LFG or combustion of LFG in conventional LFG destruction systems (e.g. passive flares) valid for SWDS's located in the country either. There are still no applicable regulations that deals with LFG management in Brazil.

The demonstration of continuation of the previously identified baseline scenario for the GS project activity (in terms of both methane emissions and electricity generation) is thus under full compliance with existing/valid applicable mandatory national, regional and/or sectorial policies and requirements.

The Brazilian National Policy on Waste Management:

After years of studies and negotiations, the Brazilian Regulation termed National Policy on Waste Management, established by Decree No. 7,404/10 (the Decree) was finally published on 23/12/2010. In force since its publication and with no modifications/complementation since its issuance, this decree regulates the National Policy on Waste Management (PNRS) as established by Federal Law No. 12,305 (the LPNRS) and creates the Steering Committee for the Implementation of Reverse Logistics Systems (Steering Committee) and the PNRS Interministerial Committee. This Brazilian Regulation of the National Policy on Waste Management does not establish any requirement, obligation or recommendation related to LFG management at landfills in Brazil. The following is pointed out by the law firm "Tauil & Chequer Advogados" about the *Regulation of the National Policy on Waste Management* in an article published in year 2011:

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

a PGRS. Regarding the National Registry for Hazardous Waste Operators, which must be integrated to the already existing Federal Technical Registry of IBAMA, the Decree establishes a registration obligation for companies that manipulate or operate hazardous waste. The Decree also describes those who are considered generators or operators of hazardous waste, establishing several requirements for their authorization or permitting. These include the preparation of hazardous waste management plan, the demonstration of technical and economic capacity and the obtaining of civil liability insurance for environmental damages.” [SIC]

The Brazilian Solid Waste Plan (recently published in April/2022):

After years of further studies and negotiations, the Brazilian Solid Waste Plan (Plano Nacional de Resíduos Sólidos - “PLANARES”), established by Decree No. 11,043/2022 (the Decree) was finally published in on 14/04/2022. In force since its publication, this decree regulates the previously established National Policy on Waste Management (PNRS) as established by Federal Law No. 12,305 (the LPNRS), proposes guidelines and strategies for waste management in the country. Like previously occurred with the National Policy on Waste Management (PNRS), the Brazilian Solid Waste Plan (PLANARES) does not establish any requirement, obligation or recommendation related to LFG management at landfills in Brazil.

The following is pointed out by the law firm “Tauil & Chequer Advogados” about the regulation of the year 2022 Brazilian Solid Waste Plan (PLANARES) in an article published in April/2022:

“On April 14, 2022, Decree No. 11,043 was issued by Brazilian government, approving the Brazilian Solid Waste Plan (Plano Nacional de Resíduos Sólidos - “Planares”). Planares is provided in Federal Law No. 12,305/2010, which instituted the Brazilian Solid Waste Policy (Política Nacional de Resíduos Sólidos – “PNRS”) and had been submitted for public consultation by the Ministry of the Environment.

Awaited by society for more than a decade, Planares aims to guide the management of solid waste nationally and over a 20-year horizon, taking into consideration (i) an analysis of waste generated in Brazil, (ii) the expected scenarios for managing different types of waste (based on national, international and macroeconomic trends), (iii) the applicable targets for managing different types of waste, (iv) the guidelines and strategies proposed to enable environmentally sound solid waste management, (v) the programs and actions for adequate solid waste management, (vi) the norms and technical conditions to enable access to government-funded resources, (vii) the norms and guidelines for the adequate final disposal of tailings (or residues, when applicable) and (viii) the means of control and inspection to implement and operationalize environmentally sound solid waste management.

Planares provides important management instruments, such as the national inventory of solid waste (which must be recorded by companies) and the Waste Transport Manifest (MTR), which aim at tracking and controlling the process for proper solid waste management. The plan presents objectives, including goals related to expanding the collection of urban solid waste, maximizing the recovery of materials, the energetic use of waste, the environmentally sound final disposal of waste, the closure of dumps and controlled landfills, the implementation of charges by municipalities related to solid waste management services, the progressive increase of solid waste mass recovery nationally, the formalization of contracts between municipalities and collector associations, and the implementation of initiatives for recovering organic waste."

Step 1.2: Assess the impact of circumstances

The previously identified baseline scenario for emissions of methane at the Ecoparque Candeias landfill and baseline scenario for electricity generation are not changed.

Since the baseline scenario for emissions of methane and electricity generation at the Ecoparque Candeias landfill represent the continuation of the pre-project practice and electricity generation occurring in existent grid-connected electricity generation sources (and addition of new power generation sources) without any investment, an assessment of eventual changes in market characteristics is thus required for the renewal of the crediting period (design certification renewal) of the GS project activity. This is required by the CDM methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period".

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

- The conditions and circumstances previously considered or taken into account to determine/identify the baseline emissions of methane and electricity generation at the Ecoparque Candeias landfill in the previous crediting periods under the CDM and later under GS4GG remain being valid.
- LFG (rich in CH₄) generated at the Ecoparque Candeias landfill would still be unutilized and would be freely emitted into the atmosphere with only a small share of generated LFG being combusted in the pre-project conventional passive LFG venting/combustion drains in the absence of the GS project activity.

- There are no changes in market or regulatory characteristics/aspects (incl. legal requirements) or new market or regulatory circumstances that would demand any type of re-assessment or re-evaluation for the determination/identification of the baseline scenario for emissions of methane at the Ecoparque Candeias landfill for the last GS crediting period of the GS project activity.

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

Since the previously identified baseline scenario for the GS project activity was not assumed as being *"the continuation of use of the current equipment(s) without any investment and, the projects proponents or third party (or parties) would undertake an investment later due, for example, to the end of the technical lifetime of the equipment(s) before the end of the crediting period or the availability of a new technology"*, this step is therefore directly regarded as not applicable in the context of confirmation validity of its previously identified baseline scenario.

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

While the registered GS PDD valid for the 2nd GS crediting period of the GS project activity applies the CDM baseline and monitoring methodology ACM0001 (version 19.0), the value and assumptions for most of the previously determined ex-ante selected data and parameters as per this PDD version are still valid.

Nonetheless, some of the ex-ante determined parameters and monitoring parameters have been updated for the last GS crediting period of the GS project activity as required by applicable CDM and/or GS4GG requirements and guidance.

The methodological approaches for the demonstration of validity of the previously identified baseline scenario, baseline emissions, ex-ante determined parameters and parameters monitored ex-post for the GS project activity are all presented

and justified in this Section, Section B.6.1, Section B.6.2 and Section B.7.1 + B.7.3 respectively.

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

Step 2.1: Update the current baseline

The baseline scenario for the GS project activity is not changed for its last crediting period under GS (when compared to the baseline scenario assumed for its previous crediting periods under both CDM and GS4GG). Anyway, for completeness reasons, this updated version of the PDD includes the whole determination of the baseline scenario and baseline emissions for the project activity as per the applicable guidance and requirements and stepwise approaches of ACM0001 (version 19.0).

The determination of the baseline scenario is included below under "*Determination of the baseline scenario*".

Step 2.2: Update the data and parameters

All applicable and required ex-ante determined parameters and monitoring parameters valid for the last crediting period of the GS project activity under GS4GG are presented in Sections B.6.2 and B.7, respectively.

While some of the ex-ante determined parameters are applied only in the context of ex-ante estimations of GHG emission reductions to be achieved by the GS project activity along its last crediting period, other ex-ante determined parameters will however be used for the ex-post calculation/determination of emission reductions in an ex-post basis (in conjunction with parameters determined ex-post) along the last crediting period of the GS project activity.

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

On the next steps, the continuation of the previously identified baseline scenario for the GS project activity is confirmed through the application of the stepwise approach for determining baseline scenario as per the CDM methodological tool

“Combined tool to identify the baseline scenario and demonstrate additionality” (version 07.0) as required by ACM0001 (version 19.0).

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

This optional step is not applicable for the renewal of the crediting period (design certification renewal) of a registered GS project activity.

STEP 1: Identification of alternative scenarios

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

Identification of alternatives for the destruction of LFG:

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

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

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

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

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

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

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

The GS project activity was implemented at a landfill site whose purpose is the final disposition of MSW through application of landfilling practices and techniques. The GS project activity has not previously promoted and is not expected to promote any change in waste recycling activities in the region where the Ecoparque Candeias landfill is located. In these context, it is crucial to note that with or without the GS project activity being implemented, no recycling of the organic fraction of waste disposed at the Ecoparque Candeias landfill, neither aerobic treatment, neither incineration of disposed waste streams have occurred or have prevented (or would have occurred or would have prevented) at this landfill and/or in any other landfill, or recycling station located in the region where the Ecoparque Candeias landfill.

Therefore, alternative scenarios LFG3, LFG4, LFG5 and LFG6 are hereby automatically excluded from the determination of baseline alternatives. Such exclusion is in accordance with applicable guidance of ACM0001 (version 19.0). In fact, recycling of organic matter, aerobic treatment and incineration of Municipal Solid Waste (MSW) has not been common practice in Brazil. The implementation and operation of the GS project activity have never promoted and is not expected to promote any quantitative change (including reduction) in the amount of organic solid waste that could or would be eventually recycled. This is an applicability condition/criteria of ACM0001 (version 19.0) of which compliance is further explained in Section B.2.

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

Identification of alternatives for electricity generation:

As per the project design, LFG is utilized as gaseous fuel for electricity generation to eventually meet the project's electricity demand and with the very largest share of generated electricity being exported through the electricity grid the

project activity is connected to (National Electricity Grid of Brazil). Therefore, realistic and credible alternatives for electricity generation in the absence of the GS project activity are also analyzed.

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

E1: Electricity generation from LFG, undertaken without being registered as CDM/GS project activity.

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

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

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

Identification of alternatives for heat generation:

Heat generation scenarios using LFG collected at the landfill as fuel are not part of the GS project activity as there are no heat requirements at the landfill and the GS project activity does not encompass use of collected LFG for heating or thermal purposes (i.e. use of collected LFG as gaseous fuel in boiler, air heater, glass melting furnace(s) and/or kiln). Therefore, scenarios H1 through H7, are directly assumed as not required to be considered on the present analysis. This is under conformance with ACM0001 (version 19.0).

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

Supply of LFG to a natural gas distribution network and/or distribution of compressed/liquefied LFG by using trucks are currently not considered as part of the GS project activity either. Therefore, this option is not considered on the present analysis. This is also under conformance with ACM0001 (version 19.0).

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

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

So far, there are still no legal restrictions or requirements for LFG collection and destruction/utilization in Brazil. Moreover, there are still no legal restrictions or requirements/obligations for utilizing collected LFG for generation of electricity (or any other type of LFG utilization) in Brazil either. Therefore, alternative LFG1 and LFG2 are thus under compliance with applicable mandatory laws and regulations. Alternatives E1 and E3 are also regarded as under compliance with applicable mandatory laws and regulations

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

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

As per the CDM methodological tool “Combined tool to identify the baseline scenario and demonstrate additionality”, STEP 2 (Barrier analysis) serves to identify barriers and to assess which alternative scenarios are prevented by these barriers. The “Combined tool to identify the baseline scenario and demonstrate additionality” establishes the following regarding STEP 3 (Investment analysis):

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

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

“If the proposed project activity is the first-of-its-kind then this step is not applicable. Otherwise, the previous Steps shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or

practice) has already diffused in the relevant sector and applicable geographical area. This test is a credibility check to demonstrate additionality and complements the barrier analysis (Step 2) and, where applicable, the investment analysis (Step 3)."

As per the applicable methodological guidance of both CDM baseline and monitoring methodology ACM0001 (version 19.0) and the CDM methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality", identifying the baseline scenario for a LFG collection and destruction/utilization initiative proposed as a project-based initiative is somehow combined with assessing and demonstrating additionality for such proposed project activity.

While in the particular situation of the renewal of the crediting period (design certification renewal) of a registered GS project activity it is not required to assess and demonstrate the validity of the earlier assessed/demonstrated additionality (of which in the particular case of the Ecoparque Candeias landfill was previously assessed and demonstrated), the application of STEP 2, STEP 3 and STEP 4 are thus regarded as not applicable in the context of the demonstration of the continuation of the previously identified baseline scenario for the GS project activity during its last crediting period under GS4GG as a requirement to its renewal of the crediting period (design certification renewal). This is under conformance with the CDM methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" and other applicable CDM/GS4GG guidelines and rules.

In summary, as also indicated in previous versions of the CDM PDD and GS4GG PDD for the GS project activity valid for previous crediting periods under CDM and/or GS4GG, as part of the assessment and demonstration of additionality for the GS project activity it is demonstrated that the alternatives LFG1 (*"The proposed project activity undertaken without being registered as a CDM/GS project activity"*) and E1 (*"Electricity generation from LFG, undertaken without being registered as CDM/GS project activity"*) do not represent baseline alternatives. Thus, the only remaining baseline alternatives are the alternatives LFG2 (*"Atmospheric release of the LFG or partial capture of LFG and destruction to comply with regulations or contractual requirements, or to address safety and*

odors concerns") + and E3 ("Electricity generation in existing and/or new grid-connected power plants").

Procedure for estimating the end of the remaining lifetime of existing equipment:
While remaining lifetime of existing equipment and prior consideration are also aspects to be considered in the context of the identification of the baseline scenario for a project-based initiative, the following details are also relevant in the particular context of the demonstration of validity of the previously identified baseline scenario for the GS project activity:

As per ACM0001 (version 19.0), this procedure is only applicable (in the context of the identification of the baseline scenario for the GS project activity) if LFG has been utilized in existing equipment that was in operation prior to the occurred implementation of the GS project activity. The GS project activity started to operate in year 2011 in a landfill which started its operations in year 2007. No type of LFG utilization equipment was in place prior to the occurred implementation of the GS project activity. It is also assumed that in the absence of the GS project activity, no LFG utilization equipment would be in place either.

This step of ACM0001 (version 19.0) is therefore directly assumed as not required in the context of the demonstration of the continuation of the previously identified baseline scenario for the GS project activity.

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

As an outcome of the application of the applicable guidance of the CDM methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" and ACM0001 (version 19.0), it is demonstrated the continuation/validity of the previously identified baseline scenario for the GS project activity along its last crediting period under GS4GG.

The baseline scenario for the GS project activity remains being identified as the atmospheric release of the LFG (with minor share of generated LFG being partially collected and destroyed in the previously existent pre-project passive

venting/combustion drains). Moreover, the baseline scenario remains with no LFG being utilized for electricity generation and with equivalent amount of electricity being generated in existing and/or new grid-connected power plants.

B.5. Demonstration of additionality

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

B.5.1 Prior Consideration

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This step is not applicable for the renewal of the crediting period of a registered CDM/GS project activity. As per currently valid applicable rules, it is not required to demonstrate prior consideration for the project activity in the context of the renewal of its crediting period. This step of ACM0001 (version 19.0) is thus not required in the context of the demonstration of the continuation of the baseline scenario for the project activity.

B.5.2 Ongoing Financial Need

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By considering the GS4GG rules applicable for a GS project activity currently requesting renewal of its GS crediting period (design certification renewal)²⁰, the project developer Orizon Valorização de Resíduos S.A. highlights and hereby demonstrates (a) the GS project activity remains below its expected and reasonable minimum financial/economical attractiveness and (b) the GS project activity has been kept under operation as a result of overall expectation of incurrence of incremental earnings due to the commercialization of GS VERs for monitoring period(s) encompassed by the 3-year period from 29/09/2023 to 28/09/2026 under attractive market conditions²¹.

²⁰ As per applicable GS4GG rules and procedures, registered GS projects requesting design renewal are requested to demonstrate Ongoing Financial Need (OFN) at its Design Certification Renewal phase. As part of the OFN demonstration, "(...) the project shall provide a qualitative narrative, supported by an overview of project finances, that demonstrates how the finance derived Gold Standard Certification is material to the ongoing sustainability of the Project. The narrative may include, but not limited to the following:

- Information highlighting the key categories and amounts or relative proportions (%) of project income and outgoings, including the relative proportion of certification related cost and revenue.
- Description on how finance derived Gold Standard Certification contributes to or is being used to sustain or enhance the project. Where no revenue is realised from Gold Standard certification during a given period, this would be considered a FAR for the next Issuance."

²¹ It is relevant to note that, in order to address one of the comments raised by GS4GG as part of its previously concluded review and approval for the design review in the context of the successfully occurred recent transition of the GS project activity from the CDM to GS4GG, a complementary financial analysis (which was enclosed to the previously completed and submitted GS4GG Transition Request Form (TRF) + PDD for the project activity (termed "Complementary Financial Analysis DEV277.xls") and was assessed by the appointed GS Validation and Verification Body (VVB)) was performed in year 2024 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 ensuring the financial stability of the project activity in light with its current and forecasted project financials (even considering the already received carbon revenues from the commercialization of CDM CERs)". This complementary financial analysis was performed (and validated/assessed by appointed GS Validation and Verification Body (VVB)) by taking into consideration the following data and assumptions:

- 1) Total incurred historical annual capital expenditures (CAPEX) by the project activity (along its gradual/phased occurred implementation schedule) up to mid of year 2024.
- 2) 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 operation up to the end of year 2023.
- 3) All CDM carbon revenues earnings incurred as a result of the operation of the project activity as a CDM project activity (based on historical records considering the quantities and prices valid for each vintage year for which CDM CERs were issued)
- 4) All electricity generation related revenues incurred up to the end of year 2023 as a result of the operation

Such demonstration is performed by considering the following aspects:

- So far incurred revenues due to commercialization of CDM Certified Emission Reductions (CDM CERs) and GS Voluntary Emission Reductions (GS VERs) so far issued as a result of operation and monitoring for the GS project activity;
- So far incurred revenues due to the commercialization of electricity during the entire so far occurred project operational period from year 2012 to year 2024;
- Projections/forecasts for future (yet to be incurred) revenues due to the commercialization of electricity during the period from year 2025 to year 2031;
- Projections/forecasts for future (yet to be incurred) revenues due to the commercialization of yet to be issued GS VERs from the GS project activity along its currently expired 2nd crediting period under GS4GG (upon successful yet to occur issuance of GS VERs).

of the project activity (based on historical records considering records of electricity amount and electricity prices up to year 2023)

- 5) Forecasted future revenues due to the commercialization of electricity to be generated by the project activity during the period from year 2025 to year 2031 based on forecasts for both (a) electricity commercialization prices and (b) amount of electricity generation valid/applicable for each considered year under 2 scenarios for electricity prices (using (i) annual price 6-year projections from year 2023 to 2028 derived by charted energy market specialist PSR, Inc (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).
- 6) Forecasted future annual OPEX of infrastructure encompassed by the project activity (including 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 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) and represents a complementary assessment to the previously performed assessment and demonstration of additionality of the project activity in year 2011 and was completed and was previously submitted with the intention to support the demonstration of the role of GS carbon revenues for the project activity (that would face a serious risk of discontinuation in the absence of carbon revenues expectations).

The OFN analysis included in this updated GS4GG PDD for the GS project activity (under its new and last crediting period under GS4GG) is based on the previously performed complementary financial analysis (which was previously enclosed to the previously completed and submitted GS4GG Transition Request Form (TRF) + PDD for the project activity (termed "Complementary Financial Analysis DEV277.xls") and was assessed by the appointed GS VVB) with dated and assumption being updated/adjusted (by taking into account values and assumptions applicable/valid for year 2024 (which were not available at the time of compilation of the so-called complementary financial analysis in mid-year 2024).

In the particular context of ongoing financial needs (OFN) of the GS project activity, the yet to be incurred remaining and eligible carbon revenues for the last GS crediting period for the GS project activity (upon its successful design certification renewal) is therefore hereby demonstrated to represent a crucial and complementary revenue source. In this context, carbon revenues for the last crediting period of the GS project activity under its last GS crediting period instrumentally complement both (i) occurred and yet to occur revenues due to commercialization of electricity generated by the GS project activity as well as (ii) carbon revenues historically promoted) (with such historical carbon revenues being acknowledged as being mostly promoted under non-attractive market conditions for so far commercialized CDM CERs (in the average)²²).

In order to demonstrate the above-summarized crucial and important role of carbon revenues for the last GS crediting period for the GS project activity, an ongoing financial needs (OFN) analysis (presented in the additional spreadsheet termed "*OFN Design Renewal Ecoparque Candeias Landfill Gas Project*") is performed with the goal/purpose of effectively and transparently demonstrating the instrumental role that yet to occur commercialization of GS VERs yet to be issued for the period encompassing the last GS crediting period for the GS project activity have towards its overall financial sustainability.

Such OFN analysis takes into consideration historical project financials and also considers realistic financial forecasts (from year 2025 onwards).

The OFN financial analysis is performed by taking into consideration the following data:

- 1) Total incurred historical annual capital expenditures (CAPEX) by the GS project activity (along its gradual/phased occurred implementation schedule).
- 2) Total incurred historical annual costs for the operation and maintenance (OPEX) of the infrastructure encompassed by the project activity (along its occurred

²² The non-attractive market conditions for previously issued and commercialized CDM CERs represents low market price for the issued CDM CERs and low liquidity during the whole period prior to year 2022. These conditions are also reflected in the occurred commercialization of issued CDM CERs for the whole period from year 2012 to year 2020 occurring only from year 2020 onwards.

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

operation^{23 24 25}.

²³ The annual OPEX figures presented in the OFN 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."*

²⁴ Under conformance with related manufacturer requirements and their technical design and construction, the INNIO Jenbacher engine-generator sets require a significantly costly major overhaul after 60,000 / 80,000 hours of operation (overhaul times may vary depending on engine series and type). Major overhaul is defined as the complete maintenance of the engine, in which all wearing parts of the engine are replaced in both the upper and lower parts (e.g. main bearings, cylinder liners, pistons, connecting rod bearings, connecting rod bushings...). The major overhauling work represents expenses in both spare parts and service (replacement of parts, machining/fine adjustment of parts, control and test of elements/systems of the units, oil replacement, etc.). As part of the major overhauling programme options made available by the aftermarket division of the engine-generator manufacturer, the following service packages are offered (depending on the conditions and design of the engine-generator set requiring such overhaul work:

- **SHORT BLOCK programme – general engine repair:** The Short Block repair option offers optimum cost and allows the use of remanufactured parts. An additional benefit is the option of technical retrofitting. The scope of the programme includes the following:
 - New spare parts: camshaft, bearings, pistons, cylinder heads, connecting rods, silencer, spark plugs and oil filter
 - Refurbished spare parts: crankcase, crankshaft, cylinder heads
 - Optional engine painting and leak test can be carried out.
- **LONG BLOCK programme – general engine and auxiliary equipment repairs:** The Long Block version of the programme is an extended version of the general engine repair of the SHORT BLOCK overhaul programme, tailored to the specific conditions of the engine-generator set. As part of this programme, the engine undergoes comprehensive testing on INNIO's Jenbacher test rig. The scope of the programme includes the following:
 - all spare parts and Short Block programme work
 - generator and heat exchanger repair
 - intercooler replacement
 - new exhaust manifold
 - Other optional services: engine painting, engine test run, engine upgrades (power boost, etc.).
- **GENSET BLOCK programme – general engine repairs, auxiliary equipment and generator repairs:** The GenSet Block scope repair programme includes the repair of the entire module. The scope of the programme includes the following:
 - Long Block programme
 - New alternator (generator) (from supplier),
 - New heat exchanger (from supplier),
 - Upgraded control cabinet and new connection elements.
 - Other optional services available: engine painting, engine test run, engine revamping, wiring diagram check.

Further details about the required costs associated major overhaul for the project's engine-generator sets are available online:

<https://www.kts-eng.com/en/service/innio-jenbacher/kapitalnyj-remont/>
<https://rsmotorps.com/en/overhaul-and-overhaul-of-jenbacher-engines/>

- 3) All CDM carbon revenues earned so far as a result of the operation of the project activity as a CDM project activity (based on historical records considering the quantities and prices valid for each vintage year for which CDM CERs were issued)
- 4) All GS carbon revenues earned so far as a result of the more recently occurred migration of the GS project activity to GS4GG (figures based on available accounting/financial records and considering the quantities and prices valid for GS VERs so far issued and commercialized).
- 5) All electricity generation related revenues earned so far as a result of the historical operation of the GS project activity (based on historical records considering records of electricity amount and electricity up to year 2024)
- 6) Forecasted future revenues due to the commercialization of electricity to be generated by the GS project activity during the period from year 2025 to year 2031 (based on realistic and credible forecasts for both electricity commercialization prices and amount of generated electricity valid/applicable for each year encompassed by the period. In this context, electricity commercialization price projections from year 2025 to 2031 are derived by taking into consideration the conclusions of a credible technical and market study conducted by the chartered energy market specialist group PSR, Inc²⁶ (price series which somehow reflect an widely acknowledged trend of decrease in electricity prices in the Brazilian market for commercialization of electricity generated by independent power producers (IPPs) for the future). It is also taken into consideration more favorable/attractive market conditions for yet to occur commercialization of GS VERs issued and to be potentially issued by GS the project activity.
- 7) Forecasted future annual OPEX of infrastructure encompassed by the project activity (including required and expensive major overhauling work in the engine-

²⁵ The annual OPEX figures presented in the complementary financial analysis include costs associated with the required performance of major overhaul in the engine-generator sets of the project's electricity generation infrastructure.

²⁶ Operating in more than 70 countries, PSR Inc is a global provider of energy consulting services, computational modeling and energy innovation. PSR Inc. has actively contributed to research and development of optimization and data analytics solutions within different power markets. More information about PSR Inc is available online: https://www.psr-inc.com/en/who_we_are/

generator sets of the project's electricity generation after 60,000 hours of operations).

It is relevant to note that historically generated carbon revenues refer to the occurred commercialization of a total combined amount of issued 1,374,593 CDM CERs (with vintages from 2012 to 2020) (issued and commercialized during the period from year 2013 to 2021) and 1,489,070 GS VERs (issued and/or commercialized during the period from year Jan./2021 to Feb./2023 as outcome of the previously performed 1st verification (performance review) of the GS project activity under GS4GG (monitoring period from 01/01/2021 to 28/02/2023).

Under conformance with GS4GG principles and requirements, the performed OFN financial analysis (that considers figures, technical 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) and later (at the time of its more recent transition in GS4GG) somehow represents a complementary assessment to the previously performed assessment and demonstration of additionality of the GS project activity (at the time of its performed validation under the CDM by year 2011) and such OFN analysis is intended to demonstrate the role and importance of GS carbon revenues for the GS project activity (that would face a serious risk of discontinuation in the absence of carbon revenues expectations) as well as meeting the applicable GS4GG requirement for renewal of crediting period (design certification renewal) of GS project activities.

Financial cash flows (under 2 scenarios for future electricity prices for the period from year 2025 onwards) are presented in the OFN analysis spreadsheet and are representative for the whole project implementation and operation period encompassing:

- (I) 7-year period from the year of the previously occurred implementation and start of operation of the project activity as a CDM project activity (under its initial configuration, in year 2012) until the year prior to the implementation and start of operation of the project's electricity generation infrastructure (year 2019). During this 7-year period, carbon revenues under the CDM represented the only revenue source for the project activity.

- (II) 13-year period encompassing the year when the implementation and start of operation of the project's electricity generation infrastructure occurred (year 2019) until the end of the project's 20-year lifetime (year 2031). During this 13-year period, occurred electricity revenues (from year 2019 until year 2022) and forecasted electricity revenues (from year 2023 to 2031) represent the project's revenue stream which are expected to be complemented by revenues due to commercialization of yet to be issued GS VERs (which cannot be precisely or reasonably estimated for the whole remaining lifetime of the project activity due to all uncertainties related both to the quantity of GS VERs to be issued as well as related to prices for issued GS VERs).

In summary, the details and results of the performed OFN analysis (as outlined in the OFN analysis spreadsheet enclosed to this GS4GG PDD) allow the sufficient and transparent demonstration that the GS project activity indeed requires future stream of carbon credit revenues under GS4GG during its last crediting period for having all previously incurred and its yet to be incurred CAPEX and OPEX of the project activity as well as assumed business and investment risks being fully and fairly amortized/remunerated and with a deemed minimum and acceptable level of profit being achieved. In this context, requires future stream of carbon credit revenues under GS4GG during its last crediting period are demonstrated to represent a crucial and complementary revenue stream to the also important revenue streams related to the commercialization of generated electricity so far occurred and yet to occur + previously occurred carbon revenues under the CDM and more recently under GS4GG.

Since the early years of the carbon market under the CDM, the management team of the project developer / project owner and its major shareholders have believed that past and future carbon revenues have 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 summary, in line with the most recent and credible market trends and forecasts (which, differently than years ago, include optimistic views for the global carbon market), the decision-making team of the project developer Orizon Valorização de Resíduos S.A. is of the opinion that future stream of GS VERs to be issued by the project activity within its last crediting period under GS4GG will indeed represent a singular and important revenue source for the GS project activity, therefore contributing to its sustainable and continuous operation. That aspect

represents an important driver to maintain the GS project activity under operational status regardless of the long-term trend of relative decrease of the commercialization prices for electricity generated by renewable energy sources in Brazil.

Regarding the rationale of how the GS project activity as been kept under operational status regardless of the lack of carbon revenues in recent years (with exception of the more recently occurred revenue incurrence due of partial commercialization of a share of more recently issued GS VERs upon the occurred successful migration of the project activity to GS4GG (GS VERs for the monitoring periods within the period from 01/01/2021 to 28/09/2023), the following aspects are also required to considered in the context of the OFN analysis:

- 1) It is instrumental to note that Orizon Valorização de Resíduos S.A. has dealt with temporary lack of promotion of carbon revenues not only for the GS project activity, but also for other of its project-based initiatives promoting LFG collection and destruction/utilization implemented in other landfill sites owned and operated by the company in Brazil.
- 2) 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 in which long term decisions are taken based on long-term strategical and operational planning for the company. The GS 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.
- 3) Since the early years of the carbon market under the CDM (by year 2006), 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/supply initiatives in Brazil.
- 4) In line with the most recent and credible market trends and forecasts with much

more optimistic views for the global carbon market (when compared to the situation within the period from year 2013 to 2020 for example), 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 GS project activity within its last crediting period under GS4GG will indeed represent a singular and important revenue source for the GS project activity, thus contributing to its sustainable and continuous operation. That represents an important driver to maintain the GS project activity (as well as other project-based initiatives implemented and/or under implementation by the group) under operational status regardless of all related market and regulatory uncertainties for carbon and electricity (including a real long-term trend of relative decrease of the commercialization prices for electricity generated by renewable energy sources in Brazil).

All operations of Orizon Valorização de Resíduos S.A. (including the GS project activity and the well-managed landfill where it is implemented) follow a clearly and well-defined/well-structured company's Corporate Social Responsibility (CSR) strategy with the company's business model being required to integrate 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.

B.6. Sustainable Development Goals (SDG) outcomes

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 (mandatory)	13.2: Integrate climate change measures into national policies, strategies and planning	SDG Impact: Reduction in GHGs emissions Indicator: Amount of GHG emissions avoided or sequestered
7 Affordable and Clean Energy	7.2: By 2030, increase substantially the share of renewable energy in the global energy mix	SDG Impact: Renewable energy generation 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 GS project activity is a renewable energy project activity which has displaced electricity generated using fossil fuels. The GS project activity therefore contributes towards the increase in the share of renewable energy in the energy mix of Brazil.

The GS project activity is expected to generate 224,852 MWh of electricity per year during its last crediting period under GS4GG.

Quantity of grid-sourced electricity consumed by the GS project activity along its last crediting period under GS4GG is expected to be 152 MWh per year.

The measurement method consists of continuous measurements by electricity meters for generated electricity exported through the electricity grid and consumption of grid-sourced electricity.

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

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

Regarding the identified baseline scenario (same situation prior to the implementation of the GS project activity), no jobs would be created since there would be no infrastructure for promoting forced collection and flaring and/or utilization of LFG historically generated at the Ecoparque Candeias Landfill in the absence of the GS project activity.

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.

As mentioned above, the GS project activity applies the CDM baseline and monitoring methodology ACM0001 "Flaring or use of landfill gas" (version 19.0) and applicable CDM methodological tools. The methods for calculating baseline emissions, project emissions, leakage emissions and emission reductions are explained below:

In accordance with ACM0001 (version 19.0) and applicable CDM methodological tools, emission reductions (ER_y) to be achieved by the GS project activity during its last crediting period under GS4GG are to be determined (in tCO₂e) as the difference between baseline emissions (BE_y) and project emissions (PE_y) as follows:

$$ER_y = BE_y - PE_y \quad (0)$$

Where:

ER _y	Emissions Reductions in year y (in tCO ₂ e/yr)
BE _y	Baseline emissions in year y (in tCO ₂ e/yr)
PE _y	Project emissions in year y (in tCO ₂ e/yr)

Determination of Baseline Emissions (BE_y):

As per ACM0001 (version 19.0), baseline emissions (BE_y) for a project activity promoting collection and destruction/utilization of LFG are to be generically determined according to equation (1) and comprises the following potential generic emission sources:

- Baseline methane emissions from the SWDS in the absence of the project activity
- Baseline emissions for electricity generation using fossil fuels or supplied by the grid in the absence of the project activity
- Baseline emission for heat generation using fossil fuels in the absence of the project activity

- Baseline emissions for natural gas use from existing natural gas network in the absence of the project activity

$$BE_y = BE_{CH_4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y} \quad (1)$$

Where:

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

Since the GS project activity promotes mitigation of CH₄ emissions, $BE_{CH_4,y}$ is thus applicable in the context of the determination of baseline emissions.

Since Electricity generation using LFG as gaseous fuel is considered/regarded as an additional GHG abatement/mitigation measure for the GS project activity, $BE_{EC,y}$ is thus applicable in the context of the determination of baseline emissions for the GS project activity.

Since as per the project design, no collected LFG is currently expected to be upgraded and supplied to consumer(s), $BE_{NG,y}$ is thus not applicable, moreover no LFG is expected to be used as gaseous fuel for heat generation purposes, $BE_{HG,y}$ is thus also not applicable in the context of the determination of baseline emissions for the GS project activity.

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

$$BE_y = BE_{CH_4,y} + BE_{EC,y} \quad (2)$$

Determination of baseline emissions of methane from the SWDS ($BE_{CH_4,y}$):

Baseline emissions of methane from the SWDS ($BE_{CH_4,y}$) is calculated in conformance with the applied CDM baseline and monitoring methodology ACM0001 (version 19.0) + applicable CDM methodological tools by following the approaches presented below (where the determination of $BE_{CH_4,y}$ is based on the amount of methane that is actually captured and combusted as a result of the implementation and operation of the GS project activity and also by taking in account the amount of methane that would be captured and destroyed in the landfill in the absence of the GS project activity (baseline scenario)). In addition, the effect of methane oxidation (that is assumed as existing in the baseline scenario, but not in the project scenario) is also taken into account as also required by ACM0001 (version 19.0)²⁷.

$$BE_{CH_4,y} = ((1 - OX_{top_layer}) * F_{CH_4,PJ,y} - F_{CH_4,BL,y}) * GWP_{CH_4} \quad (3)$$

Where:

OX_{top_layer}	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline scenario (dimensionless)
$F_{CH_4,PJ,y}$	Amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year y (in tCH ₄ /yr)
$F_{CH_4,BL,y}$	Amount of methane that would be destroyed through flaring of LFG in the baseline scenario (absence of project activity) in year y (in tCH ₄ /yr)
GWP_{CH_4}	Global warming potential of CH ₄ (in tCO ₂ e/tCH ₄)

²⁷ As established by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), the ex-ante determined parameter OX_{top_layer} is the fraction of the methane that would be oxidized in the top layer of the considered SWDS (i.e. the Orizon Valorização de Resíduos S.A.) in the absence of the GS project activity (baseline scenario).

As per ACM0001 (version 19.0), it is assumed that for a typical landfill hosting an LFG collection and destruction and/or utilization project activity, this effect is reduced since part of LFG which is captured does not pass through the top layer of the considered SWDS. This oxidation effect is also accounted for in the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1). In addition to this effect, the installation of an LFG capture system under the GS project activity may result in the suction of additional air into the considered SWDS. In some cases, such as project activities where the LFG collection is based on high suction pressure, the suction effort may decrease the amount of methane that is generated in the landfill under the project scenario. However, in most circumstances where the LFG is captured and used this effect was considered to be very small, as the operators of landfills have, in most cases, an incentive to maintain a high methane concentration in the LFG. For this reason, this effect is neglected as a conservative assumption.

Ex post determination of $F_{CH_4,PJ,y}$:

As per the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), the amount of methane which is destroyed by the GS project activity is to be generically ex-post determined as the sum of quantities of methane destroyed through combustion of collected LFG in flare(s), power plant(s), boiler(s), air heater(s), glass melting furnace(s), kiln(s) (methane destruction devices) and/or by supply of collected LFG to consumer(s) through natural gas distribution network based on ex-post measurements, as follows:

$$F_{CH_4,PJ,y} = F_{CH_4,flared,y} + F_{CH_4,EL,y} + F_{CH_4,HG,y} + F_{CH_4,NG,y} \quad (4)$$

Where:

$F_{CH_4,flared,y}$	Amount of methane which is destroyed through combustion of collected LFG in the flare in year y (in tCH_4).
$F_{CH_4,EL,y}$	Amount of methane which is destroyed through combustion of collected LFG in the engine-generator sets in year y (in tCH_4).
$F_{CH_4,HG,y}$	Amount of methane which is destroyed through combustion of collected LFG in heat generation device(s) in year y (in tCH_4/yr). The project design currently does not encompass combustion of collected LFG in heat generation device(s). Thus, $F_{CH_4,HG,y}$ is assumed as null (zero).
$F_{CH_4,NG,y}$	Amount of methane which is destroyed by supply of collected LFG to consumer(s) through natural gas distribution network in year y (in tCH_4/yr). The project design currently does not encompass the supply of collected LFG to consumer(s). Thus, $F_{CH_4,NG,y}$ is assumed as null (zero).

In summary, while the GS project activity encompasses LFG flaring and generation of electricity through utilization of LFG as its GHG abatement measures and technologies, the amount of methane which is destroyed by the GS project activity through combustion of collected LFG in project's methane destruction devices will be therefore ex-post determined as follows:

$$F_{CH_4,PJ,y} = F_{CH_4,flared,y} + F_{CH_4,EL,y} \quad (5)$$

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

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

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

Where:

$F_{CH4,flared,y}$	Amount of methane which is destroyed through combustion of collected LFG in the flare in year y (in tCH ₄ /yr)
$F_{CH4,sent_flare,y}$	Amount of methane in collected LFG which is sent to the flare in year y (in tCH ₄ /yr)
$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year y (in tCO ₂ e/yr)
GWP_{CH4}	Global warming potential of CH ₄ (in tCO ₂ e/tCH ₄)

For the installed high temperature enclosed flare, $F_{CH4,sent_flare,y}$ is determined by following applicable guidance of the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" As per the ACM0001 (version 19.0), the following requirements apply for the determination of $F_{CH4,sent_flare,y}$:

- The gaseous stream that shall be considered in the application of the CDM methodological tool is the stream of collected LFG which is sent for combustion in the flare
- CH₄ is the greenhouse gas for which the mass flow is determined
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in the CDM methodological tool)
- The mass flow should be calculated at least on an hourly basis for each hour h in year y

Determination of the amount of methane in collected LFG which is used for electricity generation ($F_{CH_4,EL,y}$)²⁸:

$F_{CH_4,EL,y}$ is determined directly using applicable guidance of the CDM methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, by applying the following requirements defined in ACM0001 (version 19.0):

- The gaseous stream the CDM methodological tool shall be applied to is the stream of collected LFG which is sent to each engine-generator sets of the electricity generation facility.
- CH₄ is the greenhouse gas for which the mass flow is determined.
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in the tool).
- The mass flow should be calculated on an hourly basis for each hour h in year y .
- The mass flow calculated for hour h is 0 if the engine-generator sets are not working in hour h ($O_{pj,h}$ = equipment not working), the accumulated hourly values are then summed to a yearly unit basis.

Applicable guidance of the CDM methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” will be applied ex-post to determine $F_{CH_4,sent_flare,y}$ and $F_{CH_4,EL,y}$ by using one of the options A, B, C or D. The selection of the determination option will depend on project conditions and/or monitoring equipment/instruments to be installed and under operation as part of the GS project activity during its last crediting period under GS4GG.

²⁸ $F_{CH_4,EL,y}$ is determined for each stream of collected LFG which is sent to each engine-generator of the project’s electricity generation infrastructure, by using applicable guidance of the CDM methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” and by applying requirements defined in ACM0001 (version 19.0).

Use of Option A, B, C or D for the determination of $F_{CH4,sent_flare,y}$ and $F_{CH4,EL,y}$:

As established by the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", depending on the project conditions, one of the following measurement options will be chosen and the following formulas applied for the ex-post determination of $F_{i,t}$.²⁹:

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

Option A:

Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. There are two ways to do this:

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

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

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

²⁹ The selection of option A, B, C or D will occur on an ex-post basis depending on the type and/or specifications of monitoring equipment installed and under operation as part of the GS project activity during its last crediting period under GS4GG.

³⁰ Flow measurement on a dry basis is not feasible at reasonable costs for a wet gaseous stream, so there will be no difference in the readings for volumetric fraction in wet basis analyzers and dry basis analyzers and both types can be used indistinctly for calculation Options A and D.

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

with

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

Where:

$F_{i,t}$	Mass flow of greenhouse gas i in the gaseous stream in time interval t (in kg gas/h)
$V_{t,db}$	Volumetric flow of the gaseous stream in time interval t on a dry basis at normal conditions (in m ³ dry gas/h)
$v_{i,t,db}$	Volumetric fraction of greenhouse gas i in the gaseous stream in time interval t on a dry basis (in m ³ gas i /m ³ dry gas)
$\rho_{i,t}$	Density of greenhouse gas i in the gaseous stream (in kg gas i /m ³ gas i)
P_t	Absolute pressure of the gaseous stream in time interval t (in Pa)
MM_i	Molecular mass of greenhouse gas i (in kg/kmol)
R_u	Universal ideal gases constant (in Pa.m ³ /kmol.K)
T_t	Temperature of the gaseous stream in time interval t (in K)

Option B:

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

$$V_{t,db} = V_{t,wb} / (1 + v_{H_2O,t,db}) \quad (9)$$

Where:

$V_{t,db}$	Volumetric flow of the gaseous stream in time interval t on a dry basis (in m ³ dry gas/h)
$V_{t,wb}$	Volumetric flow of the gaseous stream in time interval t on a wet basis (in m ³ wet gas/h)
$v_{H_2O,t,db}$	Volumetric fraction of H ₂ O in the gaseous stream in time interval t on a dry basis (in m ³ H ₂ O/m ³ 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:

$$V_{H_2O,t,db} = \frac{m_{H_2O,t,db} * MM_{t,db}}{MM_{H_2O}} \quad (10)$$

Where:

$V_{H_2O,t,db}$	Volumetric fraction of H ₂ O in the gaseous stream in time interval t on a dry basis (in 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 (in 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 (in kg H ₂ O/kmol H ₂ O)

In case this Option is selected, the absolute humidity of the gaseous stream ($m_{H_2O,t,db}$) will be determined using Option 2 specified below under “Determination of the absolute humidity of the gaseous stream” and the molecular mass of the gaseous stream ($MM_{t,db}$) will be determined using the following equation:

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

Where:

$V_{k,t,db}$	Volumetric fraction of gas k in the gaseous stream in time interval t on a dry basis (in m ³ gas k /m ³ dry gas)
MM_k	Molecular mass of gas k (kg/kmol)
k	All gases, except H ₂ O contained in the gaseous stream (e.g. N ₂ , CO ₂ , O ₂ , CO, H ₂ , CH ₄ , N ₂ O, NO, NO ₂ , SO ₂ , SF ₆ and PFCs). See simplification below.

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

Option C:

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

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

with

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

Where:

$F_{i,t}$	Mass flow of greenhouse gas i in the gaseous stream in time interval t (in kg gas/h)
$V_{t,wb,n}$	Volumetric flow of the gaseous stream in time interval t on a wet basis at normal conditions (in m ³ wet gas/h)
$v_{i,t,wb}$	Volumetric fraction of greenhouse gas i in the gaseous stream in time interval t on a wet basis (in m ³ gas i /m ³ wet gas)
$\rho_{i,n}$	Density of greenhouse gas i in the gaseous stream at normal conditions (in kg gas i /m ³ wet gas i)
P_n	Absolute pressure at normal conditions (in Pa)
T_n	Temperature at normal conditions (in K)
MM_i	Molecular mass of greenhouse gas i (in kg/kmol)
R_u	Universal ideal gases constant (in Pa.m ³ /kmol.K)

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

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

Where:

$V_{t,wb,n}$	Volumetric flow of the gaseous stream in a time interval t on a wet basis at normal conditions (in m ³ wet gas/h)
$V_{t,wb}$	Volumetric flow of the gaseous stream in time interval t on a wet basis (in m ³ wet gas/h)
P_t	Pressure of the gaseous stream in time interval t (in Pa)
T_t	Temperature of the gaseous stream in time interval t (in K)
P_n	Absolute pressure at normal conditions (in Pa)

T_n Temperature at normal conditions (in K)

Option D:

Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. There are two ways to do this:

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

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

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

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

Where:

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

$M_{t,db}$ Mass flow of the gaseous stream in time interval t on a dry basis (in kg/h)

$\rho_{t,db}$ Density of the gaseous stream in time interval t on a dry basis (in kg dry gas/m³ dry gas)

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

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

Where:

$\rho_{t,db}$ Density of the gaseous stream in a time interval t on a dry basis (in kg dry gas/m³ dry gas)

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

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

Determination of the absolute humidity of the gaseous stream

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

Option 2 of the tool is selected for the GS project activity:

Option 2: Simplified calculation without measurement of the moisture content

This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. If it is conservative to assume that the gaseous stream is dry, then $m_{H_2O,t,db}$ is assumed to equal 0. If it is conservative to assume that the gaseous stream is saturated, then $m_{H_2O,t,db}$ is assumed to be equal the saturation absolute humidity ($m_{H_2O,t,db,sat}$) and calculated using equation (7).

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

Where:

$m_{H_2O,t,db,sat}$	Saturation absolute humidity in time interval t on a dry basis (in kg H ₂ O/kg dry gas)
$p_{H_2O,t,sat}$	Saturation pressure of H ₂ O at temperature T_t in time interval t (in Pa)
T_t	Temperature of the gaseous stream in time interval t (in K)
P_t	Absolute pressure of the gaseous stream in time interval t (in Pa)
MM_{H_2O}	Molecular mass of H ₂ O (in kg H ₂ O/kmol H ₂ O)
$MM_{t,db}$	Molecular mass of the gaseous stream in a time interval t on a dry basis (in kg dry gas/kmol dry gas). $MM_{t,db}$ is estimated by using equation (11).

Determination of $PE_{flare,y}$ (required for the determination of $F_{CH4,flared,y}$):

As established by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), $PE_{flare,y}$ is determined by following applicable guidance of the CDM methodological tool "Project emissions from flaring".

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

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

- Step 1: Determination of the methane mass flow of the residual gas
- Step 2: Determination of the flare efficiency
- Step 3: Calculation of project emissions from flaring

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

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

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

- The CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" shall be applied to the residual gas
- The flow of the gaseous stream shall be measured continuously
- CH_4 is the greenhouse gas i for which the mass flow should be determined
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool)
- The time interval t for which mass flow should be calculated is every minute m .
- $F_{CH4,m}$, which is measured as the mass flow during minute m , shall then be used to determine the mass of methane (in kilograms) fed to the flare in question in the minute m ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis.

Step 2: Determination of flare efficiency:

As required by ACM0001 (version 19.0), the flare efficiency value is to be determined the installed high temperature enclosed flare. Also, as per ACM0001 (version 19.0), flare efficiency represents the combustion efficiency of LFG in the flare in terms of CH₄ by considering inter alia the time and condition that the flare in question is operating.

For determining the combustion efficiency for the enclosed flare, the selected option of the CDM methodological tool "Project emissions from flaring" are (i) the option to apply a default efficiency value or (ii) determining the flare efficiency based on monitored data (based on applicable measurements and calculations).

In the case of the GS project activity, the Option A (application of default values) is selected.

Option A: Application of default value:

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

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

If for the minute m , conditions (1) and/or (2) are not met, $\eta_{\text{flare},m}$ is set as 0% for the minute in question. Furthermore, as also established by the CDM methodological tool "Project emissions from flaring", for enclosed flare that is defined as low height flare, the flare efficiency shall be adjusted, as a conservative approach, by subtracting 10 percentile points. For example, the default value applied shall be 80%, rather than 90%.

Option B: Measured flare efficiency:

For the high temperature enclosed flare which are to be part of the GS project activity, the flare efficiency in the minute m is determined as a value which is

calculated based on performed related measurements ($\eta_{\text{flare},m} = \eta_{\text{flare},\text{calc},m}$) when the following two conditions are simultaneously met (in order to demonstrate that the flare is operating):

- (1) The temperature of the exhaust gas of the flare (monitoring parameter $T_{\text{EG},m}$) and the flow rate of LFG to the flare (monitoring parameter $F_{\text{RG},m}$) are within the manufacturer's specification for the flare ($\text{SPEC}_{\text{flare}}$) in minute m ;
- (2) Flame is detected in the flare in minute m (monitoring parameter Flame_m).

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

By applying Option B.2, where the related measurements are performed on an every-minute basis, the following calculation formula is applied:

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

The flare efficiency ($\eta_{\text{flare},\text{calc},m}$) 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:

$$\eta_{\text{flare},\text{calc},m} = 1 - \frac{F_{\text{CH}_4,\text{EG},m}}{F_{\text{CH}_4,\text{RG},m}} \quad (18)$$

Where:

$\eta_{\text{flare},\text{calc},m}$	Flare efficiency in the minute m
$F_{\text{CH}_4,\text{EG},m}$	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the minute m (kg)
$F_{\text{CH}_4,\text{RG},m}$	Mass flow of methane in the residual gas on a dry basis at reference conditions in the minute m (kg)

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:

$$F_{\text{CH}_4,\text{EG},m} = V_{\text{EG},m} \times f_{\text{CH}_4,\text{EG},m} \times 10^{-6} \quad (19)$$

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)
$f_{CH_4,EG,m}$	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:

$$V_{EG,m} = Q_{EG,m} \times M_{RG,m} \quad (20)$$

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)
$Q_{EG,m}$	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 proponent 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.

$$M_{RG,m} = \rho_{RG,ref,m} \times V_{RG,m} \quad (21)$$

Where:

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

$\rho_{RG,ref,m}$ Density of the residual gas at reference conditions in minute m (kg/m^3). $\rho_{RG,ref,m}$ is calculated as:

$$\rho_{RG,ref,m} = \frac{P_{ref}}{\frac{R_u}{MM_{RG,m}} \times T_{ref}} \quad (22)$$

Where:

P_{ref} Atmospheric pressure at reference conditions (Pa). P_{ref} is equal to the ex-ante determined parameter P_n .

R_u Universal ideal gas constant ($\text{Pa} \cdot \text{m}^3/\text{kmol} \cdot \text{K}$)

$MM_{RG,m}$ Molecular mass of the residual gas in minute m (kg/kmol)

T_{ref} Temperature at reference conditions (K). T_{ref} is equal to the ex-ante determined parameter T_n .

The equation below is to be used to calculate $MM_{RG,m}$, when applying this equation, project developer 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.

$$MM_{RG,m} = \sum (v_{i,RG,m} \times MM_i) \quad (23)$$

Where:

MM_i Molecular mass of residual gas component i (kg/kmol)

$v_{i,RG,m}$ Volumetric fraction of component i in the residual gas on a dry basis at reference conditions in the hour h

i Components of the residual gas. If Option (a) is selected to measure the volumetric fraction, then $i = \text{CH}_4, \text{CO}, \text{CO}_2, \text{O}_2, \text{H}_2, \text{H}_2\text{S}, \text{NH}_3, \text{N}_2$ or if Option (b) is selected then $i = \text{CH}_4$ 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 ($Q_{EG,m}$):

$Q_{\text{CO}_2,EG,m}$ shall be determined as follows:

$$Q_{EG,m} = Q_{\text{CO}_2,EG,m} + Q_{\text{O}_2,EG,m} + Q_{\text{N}_2,EG,m} \quad (24)$$

Where:

$Q_{CO_2,EG,m}$	Quantity of CO ₂ volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m ³ /kg residual gas)
$Q_{N_2,EG,m}$	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)
$Q_{O_2,EG,m}$	Quantity of O ₂ volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m ³ /kg residual gas)

with

$$Q_{O_2,EG,m} = n_{O_2,EG,m} \times VM_{ref} \quad (25)$$

Where:

$n_{O_2,EG,m}$	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)
VM_{ref}	Volume of one mole of any ideal gas at reference temperature and pressure (m ³ /kmol)

$$Q_{N_2,EG,m} = VM_{ref} \times \left\{ \frac{MF_{N,RG,m}}{2 \times AM_N} + \left(\frac{1 - v_{O_2,air}}{v_{O_2,air}} \right) \times [F_{O_2,RG,m} + n_{O_2,EG,m}] \right\} \quad (26)$$

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)

$$Q_{CO_2,EG,m} = \frac{MF_{C,RG,m}}{AM_C} \times VM_{ref} \quad (27)$$

Where:

$MF_{C,RG,m}$ 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)

$$n_{O_2,EG,m} = \frac{v_{O_2,EG,m}}{\left(1 - (v_{O_2,EG,m}/v_{O_2,air})\right)} \times \left[\frac{MF_{C,RG,m}}{AM_C} + \frac{MF_{N,RG,m}}{2 \times AM_N} + \left(\frac{1 - v_{O_2,air}}{v_{O_2,air}} \right) \times F_{O_2,RG,m} \right] \quad (28)$$

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)

$$F_{O_2,RG,m} = \frac{MF_{C,RG,m}}{AM_C} + \frac{MF_{H,RG,m}}{4AM_H} - \frac{MF_{O,RG,m}}{2AM_O} \quad (29)$$

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)

The mass fractions of carbon, hydrogen, oxygen and nitrogen in the residual gas is to be determined by using the volumetric fraction of component i in the residual gas and applying the equation below. In applying this equation, the project proponent 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.

$$MF_{j, RG, m} = \frac{\sum_i V_{i, RG, m} \times AM_j \times NA_{j,i}}{MM_{RG, m}} \quad (30)$$

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:

For the single installed flare, project emissions from flaring are calculated as the sum of emissions for each minute m in year y , based on the methane mass flow in the residual gas ($F_{CH_4, RG, m}$) and the flare efficiency ($\eta_{flare, m}$), as follows:

$$PE_{flare, y} = GWP_{CH_4} * \sum_{m=1}^{525,600} F_{CH_4, RG, m} * (1 - \eta_{flare, m}) * 10^{-3} \quad (31)$$

Where:

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

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

Ex-ante estimates of $F_{CH_4, PJ, y}$ is required to estimate methane baseline emissions from the Ecoparque Candeias landfill in the context of annual estimates the emission reductions to be achieved by the GS project activity within its last crediting period under GS4GG.

As established by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), $F_{CH_4, PJ, y}$ is estimated as follows:

$$F_{CH_4, PJ, y} = \eta_{PJ} * BE_{CH_4, SWDS, y} / GWP_{CH_4} \quad (32)$$

Where:

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

$BE_{CH_4,SWDS,y}$ is determined by applying applicable guidance of the CDM methodological tool “Emissions from solid waste disposal sites” (version 08.1) The following guidance is to be taken into account when applying the tool:

- f_y as per the CDM methodological tool shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for when applying the CDM baseline and monitoring methodology ACM0001 (version 19.0);
- In the tool, x begins with the year that the SWDS started receiving wastes (e.g. the first year of SWDS operation); and
- Sampling to determine the fractions of different waste types is not necessary because the waste composition can be obtained from previous studies.

Thus, for the ex-ante estimation of the amount of methane which is destroyed by the GS project activity through combustion of collected LFG in project’s methane destruction devices ($F_{CH_4,PJ,y}$) during each year y of its last crediting period under GS4GG, the calculation of $BE_{CH_4,SWDS,y}$ is given by the following formulae:

$$BE_{CH_4,SWDS,y} = \varphi_y * (1 - f_y) * GWP_{CH_4} * (1 - OX) * \frac{16}{12} * F * DOC_f * MCF * \sum_{x=1}^y \sum_j W_{j,x} * DOC_j * e^{-k(y-x)} * (1 - e^{-kj}) \quad (33)$$

Where:

$BE_{CH_4,SWDS,y}$	Baseline methane emissions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y (in tCO_2e / yr)
x	Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period ($x = 1$) to year y ($x = y$)
y	Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)
$DOC_{f,y}$	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)
$W_{j,x}$	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t)

ϕ_y	Model correction factor to account for model uncertainties for year y . The value (as per Option 2 of applicable guidance in the CDM methodological tool) is selected. Thus, $\phi_y = 0.75$
f_y	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y . f_y in the CDM methodological tool "Emission from solid waste disposal sites" shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for when applying the CDM baseline and monitoring methodology ACM0001 (version 19.0). While as per the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1), f_y is presented as a parameter to be monitored ex-post; by considering the related methodological approach of ACM0001 (version 19.0) and assigned value for f_y , this parameter will thus not be monitored ex-post
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

It is important to note that the approach to take into account characteristics of the disposed waste (used as inputs for the ex-ante estimation) are the ones recommended by IPCC. Due to that, no sampling of waste is necessary. This is in accordance with both the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1)) and the CDM baseline and monitoring methodology ACM0001 (version 19.0).

While the design of the GS project activity is limited to the promotion of collection and destruction/utilization of LFG at the Ecoparque Candeias landfill (without promoting any

change in the management and operation of this particular landfill), the GS project activity thus does not prevent any solid waste from being disposed at the landfill. An emission reduction calculation spreadsheet which includes all related calculations for figures presented is enclosed with this GS4GG PDD.

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

As required by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), this section represents the application of the stepwise procedure for the determination of the amount of methane that would have been captured and destroyed in the baseline scenario (absence of the GS project activity) at the Ecoparque Candeias landfill due to eventually applicable regulatory or contractual requirements and/or to address eventually existent applicable safety and odors concerns (which are collectively referred to as “requirement” under this step).

The four cases summarized in the table below are distinguished in ACM0001 (version 19.0). As also required by ACM0001 (version 19.0), the appropriate case for the particular baseline context of the GS project activity is identified and justified below.

Possible cases for determining methane captured and destroyed in the baseline as per ACM0001 (version 19.0)

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

Requirement to destroy methane:

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

As further detailed in Sections B.2 and B.4, currently there is still no legal obligation to promote any kind of capture and/or combustion/destruction/utilization of LFG at the

Ecoparque Candeias landfill³¹. Furthermore, this situation is currently not expected to be changed during the time period to be encompassed by the last GS crediting period of the project activity under GS4GG either. It is important to note that there has been no contractual requirement set by any official (governmental) or private party establishing/requiring collected LFG to be destroyed through combustion for the Ecoparque Candeias landfill.

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

In the particular case of the Ecoparque Candeias landfill, there is a requirement to destroy methane in order to address safety and odour concerns³².

It is also assumed that such existing requirement would also be existent/valid along the baseline scenario (absence of the GS project activity). By taking such assumptions into account, the following is thus valid/applicable for the Ecoparque Candeias landfill in the absence of the GS project activity (baseline scenario) in the context of the application of related methodological guidance of ACM0001 (version 19.0):

³¹ Currently, there are still no legal requirements for LFG gas collection and its destruction/utilization using active or passive high temperature enclosed flares and/or internal combustion engines in Solid Waste Disposals Sites (SWDS's) in Brazil (from open waste dumpsites to well-managed landfills). Moreover, there are still no legal restrictions neither legal requirement for passive venting of LFG nor combustion of LFG in conventional LFG destruction systems (e.g. passive flares or LFG venting/combustion drains) valid for SWDS's located in the country either.

³² As per the project design and licensing requirements applicable in the particular context of the Ecoparque Candeias landfill, prior to the occurred implementation and start of operation of the GS project activity, LFG was indeed required to be combusted in available pre-project LFG venting drains in order to address odors or safety concerns.

While as per the methodological approach of the applied CDM baseline and monitoring methodology ACM0001 (version 19.0) applicable for determination of $F_{CH_4, BL, y}$, any combustion of LFG in order to address any kind of safety and/or odor concerns is regarded as an existing requirement to destroy methane, it is thus assumed that, in the particular case of the Ecoparque Candeias landfill, there is a non-regulatory requirement to destroy methane. It is relevant to note that combustion of LFG in available pre-project LFG venting drains in order to address odors or safety concerns was equivocally not regarded as a requirement in the version of the CDM PDD and GS PDD valid for previous crediting periods of the GS project activity under CDM and later under GS4GG.

- *Requirement to destroy methane: YES*

By taking this assumption into account, thus, Case 1 and Case 3 (which are options/cases associated to non-existence of requirement to destroy methane in the absence of the GS project activity) are directly regarded as not applicable for the determination of $F_{CH_4,BL,y}$ in the particular case of the GS project activity (in the particular contexts of both its identification of baseline scenario and determination of baseline emissions).

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

Existence of LFG capture and destruction system at the Ecoparque Candeias landfill:

By taking into account the definitions of "LFG capture system" and "existing LFG capture system" as per ACM0001 (version 19.0), it is assumed that there was an "existing LFG capture and destruction system" at the Ecoparque Candeias landfill in the pre-project scenario. It is also assumed that such existing LFG capture and destruction system would also be existent along the baseline scenario (absence of the GS project activity). While combustion of LFG in passive (conventional) venting/combustion drains clearly represents destruction of methane (despite of its relatively very low efficiency), it is thus assumed that there was a pre-project conventional LFG capture and destruction system implemented at the Ecoparque Candeias landfill prior to the occurred gradual/phased implementation of the GS project activity (which was replaced (under a certain extent) by the project's LFG collection and destruction infrastructure).

The following is thus valid/applicable for the Ecoparque Candeias landfill in the baseline scenario:

- *Existing LFG capture and destruction system: YES*

Therefore, Case 2 (which is an option/case associated with the non-existence of LFG capture and destruction in the absence of the project activity) is regarded as a not applicable case for the determination of $F_{CH_4,BL,y}$ in the context of the demonstration of the continuation of baseline scenario and determination of baseline emissions for the crediting period of the project activity.

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

In summary, the following is thus valid in the context of the application of the stepwise procedure for the determination of $F_{CH_4,BL,y}$ for the GS project activity during its renewable crediting period:

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

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

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

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

- The design and construction of the pre-project conventional passive LFG venting/combustion drains is somehow rudimentary, and it does not allow continuous combustion of LFG through the drains (as such drains are not conceived for assuring continuous combustion of LFG). Due to construction aspects and conditions of the drains (such as the diameter of the LFG venting drains, pressure of LFG in the drains, influence of wind and other climate aspects (e.g. rain)) as well as due to the typical day-to-day operational conditions at the Ecoparque Candeias landfill prior to the occurred implementation of the GS project activity (where no working staff were ever been required to attempt to

ensure continuous combustion of LFG in the drains and/or monitor the conditions/state of such drains (e.g. regular checking whether the drains are alight)), LFG has never been continuously combusted in such pre-project passive LFG venting/combustion drains prior to the occurred implementation and start of operation of the project activity. Thus, in the absence of the GS project activity, no continuous and/or not quantitatively relevant combustion of LFG in the pre-project the drains (and additional drains that would be otherwise installed instead of the project's LFG collection wells) would occur. As above-highlighted, there is still no legal requirement to destroy methane in the Ecoparque Candeias landfill. The assumed requirement is of operational and/or design nature: requirement to address safety and odor concerns. It is also important to note that, as the owner and operator of the Ecoparque Candeias landfill, the project developer Orizon Valorização de Resíduos S.A. would not have any economic or operational incentive/motivation to convert the previously existing LFG venting/combustion drains into a more appropriate LFG flaring system (passive or active) in the absence of the GS project activity (baseline scenario).

- It is also important to note that non-continuous and/or non-quantitatively relevant combustion of LFG through conventional LFG venting/combustion drains has been the practice not only at the Ecoparque Candeias landfill, but also in several others landfills and dump sites in Brazil and other countries in Latin America where no legal requirements for destruction of LFG exists. In most of the cases (where combustion of LFG in order to address safety and odor requirements is not a relevant issue), LFG is actually directly vented through the drains and/or directly through the surface of the landfill (without any LFG being combusted)³³.

³³ It is important to observe that as per the situation currently valid, the implementation of effective active LFG collection and destruction or utilization infrastructure in landfills in Latin America has so far been occurred in the context of the emission reduction project-based initiatives under the CDM. In the absence of the incentives of the CDM, converting conventional and rudimentary LFG venting/combustion drains into appropriate LFG flaring system at the Ecoparque Candeias landfill would be an effort requiring capital investment, would face operational costs and would also represent extra work to be faced by the project developer Orizon Valorização de Resíduos S.A. which would not economically justified as there is still no national or regional legal or regulatory requirements in Brazil.

By taking into account the outcome of the above presented analysis the following methodological approach is valid for the determination of $F_{CH_4,BL,y}$:

Application of methodological guidance valid for Case 4:

Under Case 4 of the methodological guidance for the determination of $F_{CH_4,BL,y}$, the following is applicable as per ACM0001 (version 19.0):

" $F_{CH_4,BL,y}$ shall be determined based on information in contract of regulation requirements and data related to the existing LFG capture system, as follows:

$$F_{CH_4,BL,y} = \max \{F_{CH_4,BL,R,y}; F_{CH_4,BL,sys,y}\} \quad (34)$$

Where:

$F_{CH_4,BL,R,y}$ Amount of methane in the LFG which is flared in the baseline due to a requirement in year y (in tCH_4/yr)

$F_{CH_4,BL,sys,y}$ Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system (in tCH_4/yr)

$F_{CH_4,BL,R,y}$ and $F_{CH_4,BL,sys,y}$ shall be determined according to the respective procedures for Case 2 and Case 3 (...)"

By considering the above-quoted requirement, $F_{CH_4,BL,R,y}$ and $F_{CH_4,BL,sys,y}$ are thus determined as follows:

Determination of $F_{CH_4,BL,R,y}$ by following applicable guidance/procedure for Case 2 (in the context of application of Case 4):

By (i) taking into account the applicable definition of "requirement" as per ACM0001 (version 19.0); by (ii) also acknowledging that Case 2 is not an applicable case for the GS project activity, but by applying the applicable guidance of Case 2 as part of application of the guidance valid for Case 4, it is assumed the following in the particular context of the Ecoparque Candeias landfill:

While in the context of the assumed existent non-regulatory and non-contractual requirement for addressing safety and odor concerns at the Ecoparque Candeias landfill, it was never assumed or considered any particular previously defined or recommended amount (quantity) or percentage of generated LFG that is to be

combusted in order to address such concerns, by taking into consideration the nature, non-regulatory and the non-contractual characteristics of the assumed/considered requirement (where the concerns about safety and odor are assumed as required to be addressed by partial combustion of LFG which is vented through the drains under a undefined quantity³⁴), the installation of a conventional passive system to destroy LFG (applying conventional passive LFG venting/combustion drains) with an assumed default and conservative CH₄ destruction efficiency of 20% (as established by the CDM baseline and monitoring methodology ACM0001 (version 19.0)) is thus considered under a conservative and simplified approach³⁵.

³⁴ Under the baseline scenario, as per the construction, design and operational requirements applicable for the Ecoparque Candeias landfill, it is assumed by Orion Valorização de Resíduos S.A. that venting LFG through all conventional venting/combustion drains (without promoting LFG combustion in a non-defined share of the existent drains) would not be regarded as a sufficient practice to address the existent odor and safety concerns. Indeed, during the pre-project scenario (prior to the occurred implementation and start of operation of the project activity), combustion of LFG is a non-defined but representative share of the existent venting/combustion drains were indeed a practice. Combustion of LFG is thus seen as required to address the existent concerns (especially the existent odor concerns). Under the baseline scenario, it is assumed that operating the landfill with no combustion of LFG at all in the conventional drains would not represent a landfill operational practice where the available operational requirements for odor would be sufficiently met.

³⁵ As per the CDM baseline and monitoring methodology ACM0001 (version 19.0), the following is valid for the application of guidance of Case 2 (as part of the application of guidance for Case 4):

"Case 2: Requirement to destroy methane exists and no existing LFG capture system

(...)

$$F_{CH_4,BL,Y} = F_{CH_4,BL,R,Y}$$

F_{CH₄,BL,R,Y} should be determined based on the information contained in the requirement to destroy methane, as follows:

(...)

If the requirement does not specify the amount or percentage of LFG that should be destroyed but requires the installation of a capture system, without requiring the captured LFG to be flared then:

$$F_{CH_4,BL,R} = 0"$$

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

The following is also valid for the application of guidance of Case 2 (as part of the application of guidance for Case 4) as per the CDM baseline and monitoring methodology ACM0001 (version 19.0):

"(...)

If the requirement does not specify any amount or percentage of LFG that should be destroyed but requires the installation of a system to capture and flare the LFG, then a typical destruction rate of 20% is assumed:

Thus, the following equation is applicable:

$$F_{CH4,BL,R,y} = 0.2 * F_{CH4,PJ,capt,y} \quad (35)$$

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

This default value of 20% is based on assuming a situation in which: the efficiency of the LFG capture system in the project is 50%; the efficiency of the LFG capture system in the baseline is 20%; and, the amount captured in the baseline is flared using an open flare with a destruction efficiency of 50% (consistent with the default value provided in the .Tool to determine project emissions from flaring gases containing methane)."

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

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

The situation quoted above indeed represents the case/circumstance applicable for the baseline scenario. As the assumed existent non-regulatory and non-contractual requirement to collect LFG does not specify any amount or percentage of LFG that should be collected and destroyed but indeed requires LFG to be combusted (destroyed), the installation of a system to capture and flare LFG is implicitly assumed as required. The system in the particular case of the project activity are the conventional LFG venting/combustion drains which are used to vent and combust (flare) LFG in a non-controlled, non-continuous and non-systematic manner. The pre-project and baseline conventional LFG venting/combustion drains sufficiently meet the definition of "existing LFG capture system" as per ACM0001 (version 19.0). By promoting combustion of LFG, such system also meets the definition of "LFG capture and destruction system" of ACM0001 (version 19.0). It is important to note that the table above with the summary of the cases for determining methane captured and destroyed in the baseline as per ACM0001 (version 19.0) (Case 1, Case 2, Case 3 and Case 4) includes the criteria "Existing LFG capture and destruction system" (at the start of the project activity). It is crucial to note that in the context of the application of the whole stepwise approach for determining $F_{CH4,BL,y}$, it is required to take into consideration the practical difference/distinction between an "Existing LFG capture system" and an "Existing LFG capture and destruction system", where, as per the applied methodological approach, the latest definition is applicable for any system that promotes effective and/or real destruction of LFG through combustion in conventional flares or drains (such as in the situation in the particular case of the Ecoparque candeias landfill in the baseline scenario (absence of the project activity)). In this context, the formulae above ($F_{CH4,BL,R} = 0.2 * F_{CH4,PJ,capt,y}$) is indeed the applicable one.

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

Although, based on existent technical literature and years of field experience, it is the perception of the project developer Orizon Valorização de Resíduos S.A. that assuming a default value of 20% represents a very conservative and not realistic methodological approach (at least in the particular case of the GS project activity, which is implemented in a very big landfill), the selection of the 20% default value is anyway applied in the context of the determination of baseline emissions for the GS project activity during its last crediting period under GS in order to follow the applicable CDM guidance.

Where:

$F_{CH_4,PJ,capt,y}$ Amount of methane in the LFG which is captured in the project activity in year y (in tCH_4/yr).

Determination of $F_{CH_4,BL,sys,y}$ by following applicable guidance/procedure for Case 3 (in the context of application of Case 4):

By (i) taking into account the applicable definition of “*requirement*” as per ACM0001 (version 19.0); by (ii) also acknowledging that Case 3 is not an applicable case for the project activity, but by applying the applicable guidance of Case 3 as part of application of guidance for Case 4 in the particular context of the Ecoparque Candeias landfill, it is assumed the following³⁶:

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

$$F_{CH_4,BL,sys,y} = 0.2 * F_{CH_4,PJ,y} \quad (36)$$

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

While the term “ $0.2 * F_{CH_4,PJ,capt,y}$ ” > “ $0.2 * F_{CH_4,PJ,y}$ ” (by considering the equation valid for the determination of $F_{CH_4,PJ,y}$); it is thus fair and correct to assume that $F_{CH_4,BL,R} > F_{CH_4,BL,sys,y}$.

³⁶ As per the CDM baseline and monitoring methodology ACM0001 (version 19.0), the following is valid for the application of guidance of Case 3 (as part of the application of guidance for Case 4):

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

In this situation:

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

(...)

- *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:*

$$F_{CH_4,BL,sys,y} = 0.2 * F_{CH_4,PJ,y}$$

(...)

Thus, the following is applicable for the determination of $F_{CH_4,BL,y}$ by following the guidance for Case 4:

$$F_{CH_4,BL,y} = F_{CH_4,BL,R,y} = 0.2 * F_{CH_4,PJ,capt,y} \quad (37)$$

Where: In accordance with applicable guidance of the CDM baseline and monitoring methodology ACM0001 (version 19.0), $F_{CH_4,PJ,capt,y}$ is assumed as the sum of the amount of methane that is sent to the project's methane destruction devices (e.g. high temperature enclosed flare(s)) in year y , however by not taking into account flare efficiency values in the particular case of its utilization for the determination of $F_{CH_4,BL,y}$).

In summary, $F_{CH_4,BL,y}$ is determined as follows:

$$F_{CH_4,BL,y} = 0.2 * F_{CH_4,PJ,capt,y} \quad (38)$$

Where:

In accordance with applicable guidance of the CDM baseline and monitoring methodology ACM0001 (version 19.0), $F_{CH_4,PJ,capt,y}$ is to be determined as the sum of the amount of methane that is sent to the project's methane destruction devices (i.e. the high temperature enclosed flare and the engine-generator sets) in year y (however by not taking into account the working hours of such devices and by not taking into account flare efficiency in the particular case of its utilization for the determination of $F_{CH_4,BL,y}$ ³⁷).

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

³⁷ In the particular case of the determination of $F_{CH_4,BL,y}$ for the GS project activity, while for a given monitoring period, $F_{CH_4,PJ,capt,y}$ is thus equal to the sum of the accumulated values for amount of methane in the LFG which is destroyed by flaring in year y ($F_{CH_4,flared,y}$) (in tCH₄/yr) and by the engine-generator sets of the project's electricity generation infrastructure ($F_{CH_4,EL,y}$) (in tCH₄/yr) for the underlying period (with values being calculated/determined without considering/monitoring the hours h that the flare and/or engine-generator sets has operated under conformance with operational requirements and by assuming a flare efficiency of 100% (project emissions from flaring being considered as zero (null)). This represents a conservative approach as the calculated value for $F_{CH_4,BL,y}$ is maximized, and baseline emissions are reduced proportionally.

As established by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), baseline emissions associated with electricity generation in year y ($BE_{EC,y}$) shall be calculated by applying applicable guidance of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

When applying this CDM methodological tool the following is to be considered:

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

The CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" also declares the following:

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

Specifically for baseline emissions the following equation is applicable:

$$BE_{EC,y} = \sum_j EC_{BL,k,y} * EF_{EL,k,y} * (1 + TDL_{k,y}) \quad (39)$$

Where:

$BE_{EC,y}$	Baseline emissions associated with electricity generation (in tCO ₂ /yr)
$EC_{BL,k,y}$	Net amount of electricity generated using LFG in year y (in MWh)
$EF_{EL,k,y}$	Emission factor for electricity generation for source k in year y (in tCO ₂ /MWh) $EF_{EL,j/k/l,y}$ represents the combined margin (CM) emission factor for the electricity grid to which the project activity is connected to ($EF_{grid,CM,y} = EF_{EL,grid,y}$).
$TDL_{k,y}$	Average technical transmission and distribution losses for providing electricity to source k in year y
k	Sources of electricity generated identified in the selection of the most plausible baseline scenario

By following the above-quoted applicable guidance of the CDM methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”, baseline emissions for electricity generation by the project activity ($BE_{EC,y}$), are determined as follows:

$$BE_{EC,y} = EC_{BL,y} * EF_{EL,grid,y} * (1 + TDL_{grid,y}) \quad (39.1)$$

Where:

$EC_{BL,y}$ Net amount of electricity generated using LFG in year y (in MWh).
 $EF_{EL,grid,y}$ CO₂ emission factor for electricity generation in year y (in tCO₂/MWh).
 $EF_{EL,grid,y}$ is determined ex-post by following applicable guidance of the CDM methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” as follows:

“Where case C.I has been identified, the guidance for scenario A (...) should be applied (use option A1 or option A2).”

“Where case C.III has been identified, as a conservative simple approach, the emission factor for electricity generation should be the more conservative value between the emission factor determined as per guidance for scenario A and B, respectively. This means that the more conservative value should be chosen between a) the result of applying either option A1 or A2 and b) the result of applying either option B1 or B2.”

The above-quoted option of the CDM methodological tool (Options A.1 or A.2.) may thus be analyzed ex-post for the determination of $EF_{EL,grid,y}$ as follow:

Option A.1:

$EF_{EL,grid,y}$ is calculated ex-post as the combined margin (CM) emission factor ($EF_{grid,CM,y}$) as per applicable guidance of the CDM methodological tool “Tool

to calculate the emission factor for an electricity system” by following the approach summarized below in this Section under “*Determination of combined margin (CM) emission factor ($EF_{grid,CM,y} = EF_{EL,grid,y}$)*”.

Option A.2:

$EF_{EL,grid,y}$ is directly determined as 0.25 tCO₂/MWh (applicable conservative default value of the CDM methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (value applicable for electricity generated by the project activity)).

$TDL_{grid,y}$ Average technical transmission and distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the GS project activity

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

Option A.1 of the CDM methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” is selected for determining $EF_{EL,k,y}$. Therefore, according to the selected option, the following is applicable:

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

The CDM methodological tool “Tool to calculate the emission factor for an electric system” indicates that the emission factor of the electricity grid to which the project activity is to be connected is determined by the following 6-step approach:

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

Combined margin CO₂ emissions factor is calculated in accordance with the CDM methodological tool “Tool to calculate the emission factor for an electricity system”. This methodological tool determines the CO₂ emission factor for the displacement of

electricity generated by grid-connected power plants, by calculating the combined margin emission factor ($EF_{CM,y}$) of the electricity system. As per the CDM methodological tool “Tool to calculate the emission factor for an electricity system”, $EF_{CM,y}$ is determined as a weighted average of two CO₂ emission factors pertaining to the electricity system: the CO₂ operating margin emission factor ($EF_{OM,y}$) and the build margin emission factor ($EF_{BM,y}$). The operating margin emission factor refers to the group of existing power plants whose current electricity generation would be potentially affected by the GS project activity. The build margin emission factor refers to the group of prospective power plants whose construction and future operation would be potentially affected by the GS project activity.

The applicable procedures of the CDM methodological tool “Tool to calculate the emission factor for an electricity system” re described in the following steps:

- Step 1. Identify the relevant electricity systems:

For determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints. The spatial extent of the project boundary includes the project site which is connected to the National Electricity Grid of Brazil which is named National Interconnected System (Sistema Interligado Nacional – SIN).

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

Option I of the tool is chosen which is to include only grid power plants in the calculation.

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

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

- (a) Simple OM; or
- (b) Simple adjusted OM; or
- (c) Dispatch data analysis OM; or
- (d) Average OM.

Any above method can be utilized. However, the simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation

in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production. This is not the case for the project electricity system being considered. Since the simple adjusted OM (option b) emission factor is a variation of the simple OM, where the power plants/units (including imports) are separated in low-cost/must-run power sources and other power sources, this is also not applicable to this project activity. For the similar reason, the option (d), average OM emission factor is not eligible for this project, since it is calculated as the average emission rate of all power plants serving the grid, using the methodological guidance for the simple OM, but including in all equations also low-cost/must-run power plants. Therefore, for the OM calculation method, the option (c) dispatch data analysis is referred, since the Ministry of Science, Technology and Innovation of Brazil has been updated and published annually the information for power units.³⁸

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

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

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

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

The operating margin emission factor is calculated as follows:

³⁸ The Ministry of Science, Technology and Innovation have been calculating the CO₂ emission factor according to the CDM methodology tool "Tool to calculate the emission factor for an electricity system". The CO₂ emission factor was obtained in the Brazilian CDM DNA website (Source of data used: CDm methodological tool "Tool to calculate the emission factor for an electricity system" (version 7.0 and more recent versions): The actual value has been calculated by Ministry of Science, Technology and Innovation (MCTI), Brazilian CDM Designated National Authority (DNA). The Emission Factor will be monitored through ex-post calculation, following the latest version of CDM methodological tool "Tool to calculate the emission factor for an electricity system". The Brazilian DNA calculated the value based on the tool. The Combined Margin is calculated through a weighted-average formula, considering both the $EF_{grid,OM-DD,y}$ and the $EF_{grid,BM,y}$ and the weights w_{OM} and w_{BM} (default values of 0.25 and 0.75, respectively).

$$EF_{grid,OM-DD,y} = \frac{\sum EG_{PJ,y} * EF_{EL,DD,h}}{EG_{PJ,y}} \quad (40)$$

Where:

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

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

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

"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 shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be

calculated ex ante, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.”

Option 2 was selected for the GS project activity.

The build margin emissions factor is the generation-weighted average emission factor (in tCO₂/MWh) of all power units m during the most recent year y for which power generation data is available. The CDM Designated National Authority (DNA) of Brazil has regularly published an official value for $EF_{grid,BM,y}$ ³⁹. The value applicable for the 2nd crediting period is also selected for the last crediting period of the GS project activity under GS4GG (applicable for the year 2022) is thus the value for the ex-ante selected parameter $EF_{grid,BM,y}$ and is calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum EG_{m,y} * EF_{EL,m,y}}{\sum EG_{m,y}} \quad (41)$$

Where:

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

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

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM} \quad (42)$$

³⁹ Details about the determination of values for the CO₂ emission factor for the national electricity grid of Brazil by the CDM DNA of Brazil are made available online on the website of the CDM DNA of Brazil: https://antigo.mctic.gov.br/mctic/opencvms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

Where:

$EF_{grid,BM,y}$	Build margin CO ₂ emission factor in year y (tCO ₂ /MWh)
$EF_{grid,OM,y}$	Operating margin CO ₂ emission factor in year y (tCO ₂ /MWh)
w_{OM}	Weighting of operating margin emissions factor (%)
w_{BM}	Weighting of build margin emissions factor (%)

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

“The following default values should be used for w_{OM} and w_{BM} :

(a) Wind and solar power generation project activities: $w_{OM} = 0.75$ and $w_{BM} = 0.25$ (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods;

(b) All other projects: $w_{OM} = 0.5$ and $w_{BM} = 0.5$ for the first crediting period, and $w_{OM} = 0.25$ and $w_{BM} = 0.75$ for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.”

While values for the parameters $EF_{grid,BM,y}$, w_{OM} and w_{BM} (which are applicable for the whole last crediting period under GS4GG) are selected ex-ante, annual values for $EF_{grid,OM,y}$ within the crediting period will be determined ex-post as required by the CDM methodological tool “Tool to calculate the emission factor for an electric system”. Therefore, during the last crediting period of the GS project activity under GS4GG, the combined margin CO₂ emission factor will be calculated and updated annually.

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

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

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

As the project design does not encompass any utilization of collected LFG displacing the

use of natural gas or injection of collected LFG into a natural gas distribution network or used by trucks, baseline emissions associated with natural gas use in year y ($BE_{NG,y}$) are not considered. Thus, this step is not applicable.

Monitoring of the management of the landfill

As required by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), the design and operational conditions of the Ecoparque Candeias landfill site will be annually monitored on the basis of different sources, including inter alia:

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

The original operational design of the Ecoparque Candeias landfill site should be confirmed not to be modified in order to ensure that no practice to deliberately or intentionally increase methane generation at the landfill have been occurring during the period, when compared to the landfill management and operation condition prior to the implementation of the GS project activity. As required by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), any change in the management of the landfill after the implementation of the GS project activity should be justified by referring to technical or regulatory specifications and impacts of such changes in the determination of baseline emissions should in this case be taken into account appropriately. Such monitoring requirement will be used for the determination/confirmation of baseline emissions and/or confirmation of the project's implementation as described in the GS4GG PDD (in terms of operation and management conditions of the landfill from which LFG is destroyed/combusted).

Determination of project emissions (PE_y):

According to the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), project emissions are determined by the following:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} + PE_{SP,y} \quad (43)$$

Where:

$PE_{EC,y}$	Emissions from consumption of electricity due to the project activity in year y (in tCO_2/yr)
$PE_{FC,y}$	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year y (in tCO_2/yr)
$PE_{DT,y}$	Emissions from the distribution of compressed/liquefied LFG using trucks, in year y (in tCO_2/yr)
$PE_{SP,y}$	Emissions from the supply of LFG to consumers through a dedicated pipeline, in year y (tCO_2/yr)

In the particular case of the GS project activity, while grid-sourced electricity is considered source of electricity to be consumed by the GS project activity, related project emissions ($PE_{EC,y}$) are thus being determined ex-post.

Moreover, there is no consumption of fossil fuels for purposes other than electricity generation in the project activity, resulting in $PE_{FC,y} = 0$. Additionally, there are no project emissions associated with the distribution of compressed or liquefied LFG using trucks, which would otherwise be determined ex-post, thus $PE_{DT,y} = 0$. Furthermore, emissions from the supply of LFG to consumers via a dedicated pipeline are also negligible and do not need to be accounted for, resulting in $PE_{SP,y} = 0$.

Thus, the following is applicable for the particular case of the GS project activity:

$$PE_y = PE_{EC,y} \quad (43.1)$$

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

In the particular case of the GS project activity, while grid-sourced electricity is considered source of electricity to be consumed by the GS project activity, $PE_{EC,y}$ is determined as follows:

$$PE_{EC,y} = PE_{EC,grid,y} + PE_{EC,captive,y} \quad (44)$$

Where:

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

$PE_{EC,grid,y}$ is calculated according to the following approaches:

As required by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), $PE_{EC,y}$ shall be calculated by applying the methodological approach established by the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

While the GS project activity fits under "Scenario C (Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s)) of this methodological tool, the following is also established by the tool:

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

ACM0001 (version 19.0) establishes the following when applying this methodological tool:

- *" $EC_{PJ,k,y}$ ⁴⁰ in the tool is equivalent to the amount of electricity consumed by the project activity in year y ($EC_{PJ,y}$)."*
- *"If in the baseline a proportion of LFG is destroyed ($F_{CH4,BL,y} > 0$), then the electricity consumption in the tool ($EC_{PJ,j,y}$) should refer to the net quantity of electricity consumption (i.e. the increase due to the project activity). The determination of the*

⁴⁰ As per the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation", $ECP_{j,j,y}$ is the quantity of electricity consumed by the project electricity consumption source j in year y .

*amount of electricity consumed in the baseline shall be transparently documented in the CDM-PDD.*⁴¹

In the particular case of the GS project activity, electricity sources j in the tool corresponds to the source of electricity consumed due to the GS project activity: (i) grid-sourced electricity and (ii) electricity sourced by the captive off-grid engine generator fueled by diesel.

While no electricity has been previously consumed in the pre-project-implementation (baseline scenarios) for collecting and destroying LFG, the determination of the amount of electricity consumed in the baseline scenario (absence of the GS project activity) is thus not applicable/considered. In summary, according to the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" project emissions due to electricity consumption by the GS project activity ($PE_{EC,y}$) are generically calculated as follows:

$$PE_{EC,y} = \sum EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y}) \quad (45)$$

Where:

$EC_{PJ,j,y}$	Quantity of electricity consumed by the project electricity consumption source j in year y (in MWh).
$EF_{EL,j,y}$	CO ₂ emission factor for electricity generation for source j in year y (in tCO ₂ /MWh).
$TDL_{j,y}$	Average technical transmission and distribution losses for providing electricity to source j in year y

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

By following applicable guidance of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity

⁴¹ In the particular case of the GS project activity, the GS4GG PDD is to be understood as this PDD.

generation” valid for Scenario C (Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s)); project emissions due to consumption of grid-sourced electricity by the GS project activity ($PE_{EC,grid,y}$) are determined as follows:

$$PE_{EC,grid,y} = EC_{PJ,grid,y} * EF_{EL,grid,y} * (1 + TDL_{grid,y}) \quad (45.1)$$

Where:

$EC_{PJ,grid,y}$ Quantity of grid-sourced electricity consumed by the project activity in year y . Values for $EC_{PJ,grid,y}$ will be measured and monitored ex-post in MWh as per the provisions of the CDM methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”.

$TDL_{grid,y}$ Average technical transmission and distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the project activity. The value for $TDL_{grid,y}$ applicable for import of grid-sourced electricity will be determined ex-post as per the provisions of the CDM methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”.

$EF_{EL,grid,y}$ CO₂ emission factor for grid sourced electricity in year y (in tCO₂/MWh). $EF_{EL,grid,y}$ is determined ex-post by following applicable guidance of the CDM methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” as follows:

Option A.1:

$EF_{EL,grid,y}$ is calculated ex-post as the combined margin (CM) emission factor ($EF_{grid,CM,y}$) as per applicable guidance of the CDM methodological tool “Tool to calculate the emission factor for an electricity system” by following the approach summarized above in this Section under “*Determination of combined margin (CM) emission factor ($EF_{grid,CM,y} = EF_{EL,grid,y}$)*”.

Option A.2:

$EF_{EL,grid,y}$ is directly determined as 1.3 tCO₂/MWh (applicable conservative default value of the CDM methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (value applicable for grid sourced electricity consumed by the project activity)).

Project emissions from consumption of electricity generated by a captive off-grid electricity generator fueled by diesel by the project activity ($PE_{EC,captive,y}$):

By following applicable guidance of the CDM methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” valid for Scenario C (Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s)); project emissions due to consumption of electricity generated by a captive off-grid electricity generator fueled by diesel by the GS project activity ($PE_{EC,captive,y}$) are determined as follows:

$$PE_{EC,captive,y} = EC_{PJ,captive,y} * EF_{EL,captive,y} * (1 + TDL_{captive,y}) \quad \textbf{(45.2)}$$

Where:

$EC_{PJ,captive,y}$	Quantity of electricity generated in captive diesel backup generator during the year y. Values for $EC_{PJ,captive,y}$ will be measured and monitored ex-post in MWh as per the provisions of the CDM methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”.
$TDL_{captive,y}$	Average technical transmission and distribution losses for electricity sourced by the captive electricity generator. The value for $TDL_{grid,y}$ applicable for import of grid-sourced electricity will be determined ex-post as per the provisions of the CDM methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”.
$EF_{EL,captive,y}$	CO ₂ emission factor for electricity sourced by the captive off-grid electricity generators in year y (in tCO ₂ /MWh). $EF_{EL,captive,y}$ is determined ex-ante by following applicable guidance of the CDM methodological tool “Baseline,

project and/or leakage emissions from electricity consumption and monitoring of electricity generation” as follows:

Option B.2:

$EF_{EL,captive,y}$ is directly determined as 1.3 tCO₂/MWh (applicable conservative default value of the CDM methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”).

Leakage emissions:

No leakage emissions are expected to occur. Moreover, no leakage effects are accounted for under the applied CDM baseline and monitoring methodology ACM0001 (version 19.0).

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 CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1).
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	Default value as per the applied CDM baseline and monitoring methodology ACM0001 - "Flaring or use of landfill gas" (version 19.0)
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/parameter	GWP_{CH4}
Unit	tCO ₂ / tCH ₄
Description	Global Warming Potential of CH ₄
Source of data	Table 1 in Box 3.2 - Greenhouse Gas Metrics and Mitigation Pathways of the 5th Assessment Report of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon. Available at:

	https://archive.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full_wcover.pdf
Value(s) applied	28 tCO ₂ e/tCH ₄
Choice of data or Measurement methods and procedures	The applied values are also in accordance with the currently applicable guidelines from GS for the selection and application of the global warming potential to GS project activities.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/parameter	η_{PJ}
Unit	Dimensionless
Description	Efficiency of the LFG capture system installed in the GS project activity
Source of data	Value obtained from technical literature
Value(s) applied	0.9280
Choice of data or Measurement methods and procedures	Technical literature-based value ⁴² (with design and operational characteristics/aspects of the Ecoparque

⁴² The technical paper "Measuring landfill gas collection efficiency using surface methane concentration" (which was published by Raymond L. Huitric and Dung Kong, from the Solid Waste Management Department of the Los Angeles County Sanitation Districts), states the following regarding LFG collection efficiency for a well-managed LFG collection system:

"Measuring landfill gas collection efficiency is important for gauging emission control effectiveness and energy recovery opportunities. Though researched for years, practical measures of collection efficiency are lacking. Instead, a default efficiency of 75% based on surveys of industry estimates is commonly used, for example, by

	Candeias landfill and the currently considered construction and operational characteristics for the occurred implementation of project's LFG collection network being taken into consideration. ⁴³).
Purpose of data	Calculation of baseline emissions
Additional comment	Selected value can also be represented as percentage, since $0.9280 = 92.80\%$

Data/parameter	R_u
Unit	Pa.m ³ /kmol.K
Description	Universal ideal gas constant
Source of data	Default value as per the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0).

the United States Environmental Protection Agency (US EPA). Though few, actual emission measurements indicate substantially higher efficiencies ranging from 85 to 98%."

This document also mentions

"(...) landfill gas collection efficiencies should routinely reach 100%."

Practical results, shown on table 4 of the study: Weighted average collection efficiency, show a collection efficiency of 92.8 to 96.1% on well-engineered landfills with vacuum systems to extract LFG."

The paper "Measuring landfill gas collection efficiency using surface methane concentration" is available online: <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.498.2784&rep=rep1&type=pdf>

⁴³ Assumptions for the expected/considered LFG collection efficiency of the GS project activity are based on the definition of the general construction aspects (considered design and planned layout) as well as operational characteristics for the implementation of the project's LFG collection network. Such assumed efficiency for LFG collection is derived by taking into consideration the experience and expertise of the project developer Orizon Valorização de Resíduos S.A. in implementation and operation of LFG collection and destruction/utilization project-based initiatives in different landfill sites in Brazil.

Value(s) applied	8,314
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/parameter	MM_k
Unit	kg/kmol
Description	Molecular mass of gas <i>k</i>
Source of data	Default value as per the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0).
Value(s) applied	For considered gases <i>k</i> that are greenhouse gases (GHGs), the values below are applied for MM_k. As per the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" the following is applicable for the particular case of the GS project activity: <i>"The determination of the molecular mass of the gaseous stream (MM_{t,db}) requires measuring the volumetric fraction of all gases (k) in the considered gaseous stream. However, as a simplification, only the volumetric fraction of gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen.</i>

	<i>The simplification is not acceptable if it is differently specified in the underlying methodology.”</i> ACM0001 (version 19.0) does not include any restriction to such simplification. Thus, only the volumetric fraction of gases that are greenhouse gases and are considered in related calculations (CH₄ in the particular case of the GS project activity) and the difference to 100% is just considered as pure nitrogen. <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	Default value as per the CDM methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0).								
Value(s) applied	The following values of molecular mass are applicable for CH ₄ (the only GHG which is considered): <table><tr><th>Compound</th><th>Structure</th><th>Molecular mass (kg/kmol)</th></tr><tr><td>Methane</td><td>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	-								
Purpose of data	Calculation of baseline emissions.								
Additional comment	-								

Data/parameter	MM_{H2O}
Unit	kg/kmol
Description	Molecular mass of water
Source of data	Default value as per the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0).
Value(s) applied	18.0152
Choice of data or Measurement methods and procedures	-

Purpose of data	Calculation of baseline emissions.
Additional comment	-

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

Data/parameter	T_n
Unit	K
Description	Temperature at normal conditions
Source of data	Default value as per the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0).
Value(s) applied	273.15

Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/parameter	Φ_{default}
Unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	Default value applicable for determination of baseline emissions as per the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1). Value applicable for humid/wet conditions as per Application A is selected (based on the climate conditions valid for the location of the GS project activity). Source for weather condition data: http://www.bbc.com/weather
Value(s) applied	0.75
Choice of data or Measurement methods and procedures	Determined based on default value of table 3 of the referred CDM methodological tool as per Option 1, Application A (value applicable for humid/wet conditions).
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/parameter	OX
Unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Applicable default value as per the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1).
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/parameter	F
Unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	Applicable default value as per the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1).
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under

	anaerobic conditions in the considered SWDS. A default value of 0.5 is recommended by IPCC.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/parameter	DOC_{f,default}
Unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	Applicable default value as per the CDM methodological tool "Emissions from solid waste disposal sites" which refers to applicable value as per IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. The default value was applied as per Application A of the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1): <i>"The CDM project activity mitigates methane emissions from a specific existing SWDS"</i> ⁴⁴ .
Purpose of data	Calculation of baseline emission.

⁴⁴ In the particular case of the GS project activity, the statement is to be interpreted as follows:

"The proposed GS project activity mitigates methane emissions from a specific existing SWDS", where the existing SWDS is the Ecoparque Candeias landfill.

Additional comment	Application A of the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1) is the applicable case of the GS project activity.
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Data/parameter	MCF_{default}
Unit	-
Description	Methane Correction factor
Source of data	Value is sourced by the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1), that refers to IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Value(s) applied	1.0
Choice of data or Measurement methods and procedures	In accordance with the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1), default values presented in the tool shall be selected in case the SWDS does not have a water table above the bottom of the SWDS. The Environmental Impact Assessment (EIA) for the Ecoparque Candeias landfill (previously elaborated as a requirement for having the landfill being granted with its implementation authorization by the environmental authority of the Minas Gerais State (Secretaria de Estado de Meio Ambiente e Desenvolvimento Sustentável - SEMAD) clearly confirms that the landfill does not have a water table above its bottom level. Value is thus selected as per Application A of the CDM methodological tool, under the following conditions: <i>"1.0: for anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e.,</i>

	waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste” The day-to-day MSW disposal activities at the Ecoparque Candeias landfill encompasses utilization of appropriate MSW landfilling practices (covering, leveling and mechanical compacting of disposed material, etc.) as part of the operation of this landfill. The Ecoparque Candeias landfill is regarded as a well-managed landfill site.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/parameter	DOC_j
Unit	-
Description	Fraction of degradable organic carbon in the waste type <i>j</i> (weight fraction)
Source of data	Values are selected as per applicable guidance of the CDM methodological tool “Emissions from solid waste disposal sites” (version 08.1), that refers to IPCC values. The adopted values are thus under conformance with the latest IPCC’s “2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories” ⁴⁵ .
Value(s) applied	

⁴⁵ Please note that values for the fraction of degradable organic carbon in waste types were not changed in the IPCC’s 2019 Refinement to the 2006 IPCC. The only revisions in Chapter 2.3.1 (Waste Composition – Municipal Solid Waste) of Volume 5 of the IPCC 2019 Refinement was the general composition per country (updated table 2.3). Thus, the adopted values are under conformance with Table 2.4, Volume 5 of the IPCC 2006 Guidelines for National Greenhouse Gas Inventories (which was not revised under the IPCC 2019 Refinement).

	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	The selected values are based on wet waste basis (moisture concentrations in the waste streams as waste is delivered to the SWDS). The IPCC 2006 Guidelines also specify DOC values on a dry waste basis, which refers to the moisture concentrations after complete removal of all moisture from the waste. However, this selection is not practical for the situation/practice at the Ecoparque Candeias landfill.	
Purpose of data	Calculation of baseline emissions.	
Additional comment	-	

Data/parameter	k_j
Unit	1/yr
Description	Decay rate for the waste type j
Source of data	Values are selected as per applicable guidance of the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1). The CDM methodological tool refers to IPCC values. The adopted values are thus under conformance with the latest IPCC's "2019 Refinement to the

	2006 IPCC Guidelines for National Greenhouse Gas Inventories".(Volume 5, Table 3.3).																
Value(s) applied	<table><tr><th colspan="2">Waste type <i>j</i></th><th><i>k_j</i></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 <i>j</i>		<i>k_j</i>	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 <i>j</i>		<i>k_j</i>															
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	Parameters are selected in accordance with the climate zone valid for the project site: Mean Annual Temperature (MAT) = 26.0 °C Mean Annual Precipitation (MAP) = 2,155.5 mm – (wet climate). Aridity index (MAP/PET) = 1.27 Source of data for mean annual temperature (MAT), mean annual precipitation (MAP) and aridity index: INSTITUTO NACIONAL DE METEOROLOGIA DO BRASIL – INMET. Normais Climatológicas 1991 - 2020 - Precipitação acumulada mensal e anual (mm) e Temperatura média compensada mensal e anual (°C). link: https://www.confluvio.com/attributes/global-aridity-index																
Purpose of data	Calculation of baseline emissions.																
Additional comment	-																

Data/parameter	W_j
Unit	-
Description	Weight fraction of the waste type j

Source of data	Values are selected as per applicable guidance of 2019 Refinement of IPCC 2006 Guidelines for National Greenhouse Gas, Volume 5, Chapter 2, tables 2.3, MSW composition regional default values for South America.														
Value(s) applied	<table> <tr> <th>Waste type j</th><th>W_j (% wet waste)</th></tr> <tr> <td>Wood and wood products</td><td>0</td></tr> <tr> <td>Pulp, paper and cardboard (other than sludge)</td><td>12.4</td></tr> <tr> <td>Food, food waste, beverages and tobacco (other than sludge)</td><td>54.1</td></tr> <tr> <td>Textiles</td><td>1.7</td></tr> <tr> <td>Garden, yard and park waste</td><td>3.3</td></tr> <tr> <td>Glass, plastic, metal, other inert waste</td><td>28.5</td></tr> </table>	Waste type j	W_j (% wet waste)	Wood and wood products	0	Pulp, paper and cardboard (other than sludge)	12.4	Food, food waste, beverages and tobacco (other than sludge)	54.1	Textiles	1.7	Garden, yard and park waste	3.3	Glass, plastic, metal, other inert waste	28.5
Waste type j	W_j (% wet waste)														
Wood and wood products	0														
Pulp, paper and cardboard (other than sludge)	12.4														
Food, food waste, beverages and tobacco (other than sludge)	54.1														
Textiles	1.7														
Garden, yard and park waste	3.3														
Glass, plastic, metal, other inert waste	28.5														
Choice of data or Measurement methods and procedures	-														
Purpose of data	Calculation of baseline emissions.														
Additional comment	No composition analysis for MSW disposed at the Ecoparque Candeias landfill is currently available.														

Data/parameter	SPEC_{flare}
Unit	Temperature - °C Flow rate or heat flux – kg/h or 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 data (for the single flare installed as part of the GS project activity).

Value(s) applied	SPEC _{flare}	Min.	Max.
	Operational LFG flow (for continuous operation):	500 Nm³/h	2,500 Nm³/h
	Required temperature of the exhaust gas of the flare (to ensure LFG destruction (combustion) under high CH ₄ destruction efficiency):	850 °C	1,200 °C
	Required minimum frequency for inspection and maintenance service (incl. inspection in the conditions of the flare isolation ceramics revetment material):	12 months	
Choice of data or Measurement methods and procedures	As established by the CDM methodological tool “Project emissions from flaring”, the flares’ 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}. Ex-ante selected data will be compared against monitored data related to the operation of the flares along the project’s lifetime, 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	All flare specification and operation details/requirements are based on information provided by the manufacturer of equipment currently expected to be installed as part of the GS project activity. Data is used as a reference for later ex-post determination of values of flare efficiency ($\eta_{\text{flare},m}$) for the high temperature enclosed flare in the context of determination of baseline emissions.

Data/parameter	EF_{EL,grid,y}
Unit	tCO ₂ /MWh
Description	CO ₂ emission factor for electricity generation / grid-sourced electricity in year y
Source of data	Applicable conservative default values as per the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (by following option A.2 of the underlying methodological tool).
Value(s) applied	0.25 (for electricity exported by the GS project activity through the electricity grid) (for baseline emissions) 1.3 (for consumption of grid-sourced electricity by the GS project activity) (for project emissions)
Choice of data or Measurement methods and procedures	Data is determined as per applicable guidance of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0).
Purpose of data	Calculation of project emissions (due to the consumption of grid-sourced electricity by the GS project activity) and baseline emissions (due to generation of electricity by the GS project activity).

Additional comment	The default values for the CO ₂ emission factor for electricity generation / grid sourced electricity will be used in case required data for the determination of the CO ₂ Combined Margin emission factor for the National Electricity Grid of Brazil or related calculation results are not available for a given monitoring period.
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Data/parameter	W_{BM}
Unit	%
Description	Weighting of build margin emissions factor
Source of data	Applicable default value as per the CDM methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0).
Value(s) applied	0.75 (75%) during the last crediting period of the GS project activity under GS4GG
Choice of data or Measurement methods and procedures	The applicable value for the last crediting period of the GS project activity under GS4GG as per applicable requirements of the CDM methodological tool "Tool to calculate the emission factor for an electricity system" is selected.
Purpose of data	Calculation of project emissions (due to the consumption of grid-sourced electricity by the GS project activity) and baseline emissions (due to generation of electricity by the GS project activity).
Additional comment	-

Data/parameter	W_{OM}
Unit	%
Description	Weighting of operating margin emissions factor
Source of data	Applicable default value as per the CDM methodological tool "Tool to calculate the emission factor for an electricity system"
Value(s) applied	0.25 (25%) during the last crediting period of the GS project activity under GS4GG
Choice of data or Measurement methods and procedures	The applicable value for the last crediting period of a GS project activity under GS4GG as per the CDM methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0) is selected.
Purpose of data	Calculation of project emissions (due to the consumption of grid-sourced electricity by the GS project activity) and baseline emissions (due to generation of electricity by the GS project activity).
Additional comment	Calculation of project emissions and baseline emissions.

Data/parameter	EF_{grid,BM,y}
Unit	tCO ₂ /MWh
Description	Build margin CO ₂ emission factor in year y
Source of data	Selected value valid for all years of the 5-year renewable crediting period of the GS project activity (applicable for the year 2022) represents the latest value made public available by the CDM DNA of Brazil (https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao).

Value(s) applied	0.0270 (value applicable/valid for year 2022)
Choice of data or Measurement methods and procedures	The applicable value for the 2 nd crediting period of the GS project activity as per Option 2 from Step 5 of the CDM methodological tool "Tool to calculate the emission factor for an electricity system" is selected.
Purpose of data	Calculation of project emissions (due to the consumption of grid-sourced electricity by the GS project activity) and baseline emissions (due to generation of electricity by the GS project activity).
Additional comment	-

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 (224,852 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)

Since the last crediting period for the GS project activity under the GS4GG encompasses the period from 29/09/2023 to 28/09/2026, the estimated number of jobs created by the project activity (21 jobs in 2023 and 21 in 2024) is based on the actual number of employees of the project during the years of 2023, 2024, 2025 and 2026. 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)

While emission reductions to be achieved by the GS project activity are determined as the difference between baseline emissions (BE_y) and project emissions (PE_y), as established by ACM0001 (version 19.0), the following relevant equations and conditions are applied for the ex-ante estimation of emission reductions to be achieved by the GS project activity during its last crediting period under the GS4GG:

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

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

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

Where:

$BE_{CH_4,y}$ Baseline emissions of methane from the SWDS in year y (in tCO_2e/yr)

$BE_{EC,y}$ Baseline emissions associated with electricity generation in year y (in tCO_2e/yr)

Determination of $BE_{CH_4,y}$:

$BE_{CH_4,y}$ is determined as follows:

$$BE_{CH_4,y} = [(1 - OX_{top_layer}) * F_{CH_4,PJ,y} - F_{CH_4,BL,y}] * GWP_{CH_4}$$

Where:

OX_{top_layer} Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline scenario (dimensionless). Further details in Section B.6.2.

$F_{CH_4,PJ,y}$ Amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year y (in tCH_4/yr)

$F_{CH_4,BL,y}$ Amount of methane that would be destroyed through flaring of LFG in the baseline scenario (absence of project activity) in year y (in tCH_4/yr)

GWP_{CH_4} Global warming potential of CH_4 (in tCO_2e/tCH_4). Further details in Section B.6.2.

Determination of ex-ante estimations of $F_{CH_4,PJ,y}$:

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

Where:

η_{PJ} Efficiency of the LFG capture system that will be installed in the project activity. Further details in Section B.6.2.

$BE_{CH_4,SWDS,y}$ Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y (in tCO_2e)

GWP_{CH_4} Global warming potential of CH_4 (in tCO_2e/tCH_4). Further details in Section B.6.2.

$BE_{CH_4,SWDS,y}$ is estimated as follows:

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

For the determination of $BE_{CH_4,SWDS,y}$, the ex-ante determined values for all parameters in the formulae above as well as historical and forecasts of MSW disposal at the Ecoparque Candeias landfill site are applied. See Section B.6.2 for details about such ex-ante determined values for such parameters.

Determination of $BE_{EC,y}$:

In the particular context of ex-ante estimates of emission reductions to be achieved by the GS project activity within its last crediting period under GS4GG, $BE_{EC,y}$ is determined as follows:

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

Where:

$EC_{BL,y}$ ⁴⁶	Net amount of electricity generated using LFG in year y (in MWh). Further details in Section B.7.1.
$TDL_{grid,y}$	Average technical transmission and distribution losses for providing electricity to the grid and/or for grid-sourced electricity consumed by the project activity. Further details in Section B.7.1.
$EF_{EL,grid,y}$	CO ₂ emission factor for electricity generation in year y (in tCO ₂ /MWh). In the particular context of ex-ante estimates of emission reductions to be achieved by the GS project activity within its last crediting period under GS4GG, $EF_{EL,grid,y}$ is estimated as representing the combined margin CO ₂ emission factor ($EF_{grid,CM,y}$) for the electricity grid of Brazil (SIN grid) as per

⁴⁶ Values of net electricity to be generated by the GS project activity during its last crediting period under GS4GG that are to be used for the determination of emission reductions take into account the limited increased capacity of 20% of the capacity specified in the original design certified PDD. Any excess of electricity generated by the project activity beyond this value (28,481 MWh/year) will not be considered for the calculation of emission reductions, as a conservative approach.

applicable guidance of the CDM methodological tool “Tool to calculate the emission factor for an electricity system” (version 07.0). By following procedures and guidance described in Section B.6.1, the combined margin CO₂ emission factor ($EF_{grid,CM,y}$) for the electricity grid of Brazil (SIN grid) is estimated as follows:

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

Where:

$EF_{grid,OM,y}$ Operating margin CO₂ emission factor in year y (in tCO₂/MWh). *Operational Margin CO₂ emission factor (dispatch analysis calculation method ($EF_{grid,OM-DD,y}$)):*

In the particular context of ex-ante estimations of emission reductions to be achieved by the GS project activity, the adopted value for $EF_{grid,OM-DD,y}$ is the value published by the CDM DNA of Brazil of as being the calculated value which is valid for year 2023 (the latest year for which values are available at the time of the completion of this GS4GG PDD and starting of validation assessment for the last crediting period of the GS project activity under GS4GG):

Operating Margin Emission Factor of Brazilian Integrated Electric System for year 2023 (dispatch analysis calculation method)

Operating Margin Emission Factor, year 2023 CO ₂ Emission Factor (tCO ₂ /MWh)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.2917	0.2377	0.2957	0.3403	0.2951	0.5231	0.4939	0.4190	0.3433	0.3873	0.4882	0.4273

The average value of $EF_{grid,OM-DD,2023}$ is thus calculated as 0.3786 tCO₂/MWh. Values of $EF_{grid,OM-DD,2023}$ are determined and

reported by the CDM DNA of Brazil. Further details are available online at the website of the CDM DNA of Brazil.

w_{OM}	Weighting of operating margin emissions factor. w_{OM} is ex-ante determined as 25% (0.25). See Section B.6.2 for further details.
$EF_{grid,BM,y}$	Build margin CO ₂ emission factor in year y . The build margin CO ₂ emission factor for the national electricity grid of Brazil is ex-ante determined as the value applicable for year 2022 (as determined and published by the CDM DNA of Brazil). Thus, in the particular case of the GS project activity, $EF_{grid,BM,y} = EF_{grid,BM,2022}$ is ex-ante determined as 0.0270 tCO ₂ /MWh. Further details are available in Section B.6.2 ⁴⁷ .
w_{BM}	Weighting of build margin emissions factor. w_{BM} is ex-ante determined as 75% (0.75). See Section B.6.2 for further details.

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

$$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y} = 0.25 * 0.3786 + 0.75 * 0.0270 = 0.2907 \text{ tCO}_2/\text{MWh} \text{ (where related calculations are summarized in the emission reduction calculation spreadsheet enclosed to this GS4GG PDD).}$$

⁴⁷ Details about the determination of the CO₂ Emission Factors for the national electricity grid of Brazil (according to the CDM methodological tool "Tool to calculate the emission factor for an electricity system (version 07.0 and previous versions) are made available online:

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

It is important to note that, as a simplification (only in the particular context of the ex-ante estimation of emission reductions to be achieved by the GS project activity during its last crediting period under GS4GG), it is assumed that the calculated combined margin grid emission factor ($EF_{grid,CM,y}$) based on the value of $EF_{grid,OM-DD,2023}$ (valid for year 2023) and the value of $EF_{grid,BM,2022}$ is valid/applicable for the determination of ex-ante estimates of emission reductions for all years encompassed by the last crediting period of the GS project activity under GS4GG (regardless of the fact that annual values for the operating margin CO₂ emission factor ($EF_{grid,OM,y}$) are to be ex-post determined every year, thus potentially affecting the value to be calculated for $EF_{grid,CM,y}$ for each individual year encompassed by the crediting period). This simplification is anyway under conformance with applicable rules.

Information related to the determination of the combined margin CO₂ emission factor for the national electricity grid of Brazil is made available on the website/web portal of the CDM DNA of Brazil⁴⁸.

An emission reduction calculation spreadsheet is enclosed to this GS4GG PDD. This calculation spreadsheet includes all required related calculations for the ex-ante estimation of $BE_{CH_4,y}$ and $BE_{EC,y}$ during the last crediting period of the GS project activity under GS4GG.

The ex-ante estimation of $BE_y = BE_{CH_4,y} + BE_{EC,y}$ is thus summarized as follows:

⁴⁸ CDM methodological tool "Calculation of CO₂ emission factor for the National Electricity Grid of Brazil: Data" source is available online:
https://antigo.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

Year	Estimation of $F_{CH_4,PJ,Y}$ (tCH ₄)	Estimation of $F_{CH_4,BL,Y}$ (tCH ₄)	Estimation of $BE_{CH_4,Y}$ (tCO _{2e})	Estimation of $BE_{EC,Y}$ (tCO _{2e})
2023	9,400	1,880	184,235	17,336
2024	36,847	7,369	722,192	67,316
2025	37,280	7,456	730,678	67,316
2026	28,040	5,608	549,591	49,980
Total	111,566	22,313	2,186,696	201,948

Estimations of $BE_y = BE_{CH_4,y} + BE_{EC,y}$ is thus summarized as follows:

Year	Estimation of Baseline emissions (BE_y) (tCO _{2e})
2023	201,571
2024	789,508
2025	797,994
2026	599,571
Total	2,388,644

Note: All values applicable for years 2023 and 2026 are valid for the fractions of these years which are encompassed by the last crediting period of the GS project activity under GS4GG (period from 29/09/2023 to 31/12/2023 and period from 01/01/2026 to 28/09/2026, respectively).

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

As outlined in Section B.6.1, the sources of project emissions to be considered in the context of the determination of emission reductions to be achieved by the GS project activity are those due to the consumption of grid-sourced electricity.

Related ex-ante estimations of the corresponding project emissions are determined as follows:

$$PE_y = PE_{EC,grid,y} + PE_{EC,captive,y}$$

Where:

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

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

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

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

Where:

- $EC_{PJ,grid,y}$ Quantity of grid sourced electricity consumed by the project activity in year y (in MWh). $EC_{PJ,grid,y}$ is estimated as being 152 MWh per year. Further details are included in Section B.7.1. This value is assumed based on the installed nominal power output for the main electrical equipment currently installed as part of the project activity and also by assuming that such equipment will work continuously (24 hours a day) under full power during the whole last crediting period of the GS project activity under GS4GG.
- $TDL_{grid,y}$ Average technical transmission and/or distribution losses for grid-sourced electricity consumed by the project activity in year y . For the particular

case of ex-ante estimates of $PE_{EC,grid,y}$, $TDL_{grid,y}$ is selected as 20% ($TDL_{grid,import,y}$). Further details are included in Section B.7.1.

$EF_{EL,grid,y}$ CO₂ emission factor for electricity generation / grid sourced electricity in year y (in tCO₂/MWh). In the particular context of ex-ante estimates of emission reductions to be achieved by the GS project activity within its last crediting period under GS4GG, $EF_{EL,grid,y}$ is estimated as per applicable guidance of the CDM methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0) as the combined margin CO₂ emission factor ($EF_{grid,CM,y}$) for the electricity grid of Brazil (SIN grid) with its value being estimated for each year encompassed by the last crediting period of the GS project activity under GS4GG as 0.2907 tCO₂/MWh (in the particular context of ex-ante estimates of emission reductions to be achieved by the GS project activity during its last crediting period under GS4GG). Further details are presented above in this Section.

Determination of ex-ante estimations of project emissions from consumption of electricity generated by a captive off-grid electricity generator fueled by diesel by the GS project activity ($PE_{EC,captive,y}$):

$PE_{EC,captive,y}$ is estimated as being 0 tCO₂e, since no consumption of electricity generated by the installed backup captive off-grid electricity generator is considered in the particular case of the determination of ex-ante estimates of emission reductions to be achieved by the GS project activity within its last crediting period under GS4GG.

In summary, ex-ante estimations of project emissions for the GS project activity during its last crediting period under GS4GG (period from 29/09/2023 to 28/09/2026) are thus summarized as follows:

Year	Project emissions from consumption of grid electricity (in tCO ₂ /yr)	Project emissions from consumption of electricity generated by the captive off- grid electricity generator fueled by diesel (in tCO ₂ /yr)	Total Project emissions (tCO ₂ e)
	$PE_{EC,grid,y} = EC_{PJ,grid,y} * EF_{EL,grid,y} * (1 + TDL_{grid,y})$	$PE_{EC,captive,y} = EC_{PJ,captive,y} * EF_{EL,captive,y} * (1 + TDL_{captive,y})$	$PE_y = PE_{EC,grid,y} + PE_{EC,captive,y}$
2023	14	0	14
2024	54	0	54
2025	54	0	54
2026	40	0	40
Total	162	0	162

Note: All values applicable for years 2023 and 2026 are valid for the fractions of these years which are encompassed by the last crediting period of the GS project activity under GS4GG (period from 29/09/2023 to 31/12/2023 and period from 01/01/2026 to 28/09/2026, respectively).

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

By taking into account the above summarized values for baseline and project emissions, the ex-ante estimations of the emission reductions for the GS project activity along its last crediting period under GS4GG (period from 29/09/2023 to 28/09/2026) are summarized as follows:

Emission reductions (tCO ₂ e)	
Year	$ER_y = BE_y - PE_y$
2023	201,557
2024	789,454
2025	797,940
2026	599,531
Total	2,388,482

Note: All values applicable for years 2023 and 2026 are valid for the fractions of these years which are encompassed by the last crediting period of the GS project activity under GS4GG (period from 29/09/2023 to 31/12/2023 and period from 01/01/2026 to 28/09/2026, respectively).

Details about all the ex-ante determined parameters which are used for the ex-ante estimations of emissions reductions are included in the previous section. An emission reduction calculation spreadsheet with all related calculations for the ex-ante estimations of emission reductions to be achieved by the GS project activity during its last crediting period under GS4GG is enclosed to this GS4GG PDD.

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

SDG 13

YEAR	BASELINE ESTIMATE	PROJECT ESTIMATE	NET BENEFIT
2023	201,571	14	201,557
2024	789,508	54	789,454
2025	797,994	54	797,940
2026	599,571	40	599,531
Total	2,388,644	162	2,388,482
Total number of crediting years		3	
Annual average over the crediting period	796,215	54	796,161

SDG 7

YEAR	BASELINE ESTIMATE	PROJECT ESTIMATE	NET BENEFIT
2023	57,907	0	57,907
2024	224,852	0	224,852
2025	224,852	0	224,852
2026	166,945	0	166,945
Total	674,555	0	674,555
Total number of crediting years		3	
Annual average over the crediting period	224,852	0	224,852

SDG 8

YEAR	BASELINE ESTIMATE	PROJECT ESTIMATE	NET BENEFIT
2023	20	0	20
2024	21	0	21

2025	21	0	21
2026	21	0	21
Total	21	0	21
Total number of crediting years		3	
Annual average over the crediting period	21	0	21

B.7. Monitoring plan

B.7.1 Data and parameters to be monitored

SDG 13

Data / Parameter	Management of SWDS
Unit	Dimensionless
Description	Management of SWDS
Source of data	Monitoring performed by the project developer and/or appointed 3rd party. The design and operational conditions of the solid waste disposal site (SWDS) (Ecoparque Candeias landfill) will be annually monitored on the basis of different sources, including <i>inter alia</i>: - Original construction and operational design of the landfill - Technical specifications and requirements for the management of the landfill - Applicable local or national regulations dealing with management and operation of existing landfills Any occurred or planned relevant change in terms of management of the landfill will be reported and justified.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.
Measurement methods and procedures	Original construction and operational design of the Ecoparque Candeias landfill should be confirmed as not being modified along the project's operational lifetime. This is to ensure that no practice aiming to increase methane generation in the landfill occurs after the implementation of the GS project activity. As required by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), any change in the management of the Ecoparque Candeias landfill after the

	implementation of the GS project activity should be justified by referring to technical or regulatory specifications.
Monitoring frequency	Annually
QA/QC procedures	Not applicable
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$V_{t,db,j}$
Unit	m ³ dry gas/h
Description	Volumetric flow of LFG stream in time interval t on a dry basis for j (where j is the LFG delivery pipeline to the flare and/or to each engine-generator set).
Source of data	Measurements/monitoring performed by the project developer. Measured as part of the operation of the GS project activity by applying appropriate LFG flow meters.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.
Measurement methods and procedures	Volumetric flow measurement of collected LFG should always refer to the actual LFG absolute pressure and LFG temperature. Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events for the LFG flow meters will be performed by using a reference primary device provided by a third party independent accredited calibration

	laboratory. Calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance with appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter will be monitored in case Option A of the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" are applied for the determination of $F_{CH_4,flared,y}$ and/or $F_{CH_4,EL,y}$.

Data / Parameter	$V_{t,wb,j}$
Unit	m ³ wet gas/h
Description	Volumetric flow of LFG stream in time interval t on a wet basis for j (where j is the LFG delivery pipeline to the flare and/or to each engine-generator set).
Source of data	Measurements/monitoring performed by the project developer. Measured as part of the operation of the GS project activity by applying appropriate LFG flow meters.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.
Measurement methods and procedures	Volumetric flow measurement of collected LFG should always refer to the actual LFG absolute pressure and LFG temperature. Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.

QA/QC procedures	Periodic calibration events for the LFG flow meters will be performed by using a reference primary device provided by a third party independent accredited calibration laboratory. Calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance with appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter will be monitored in case Options B or C of the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" are applied for the determination of $F_{CH_4, flared, y}$ and/or $F_{CH_4, EL, y}$.

Data / Parameter	$V_{CH_4, t, db, j}$
Unit	m^3CH_4 / m^3 dry gas
Description	Volumetric fraction of CH_4 in the collected LFG in time interval t on a dry basis for j (where j is the LFG delivery pipeline to the flare and/or to each engine-generator set).
Source of data	Measurements/monitoring performed by the project developer. Measured as part of the operation of the project activity by applying an appropriate continuous CH_4 content gas analyzer.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.

Measurement methods and procedures	Measurements to be performed by appropriate continuous gas analyzer(s) operating on a dry basis. Volumetric flow measurement should always refer to the actual pressure and temperature. Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events in the continuous CH₄ content gas analyzer(s) will be performed by utilization of calibration span gas with certified CH₄ content (for span checking/adjustment). Utilization of an inert calibration gas (e.g., N₂) will also occur (for span checking/adjustment). All calibration gases (span gases) must have a certificate provided by the gas supplier and must be within their validity period. Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance with appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter will be monitored in case Option B of the CDM methodological tool "Tool to determine the mass

	flow of a greenhouse gas in a gaseous stream” is applied for the determination of $F_{CH_4,flared,y}$ and/or $F_{CH_4,EL,y}$. This parameter may be monitored in case Options A or D of the CDM methodological “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” are applied instead.
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Data / Parameter	$V_{CH_4,t,wb,j}$
Unit	m^3CH_4 / m^3 dry gas
Description	Volumetric fraction of CH_4 in the collected LFG in time interval t on a wet basis for j (where j is the LFG delivery pipeline to the flare and/or to each engine-generator set).
Source of data	Measurements/monitoring performed by the project developer. Measured as part of the operation of the project activity by applying an appropriate continuous CH_4 content gas analyzer.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.
Measurement methods and procedures	Measurements to be performed by appropriate continuous gas analyzer(s) operating in wet basis. Volumetric flow measurement should always refer to the actual pressure and temperature. Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.

QA/QC procedures	Periodic calibration events in the continuous CH₄ content gas analyzer(s) will be performed by utilization of calibration span gas with certified CH₄ content (for span checking/adjustment). Utilization of an inert calibration gas (e.g. N₂) will also occur (for span checking/adjustment). All calibration gases (span gases) must have a certificate provided by the gas supplier and must be within their validity period. Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance with appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter will be monitored in case Option C of the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" is applied for the determination of $F_{CH_4, flared, y}$ and/or $F_{CH_4, EL, y}$. This parameter may be monitored in case Options A or D of the CDM methodological "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" are applied instead.

Data / Parameter	$V_{CH_4, t, db, j}$
Unit	m ³ CH ₄ /m ³ dry gas
Description	Volumetric fraction of CH ₄ in the collected LFG in time interval t on a dry basis for j (where j is the LFG delivery pipeline to the flare and/or to each engine-generator set).

Source of data	Measurements/monitoring performed by the project developer. Measured as part of the operation of the project activity by applying an appropriate continuous CH₄ content gas analyzer.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.
Measurement methods and procedures	Measurements to be performed by appropriate continuous gas analyzer(s) operating on a dry basis. Volumetric flow measurement should always refer to the actual pressure and temperature. Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events in the continuous CH₄ content gas analyzer(s) will be performed by utilization of calibration span gas with certified CH₄ content (for span checking/adjustment). Utilization of an inert calibration gas (e.g., N₂) will also occur (for span checking/adjustment). All calibration gases (span gases) must have a certificate provided by the gas supplier and must be within their validity period. Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations.

	Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance with appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter will be monitored in case Option B of the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" is applied for the determination of $F_{CH_4,flared,y}$ and/or $F_{CH_4,EL,y}$. This parameter may be monitored in case Options A or D of the CDM methodological "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" are applied instead.

Data / Parameter	$V_{O_2,EG,m}$
Unit	-
Description	Volumetric fraction of O_2 in the exhaust gas 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 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.
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	$V_{RG,m}$
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	$V_{i,RG,m}$
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
Data / Parameter	f_{CCH₄,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 <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 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.
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.
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Data / Parameter	T_t
Unit	K ⁴⁹
Description	Temperature of the LFG stream in time interval t
Source of data	Measurements/monitoring performed by the project developer. Measured as part of the operation of the GS project activity by applying appropriate LFG temperature sensor(s).
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.
Measurement methods and procedures	Measured to determine the density of methane ρ_{CH_4} . No separate monitoring of LFG temperature is necessary when using LFG flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters (by considering standard temperature and pressure (STP) conditions). Instruments with recordable electronic signal (analogical or digital) are required.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.

⁴⁹ Measurements for T_t may be recorded and reported in °C. Under such circumstance, recorded/reported data in °C will be converted to Kelvin (K) (in order to also being recorded/reported in K).

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

Data / Parameter	P_t
Unit	Pa. ⁵⁰
Description	Pressure of the LFG stream in time interval t
Source of data	Measurements/monitoring performed by the project developer. Measured as part of the operation of the GS project activity by applying appropriate LFG pressure sensor(s).
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.
Measurement methods and procedures	Measured to determine the density of methane ρ_{CH_4} . No separate monitoring of LFG pressure is necessary when

⁵⁰ Depending on installed measurement instrument, measurements for P_t may be recorded and reported in mbar. Under such circumstance, recorded/reported data in mbar will be converted into Pascal (Pa) (in order to be also recorded and reported in Pa).

	using LFG flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters (by considering standard temperature and pressure (STP) conditions). Instruments with recordable electronic signal (analogical or digital) are required.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events for the LFG pressure sensor(s) will be performed by using a reference primary device provided by a third party independent accredited calibration laboratory. Calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance with appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions
Additional comment	In case of measurements for the applicable LFG flow parameter are automatically converted and recorded in normalized cubic meters (by considering standard temperature and pressure (STP) conditions), monitoring of this parameter may not be required.

Data / Parameter	EC_{PJ,grid,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> <tr> <th>Year</th><th>$EC_{PJ1,y}$ (MWh/year)</th></tr> <tr> <td>29/09/2023 to 31/12/2023</td><td>39</td></tr> <tr> <td>2024</td><td>152</td></tr> <tr> <td>2025</td><td>152</td></tr> <tr> <td>01/01/2026 to 28/09/2026</td><td>113</td></tr> </table>	Year	$EC_{PJ1,y}$ (MWh/year)	29/09/2023 to 31/12/2023	39	2024	152	2025	152	01/01/2026 to 28/09/2026	113
Year	$EC_{PJ1,y}$ (MWh/year)										
29/09/2023 to 31/12/2023	39										
2024	152										
2025	152										
01/01/2026 to 28/09/2026	113										
Measurement methods and procedures	Continuously measured by electricity meters for the grid electricity consumption as per the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0) and CDM baseline and monitoring 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_{PJ,captive,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	0 No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity as the backup captive diesel generator is to be used for emergency purposes in cases when the grid electricity or electricity generated by the electricity generation facility fueled by LFG are not available.
Measurement methods and procedures	Continuously measured by electricity meters for the diesel generators as per the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0) and CDM baseline and monitoring 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.
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	$EF_{grid,OM,y} = EF_{grid,OM-DD,y}$
Unit	tCO ₂ /MWh
Description	Operation margin CO ₂ emission factor in year y = Dispatch data analysis operating margin CO ₂ emission factor in year y .
Source of data	Data will be determined as per applicable guidance for dispatch data analysis operating margin CO ₂ emission factor as per Option A.1 of the CDM methodological tool "Tool to calculate the emission factor for an electricity system".
Value(s) applied	0.3786 The selected value considered for all years encompassed by the last crediting period of the GS project activity under GS4GG in the context of the ex-ante estimation of emission reductions to be achieved by the GS project activity during its last crediting period under GS4GG represents the value calculated by the CDM DNA of Brazil and valid for year 2023 (the most recent annual value available). Data is made available online: https://antigo.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html
Measurement methods and procedures	Data will be determined as per applicable guidance for dispatch data analysis operating margin CO ₂ emission factor as per applicable guidance of the CDM methodological tool "Tool to calculate the emission factor for an electricity system".
Monitoring frequency	Yearly
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions and project emissions

Additional comment	-
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Data / Parameter	P_{H2O,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	Op_{j,h}
Unit	-
Description	Operation of the equipment that consumes LFG (engine-generator sets of the electricity generation infrastructure)
Source of data	Measured as part of the operation of the project activity.

Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.
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 PDD; (b) Flame. Flame detection system is used to ensure that the equipment is in operation; (c) Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnaces. This option is not applicable to brick kilns. $Op_{j,h} = 0$ when: (a) One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); (b) Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); (c) No products are generated in the hour h. Otherwise, $Op_{j,h} = 1$
Monitoring frequency	Hourly
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	In the particular case of the GS project activity the only equipment/infrastructure that promotes utilization of LFG

	are the engine-generator sets of the electricity generation infrastructure.
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Data / Parameter	$T_{EG,m}$
Unit	°C
Description	Temperature in the exhaust gas of the enclosed flare in minute m
Source of data	Measurements performed for each operational flare by the project developer.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.
Measurement methods and procedures	Measure the temperature of the exhaust gas of the operational high temperature enclosed flare by appropriate temperature measurement equipment (e.g. thermocouples). Measurements outside the operational temperature specified/recommended by the manufacturer may indicate that the flare is not functioning correctly and may require maintenance. Flare manufacturers must provide suitable monitoring ports for the monitoring of the temperature of the exhaust gas of the flare. These would normally be expected to be in the middle third of the flare. Where more than one measurement port for temperature of the exhaust gas of the flare is fitted to the flare, the flare manufacturer must provide written instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the

	operation of the flare according to manufacturer's specifications for temperature ⁵¹ .
Monitoring frequency	Continuous measurements will be recorded and reported with a least every minute frequency.
QA/QC procedures	Temperature measurement equipment should be replaced or calibrated in accordance with their maintenance schedule. Periodic calibration events will be performed in the instruments by a third party independent accredited calibration laboratory in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance with appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions
Additional comment	Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. As part of the monitoring procedure, these events will be noted in the site records along with any corrective action that was implemented to correct the issue. Measurements are required to determine if manufacturer's flare specifications for operating temperature are met.

⁵¹ In the particular case of the high temperature enclosed flare installed as part of the GS project activity, only one individual measuring instrument (e.g. thermocouple) may be located in the upper section of the flare. Anyway, in case flare installed as part of the GS project activity has more than one measurement port (for temperature of the exhaust gas of the flare), the requirement applicable for flare with more than one measurement port for temperature of the exhaust gas will thus be considered.

Data / Parameter	Flame_m
Unit	Flame status "on" or flame status "off"
Description	Flame detection of flare in the minute <i>m</i>
Source of data	Measurements/monitoring for the flare performed by the project developer. Whenever, flame is detected in the flare, flame status "on" is attributed. Whenever, flame is not detected in the flare, flame status "off" is attributed.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.
Measurement methods and procedures	Measure for the installed flare using a fixed installation optical flame detector: Ultraviolet detector or Infra-red or both.
Monitoring frequency	Once per minute.
QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations.
Purpose of data	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations.
Additional comment	Applicable to the flare.

Data / Parameter	Maintenance_y
Unit	Calendar dates
Description	Maintenance events completed in year <i>y</i> as monitored by the project developer.
Source of data	Measurements/monitoring performed by the project developer.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.
Measurement methods and procedures	Record the date that maintenance events were completed in year <i>y</i> . Records of maintenance logs must include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced, or needing to be replaced, source of replacement parts, serial numbers and calibration certificates.
Monitoring frequency	Annual
QA/QC procedures	Records must be kept in a maintenance log for two years beyond the life of the flare
Purpose of data	Calculation of baseline emissions
Additional comment	These dates are required so that they can be compared to the maintenance schedule to check that maintenance events were completed within the minimum time between maintenance events specified by the manufacturer (SPEC _{flare}).

Data / Parameter	Status of biogas destruction device
Unit	-
Description	Operational status of biogas destruction device(s)
Source of data	Not applicable
Value(s) applied	Not applicable. No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the GS project activity.
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 measurements will be recorded and reported with a least every minute frequency.
QA/QC procedures	Not applicable.
Purpose of data	Calculation of baseline emissions
Additional comment	Monitoring records for the monitoring parameter "Flame detection of flare in the minute m " (Flame_m) may be considered for the case of the flare. Monitoring the operational status of the engine-generator sets by embedded electronics of the sets may also be considered.

Data / Parameter	TDL_{grid,y}
Unit	-
Description	Average technical transmission and distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the project activity
Source of data	Use of recent, accurate and reliable data available within the host country or selection of applicable default values as per Option A of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" or use of recent, accurate and reliable data available within the host country.
Value(s) applied	3% (for generated electricity exported through the electricity grid the project activity is connected to (TDL _{grid,export,y})) 20% (for electricity imported by the project activity through the electricity grid the project activity is connected to (TDL _{grid,import,y}))
Measurement methods and procedures	The CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" defines, as alternative, default value of 20% for project consumption sources (applicable for determination of project emissions due to consumption of grid-sourced electricity by the GS project activity) and default value of 3% for baseline electricity consumption sources (applicable for the determination of baseline emissions for electricity generation by the GS project activity). The selection of these default values is in conformance with applicable guidance of the CDM baseline and monitoring methodology ACM0001 (version 19.0).

While transmission and distribution sources applicable for both grid-sourced electricity to be consumed by the GS project activity and for electricity generation by the GS project activity (equivalent to electricity consumption of baseline electricity consumption sources when applying the underlying tool) do not fit under Scenario B and/or Scenario C (case II) of the such tool, the selected 20% value for $TDL_{grid,import,y}$ and 3% values for $TDL_{grid,export,y}$ are thus under conformance with applicable guidance of the CDM methodological tool.

The selection of 20% value for $TDL_{grid,import,y}$ and 3% value for $TDL_{grid,export,y}$ meets applicable guidance for Scenarios A and C of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (whichever of these scenarios are applicable for the particular case of the GS project activity).

It is relevant to note that as per the project design, the amount of electricity to be consumed by the GS project activity (project electricity consumption sources) to which scenario A of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" refers is smaller than the so-called electricity consumption of baseline electricity consumption sources ($EC_{BL,k,y}$) as per such methodological tool (where $EC_{BL,k,y}$ in the tool is equivalent to the net amount of electricity generated using LFG in year y ($EC_{BL,y}$) as defined by ACM0001 (version 19.0)).

In summary, the GS project activity generates more electricity than it requires for its operation, with the largest amount of generated electricity being exported through the electricity grid the GS project activity is connected to. Under these particular conditions, also

	considering the 3% default value for electricity imported by the project activity (through the electricity grid the project activity is connected to) in thesis would represent an acceptable alternative. However, as a conservative approach, the generic 20% default value of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" applicable for project consumption sources is selected. This approach results in higher project emissions, thus reducing emission reductions to be achieved by the GS project activity accordingly.
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	Calculation of baseline emissions 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	0.2907
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	-
Purpose of data	Calculation of baseline emissions and project emissions
Additional comment	-

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										
Source of data	Measured as part of the operation of the GS project activity by applying appropriate electricity meter(s).										
Value(s) applied	<table> <tr> <th>Year</th><th>$EC_{PJ,y}$ (MWh)</th></tr> <tr> <td>2023 (period from 29/09/2023 to 31/12/2023)</td><td>57,907</td></tr> <tr> <td>2024</td><td>224,852</td></tr> <tr> <td>2025</td><td>224,852</td></tr> <tr> <td>2026 (period from 01/01/2026 to 28/09/2026)</td><td>166,945</td></tr> </table>	Year	$EC_{PJ,y}$ (MWh)	2023 (period from 29/09/2023 to 31/12/2023)	57,907	2024	224,852	2025	224,852	2026 (period from 01/01/2026 to 28/09/2026)	166,945
Year	$EC_{PJ,y}$ (MWh)										
2023 (period from 29/09/2023 to 31/12/2023)	57,907										
2024	224,852										
2025	224,852										
2026 (period from 01/01/2026 to 28/09/2026)	166,945										
Measurement methods and procedures	Authorized electricity meter(s) may be used. The parameter $EC_{BL,y}$ is equivalent to the parameter $EG_{PJ,y}$ as indicated in ACM0001 (version 19.0). Measurement records will be cross-checked against available electricity sales receipts/invoices issued by the local electricity commercialization/distribution company.										
Monitoring frequency	Continuous measurements will be aggregated automatically. Accumulated measurement records will be reported at least once a month.										

QA/QC procedures	Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept. Measurement records will be cross-checked against available electricity sales receipts/invoices issued by the local electricity commercialization/distribution company.
Purpose of data	Calculation of baseline emissions
Additional comment	-

SDG 8

Data / Parameter	Number of employments
Unit	Number of jobs created by the GS project activity.
Description	Number of employees related to the operation of the GS project activity
Source of data	Employment records
Value(s) applied	21 jobs
Measurement methods and procedures	In accordance with records of employees related to the operation of the GS project activity. As an additional monitoring requirement, the quality of jobs created shall be monitored on the basis of: - Conformity with national Labor Laws - Availability of Personnel Protection Equipment and safety/health instructions and procedures Control of personnel working hours and overtime pay

Monitoring frequency	Annually.
QA/QC procedures	Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the GS project activity are performed by Essencis MG Soluções Ambientais S.A. in accordance with the available detailed working instructions.
Purpose of data	Determination of the monitoring indicator applicable for SDG 8.
Additional comment	-

B.7.2 Sampling plan

>>

Not applicable.

B.7.3 Other elements of monitoring plan

>>

General monitoring:

The following instruments/equipment will be used to monitor required data along the lifetime of the GS project activity (depending on the applied measurement options and calculation approaches - to be chosen ex-post)⁵²:

Instrument or Source of data	Measurement option		Data monitored	
Appropriate volumetric or mass flow meter(s)	A	Volume flow – dry basis;	$V_{t,db,j}$	Volumetric flow of LFG stream j in time interval

⁵² Measurement options defined in the CDM methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” when referring to “Adequate volumetric or mass flow meter(s)” and defined in the CDM methodological tool “Project emissions from flaring” in other cases. Different measurement options are indeed defined in the CDM methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” when referring to “Adequate volumetric or mass flow meter (s)”. The applicable guidance of the CDM methodological tool “Project emissions from flaring” also refers to different measurement and calculation options.

(one individual LFG flow meter for each operational high temperature enclosed flare and/or each operational engine-generator with separated measurement data being recorded and reported for each one of these methane destruction devices)		Volumetric fraction dry or wet basis		t on a dry basis (in m^3 dry gas/h). j = LFG delivery pipeline to the high temperature enclosed flare and/or each operative engine-generator set (i.e. each installed methane destruction device)
	B	Volume flow – wet basis; Volumetric fraction dry basis	$V_{t,wb,j}$	Volumetric flow of LFG stream j in time interval t on a wet basis (in m^3 dry gas/h). j = LFG delivery pipeline to the high temperature enclosed flare and/or each operative engine-generator set (i.e. each installed methane destruction device)
	C	Volume flow – wet basis; Volumetric fraction wet basis	$V_{t,wb,j}$	Volumetric flow of LFG stream j in time interval t on a wet basis (in m^3 wet gas/h). j = LFG delivery pipeline to the high temperature enclosed flare and/or each operative engine-generator set (i.e. each installed methane destruction device)
	B.2	Continuous monitoring of flare efficiency	VRG,m	Volumetric flow of the residual gas on a dry basis at reference conditions in the minute m

				Monitoring of this parameter is applicable for enclosed flares and continuous monitoring of the flare efficiency.
	B.2	Continuous monitoring of flare efficiency	$\dot{M}_{RG,m}$	Mass flow of the residual gas on a dry basis at reference conditions in the minute m Monitoring of this parameter is applicable for enclosed flares and continuous monitoring of the flare efficiency.
Continuous CH ₄ content gas analyzer unit	C	Volume flow – wet basis; Volumetric fraction wet basis	$V_{CH_4,t,db/wb,j}$	Volumetric fraction of methane on the LFG stream directed to the flare and/or to the engine-generator sets in a time interval t on a dry or wet basis (in m ³ CH ₄ /m ³ dry or wet gas)
	B.2	Continuous monitoring of flare efficiency	$V_{i,RG,m}$	Volumetric fraction of component i in the residual gas on a dry basis in the minute m where $i = CH_4, CO, CO_2, O_2, H_2, H_2S, NH_4, N_2$ (As a simplified approach, the project proponent 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 applicable

				for enclosed flares and continuous monitoring of the flare efficiency.
	B.2	Continuous monitoring of flare efficiency	$V_{O_2,EG,m}$	Volumetric fraction of O_2 in the exhaust gas on a dry basis at reference conditions in the minute m Monitoring of this parameter is applicable for enclosed flares and continuous monitoring of the flare efficiency.
	B.2	Continuous monitoring of flare efficiency	$f_{CH_4,EG,m}$	Concentration of methane in the exhaust gas of the flare on a dry basis at reference conditions in the minute m Monitoring of this parameter is applicable for enclosed flares and continuous monitoring of the flare efficiency.
LFG pressure sensor	-		P_t	Pressure of the LFG stream directed to the flare and/or to each operative engine-generator set in time interval t (in Pa or mbar) Note: P_t may not be monitored when using LFG flow meters that automatically consider and measures LFG temperature and LFG

			pressure, thus expressing LFG volumetric or mass flows in normalized units
LFG temperature sensor	-	T_t	Temperature of the LFG stream directed to the flares and/or to each operative engine-generator in time interval t (in K or °C) Note: T_t may not be monitored when using LFG flow meters that automatically consider and measures LFG temperature and LFG pressure, thus expressing LFG volumetric or mass flows in normalized units.
Not based on measurements. Monitoring performed in the context of operation/monitoring for the GS project activity (based on calculations)	-	$p_{H_2O,t,Sat}$	Saturation pressure of H₂O at temperature T_t in time interval t. This parameter is solely a function of the LFG stream temperature T_t and can be found at referenced literature.
Electricity meters	-	$EC_{PJ,grid,y}$	Amount of grid electricity consumed by the GS project activity in year y (in MWh)
		$EC_{PJ,captive,y}$	Quantity of electricity consumed from diesel

			generator by the project activity during the year y
		EC_{BL,y}	Amount of electricity generated using LFG by the GS project activity in year y (in MWh)
Not based on measurements. Monitoring performed in the context of operation/monitoring for the GS project activity (based on calculations)	-	EF_{grid,OM,y} = EF_{grid,OM-DD,y}	Operation margin CO ₂ emission factor in year y = Dispatch data analysis operating margin CO ₂ emission factor in year y. (in tCO ₂ /MWh). Data will be determined as per applicable guidance for dispatch data analysis operating margin CO ₂ emission factor of the CDM methodological tool "Tool to calculate the emission factor for an electricity system"
Not based on measurements performed in the context of operation/monitoring for the GS project activity	-	Management of SWDS	Management of SWDS The design and operational conditions of the landfill will be annually monitored on the basis of different sources, including inter alia: - Original design of the landfill; - Technical specifications for the

			management of the landfill; - Applicable local or national regulations
Meter or equipment electronics.	-	Op_{j,h}	Operation of the equipment that consumes LFG (engine-generator sets). For each engine-generator <i>j</i> combusting LFG, it will be continuously monitored whether the equipment is operating in hour <i>h</i> by monitoring any one the following sub-parameters/conditions: - Amount of electricity generated in hour <i>h</i> - Operational status of the engine-generator during each hour <i>h</i> .
Appropriate Gas analyzer(s) (one individual gas analyzer for each high temperature enclosed flare)	Option B.1	F_{CH₄,EG,t}	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period <i>t</i> (kg). For each one of the installed high temperature enclosed flare, it will be measured the mass flow of methane in the exhaust gas according to an appropriate

			national or international standard (e.g. UKs Technical Guidance LFTGN05). The time period t over which the mass flow is measured must be at least one hour. The average flow rate to the flare during the time period t must be greater than the average flow rate observed for the previous six months. Monitoring of this parameter is only required in the case the project participants select Option B.1 to determine the efficiency values for the high temperature enclosed flare.
Thermocouples	A or B.1	T_{EG,m}	Temperature in the exhaust gas of the enclosed flare in minute m (°C) For each one of the installed high temperature enclosed flare, it will be continuously measured the temperature of the exhaust gas through use of appropriate temperature

			measurement instrument (e.g. thermocouples). Measurements outside the operational temperature specified by the flare manufacturer may indicate that the flare is not functioning correctly and may require maintenance or repair work. The temperature of the exhaust gas in the flare has to be measured in a suitable monitoring port. In high temperature enclosed flares, monitoring ports are normally expected to be located within the middle third of the flare. In case more than one temperature port is fitted to the high temperature enclosed flare, the flare manufacturer must provide written instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the operation of the flare according to manufacturer's
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			specifications for temperature of exhaust gas. The high temperature enclosed flare currently installed as part of the GS project activity only have one monitoring port for temperature of the exhaust gas. Measurements are required to determine if manufacturer's flare specifications for operating temperature are met.
Optical flame detector (using ultraviolet or infra-red technology or both)	A or B.1	Flame_m	Flame detection of flare in the minute m (Flame "on" or Flame "off"). For the installed high temperature enclosed flare, continuous monitoring of flame detection through use of appropriate installation (e.g. optical flame detector (using ultraviolet or infra-red technology or both)).
Records from the project developer gathered as part of the operation of the GS project activity.	B.1	Maintenance_y	Maintenance events completed in year y (Calendar dates) for the high temperature enclosed flare combusting LFG. For the high temperature enclosed flare, record the date when

			maintenance events are performed in year y. Records of maintenance logs will include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced/repaired, or needing to be replaced, source of replacement parts, serial numbers and related calibration certificates.
Not based on measurements	Calculated or application of default value	TDL_{grid,y}	Use of recent, accurate and reliable data available within the host country or selection of the applicable default value as per the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"
Project developer	-	Status of biogas destruction device	Operational status of biogas destruction device. The same procedures as adopted for monitoring parameter $Flame_m$ (in the case of the flare) and for parameter $Op_{j,h}$ (in the case of engine-

			generator sets). For installed high temperature enclosed flare, continuous monitoring of flame detection through use of appropriate installation (e.g. optical flame detector (using ultra violet or infrared technology or both). For installed engine-generator sets, continuous monitoring of operational status signal in each engine
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During the lifetime of the GS project activity, all continuously measured LFG related parameters as well as measurements related to the exhaust gas of the flare (temperature in the exhaust gas of the flare) and parameters related to flare operational conditions of the flare and/or engine-generator(s) (i.e. status of the methane destruction device(s)) will all be recorded electronically via an appropriate data logger / data acquisition system (to be located within the site boundary).

The data logger / data acquisition system will have the capability to record all data in a safe and reliable manner (thus ensuring the required data reliability and validity). Data recording and reporting frequency for these parameters will be at least every minute.

Records of electricity generated by the GS project activity as well as records of electricity consumed by the GS project activity will also be recorded electronically via an appropriate data logger / data control / data acquisition system (to be located within the site boundary). Data from invoices of commercialization of generated electricity and consumption of grid-sourced electricity (issued by local electricity transmission/commercialization company and/or electricity purchaser) may also be used as cross-checking.

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

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

All monitoring data will be recorded and backed-up in a central database. As per the applicable monitoring procedure, data records will be summarized into emission reduction calculations prior to each periodic GS verification. All data recorded by the data logger / data acquisition system will be made available to the GS Validation and Verification Body (VVB) responsible for each periodic verification. This will ensure that data integrity and reliability for related monitoring data.

Procedures for handling non-conformances with the validated monitoring plan will also be in place.

As per the monitoring procedure to be adopted by the project developer Orizon Valorização de Resíduos S/A, access to monitoring data will be restricted and controlled. All monitoring records will be kept archived until at least two years after the end of the last crediting period of the GS project activity under GS4GG or at least two years after the last issuance of CERs for the GS project activity, whichever occurs later.

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

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

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

During the lifetime of the GS project activity, all maintenance service and routines will include all preventive and corrective actions necessary for ensuring good functioning of all project related equipment, such as:

- Visual control of the equipment state and real-time check of displayed parameters
- Cleaning up the equipment and the sensors
- Lubrication and greasing
- Replacement or overhauling of defective parts (including regular welding service in the HDPE pipelines and manifolds, testing and replacement of components from the engine-generator, etc.)
- Calibration events in monitoring instruments/equipment will be periodically and appropriately performed as per applicable frequency, procedures and methods established or recommended by instrument/ equipment manufacturer, applicable national/international standards and/or best practice, as available.

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

Project's operational and management structure:

An appropriate project's operational and management structure will be made available as part of the operation of the GS project activity during its lifetime.

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

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

- e) Emergency and safety procedures.
- f) General competence development about methane destruction through combustion of LFG in high temperature enclosed flare.
- g) General competence development about utilization of LFG as gaseous fuel for electricity generation

The monitoring plan will be implemented and operationalized during the lifetime of the GS project activity by reflecting the best practice in terms of monitoring efforts for LFG collection and destruction/utilization project-based initiatives under Gold Standard.

Monitoring of the management of the landfill:

As required by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), the design and operational conditions of the Ecoparque Candeias landfill will be monitored along the lifetime of the GS project activity on the basis of different sources, including *inter alia*:

- Original design of the landfill
- Technical specifications for the management of the Ecoparque Candeias landfill;
- Applicable local or national regulations

During the lifetime of the GS project activity, original operational design of the landfill should be confirmed not to be modified in order to ensure that no practice to increase methane generation at the landfill have been occurring, when compared to the landfill management and operation condition prior to implementation of the GS project activity. As required by ACM0001 (version 19.0), any change in the management of the landfill after the implementation of the GS project activity should be justified by referring to technical or regulatory specifications and impacts of such changes in the determination of baseline emissions should in this case be taken into account appropriately. Such monitoring requirement will be used for the determination/confirmation of baseline emissions and/or confirmation of the project's implementation as described in the GS PD (in terms of operation and management conditions of the landfill from which LFG is combusted).

SECTION C. DURATION AND CREDITING PERIOD

C.1. Duration of project

C.1.1 Start date of project

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Project starting date: 29/09/2011.

C.1.2 Expected operational lifetime of project

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The expected operational lifetime for the project's LFG collection and destruction/utilization infrastructure is at least 21 years. However, related equipment and infrastructure lifetime may even exceed 21 years if required service and maintenance is performed correctly and in case the GS project activity is always operated as per recommendation and requirements set by manufacturers/suppliers of included equipment/instruments.

C.2. Crediting period of project

C.2.1 Start date of crediting period

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The 2 renewable 7-year crediting periods for the GS 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 and last CP: from 29/09/2023 to 28/09/2026

C.2.2 Total length of crediting period

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3 years (from 29/09/2023 to 28/09/2026)

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 parameters “Number of employments”, “Number of employees provided skill development training” 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 which deal with gender equality. The project provides employment opportunities equally for men and women.
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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.⁵³ 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.”

The law Nº 7.353.⁵⁴ 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).⁵⁵, 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 project 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.

⁵³ https://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm

⁵⁴ http://www.planalto.gov.br/ccivil_03/leis/1980-1988/L7353.htm

⁵⁵ https://www.planalto.gov.br/ccivil_03/decreto-lei/del5452.htm

Question 4 - Is an Expert required to assist with Gender issues at the Stakeholder Consultation?

A Stakeholder's consultation was held in 2023 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 "Safeguarding Principles and Requirements", no Expert would be required to assist with Gender issues at the Stakeholder Consultation.

SECTION E. SUMMARY OF LOCAL STAKEHOLDER CONSULTATION

The information presented 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

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The project developer sent e-mail invitations for the identified stakeholders⁵⁶ 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.

⁵⁶ 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.

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).

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).

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 grievance process book has been made available at the main office of the Ecoparque Candeias landfill as the stakeholders's choosen place. Project developer will be checking the comments in the book on a regular basis, and record responses. They will be respectful to the views of stakeholders and suggest alternative solutions or compromises wherever possible. It is chosen as main mechanism.
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

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.

SOCIAL SAFEGUARDING PRINCIPLES		
Reference requirement	Question	Response
P.1 Human Rights		
P.1.1.1 	Does the project developer, its representatives and the Project disrespect internationally proclaimed human rights?	☐ YES ☒ NO
P.1.1.1 	Is the project involved or complicit in violence or human rights abuses of any kind as defined in the Universal Declaration of Human Rights?	☐ YES ☒ NO
P.1.1.2 	Have local communities or individuals raised human rights concerns regarding the project (e.g., during the stakeholder engagement process, grievance processes, public statements)?	☐ YES ☒ NO
P.1.1.3 	Is there a risk that rights-holders (e.g., Project-affected stakeholders) do not have the capacity to claim their rights?	☐ YES ☒ NO
P.1.1.3 	Does this project undermine national or regional measures for the realisation of the right to development?	☐ YES ☒ NO

If the answer to any of the questions above is "yes," please explain the reason and how the project will ensure compliance with applicable requirements.

The project respects internationally proclaimed human rights. Brazil has its own legislation⁵⁷ in place prohibiting the violation of the human rights principle and it actively enforces the compliance of such principle. No comments were received from local stakeholders regarding human rights. While Orizon Valorização de Resíduos S.A. is the sole owner of the project activity and the property where the Ecoparque Candeias landfill is located and the project

⁵⁷ https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2014/lei/l12986.htm

activity is implemented, there are no other right-holders involved in the implementation of the project activity. The project does not undermine any national or regional measures for the realization of the right to development

Would the project potentially involve or lead to:

P.1.1.1 	adverse impacts on enjoyment of the human rights (civil, political, economic, social or cultural) of the affected population and particularly of marginalised groups?	☐ YES ☐ POTENTIALLY ☒ NO
P.1.1.2 	inequitable or discriminatory impacts on affected populations, particularly people living in poverty or marginalised or excluded individuals or groups, including persons with disabilities?	☐ YES ☐ POTENTIALLY ☒ NO
P.1.1.3 	restrictions in availability, quality of and/or access to resources or basic services, in particular to marginalised individuals or groups, including persons with disabilities?	☐ YES ☐ POTENTIALLY ☒ NO
P.1.1.3 	exacerbation of conflicts among and/or the risk of violence to project-affected communities and individuals?	☐ YES ☐ POTENTIALLY ☒ NO

Briefly describe below how the project incorporates a human rights-based approach.

Please add text here....

1. The project respects internationally proclaimed human rights. Brazil has its own legislation.⁵⁸ in place prohibiting the violation of the human rights principle and it actively enforces the compliance of such principle. Brazil has ratified two UN human rights treaties:

- the International Covenant on Civil and Political Rights.⁵⁹
- the International Covenant on Economic, Social, and Cultural Rights.⁶⁰

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 involve nor is complicitly in any form of discrimination.

P.2 | GENDER EQUALITY AND WOMEN'S EMPOWERMENT

P.2.1.1 	Have women's groups/leaders raised gender equality concerns regarding the project, (e.g., during the stakeholder engagement process, grievance processes, public statements)?	☐ YES ☒ NO
P.2.1.2 	Does the project undermine the principles of non-discrimination, equal treatment, and equal pay for equal work?	☐ YES ☒ NO

⁵⁸ https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2014/lei/l12986.htm

⁵⁹ https://treaties.un.org/Pages/ViewDetails.aspx?chapter=4&clang=_en&mtdsg_no=IV-4&src=IND

⁶⁰ https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=IV-3&chapter=4&clang=_en

P.2.1.2 	Does the project prevent men and women from having equal opportunities to participate in identified tasks and activities, whether through paid work, volunteer work, or community contributions, as appropriate?	☐ YES ☒ NO
P.2.1.2 	Does the project limit the participation of women or men based on pregnancy, maternity/paternity leave, or marital status?	☐ YES ☒ NO
P.2.1.2 	Is information about project objectives being communicated in a way that is inappropriate for the local context and not tailored to the methods of understanding of both women and men, which could hinder their participation?	☐ YES ☒ NO
P.2.1.3 	Has the project assessed gender risks without referencing the country's gender strategy or equivalent national commitment?	☐ YES ☒ NO
P.2.1.4 	Has expert stakeholder(s) been involved, and has their input been requested for the project design on gender equality and women's empowerment?	☐ YES ☒ NO

If the answer to any of the questions above is "yes," please explain the reason and how the project will ensure compliance with applicable requirements.

No comments were received from local stakeholders regarding gender equality. The project developers do not discriminate against gender and support gender equality. The project offers equal opportunities for women and men to contribute both in volunteer and working positions. Given the nature of the project activity (which encompasses exclusively landfill gas collection and destruction/utilization in an already existent landfill), an expert opinion is not deemed necessary for the stakeholder consultation process.

Would the project potentially involve or lead to:

P.2.1.1 	adverse impacts on gender equality and/or the situation of women and girls?	☐ YES ☐ POTENTIALLY ☒ NO
P.2.1.1 	exacerbation of risks of gender-based violence? For example, through the influx of workers to a community, changes in community and household power dynamics, increased exposure to unsafe public places and/or transport, etc.	☐ YES ☐ POTENTIALLY ☒ NO
P.2.1.2 	reproducing discriminations against women based on gender, especially regarding participation in design and implementation or access to opportunities and benefits?	☐ YES ☐ POTENTIALLY ☒ NO
P.2.1.2 	limitations on women's ability to use, develop and protect natural resources, taking into account different roles and positions of women and men in accessing environmental goods and services?	☐ YES ☐ POTENTIALLY ☒ NO

	For example, activities that could lead to natural resources degradation or depletion in communities who depend on these resources for their livelihoods and well-being.	
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Briefly describe below how the project is addressing any identified risk to gender equality and women's empowerment.

The GS project activity 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 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.

The project complies with the requirements of gender equality, as it is under the jurisdiction of Brazilian legislation. Article 5 of the Brazilian Constitution.⁶¹ 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".

The law N° 7.353.⁶² 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).⁶³, 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.

P.3 | COMMUNITY HEALTH AND SAFETY

P.3.1.1 	Does the project involve potential risks to the health and safety of affected communities during its life cycle?	☐ YES ☒ NO
P.3.1.2 	Does the project involve any potential risks to the workers' safety and health?	☐ YES ☒ NO

If the answer to any of the questions above is "yes," please explain the reason and how the project will ensure compliance with applicable requirements.

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.

Would the project potentially involve or lead to:

P.3.1.1 	construction and/or infrastructure development (e.g., roads, buildings, dams)?	☒ YES ☐ NO
P.3.1.2 	air pollution, noise, vibration, traffic, injuries, physical hazards, poor surface water quality due to runoff, erosion, sanitation?	☐ YES ☐ POTENTIALLY ☒ NO

⁶¹ https://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm

⁶² http://www.planalto.gov.br/ccivil_03/leis/1980-1988/L7353.htm

⁶³ https://www.planalto.gov.br/ccivil_03/decreto-lei/del5452.htm

P.3.1.2 	harm or losses due to failure of structural elements of the project (e.g., collapse of buildings or infrastructure)?	☐ YES ☐ POTENTIALLY ☒ NO
P.3.1.2 	risks of water-borne or other vector-borne diseases (e.g., temporary breeding habitats), communicable and noncommunicable diseases, nutritional disorders, mental health?	☐ YES ☐ POTENTIALLY ☒ NO
P.3.1.2 	transport, storage, and use and/or disposal of hazardous or dangerous materials (e.g., explosives, fuel and other chemicals during construction and operation)?	☐ YES ☐ POTENTIALLY ☒ NO
P.3.1.2 	adverse impacts on ecosystems and ecosystem services relevant to communities' health (e.g., food, surface water purification, natural buffers from flooding)?	☐ YES ☐ POTENTIALLY ☒ NO

Briefly describe below how the project is addressing any identified risk related to community health and safety.

The project developers are committed to applying safe and healthy working conditions for all employees during all phases of the project. Health and safety procedures (including training of involved personnel) are in place to ensure safe working conditions to all the employees of the project activity.

P.4 | CULTURAL HERITAGE, INDIGENOUS PEOPLE, DISPLACEMENT AND RESETTLEMENT

P.4.1 | Sites of Cultural and Historical Heritage

P.4.1.1 	Does the project involve altering, damaging, or removing sites, objects, or structures of significant cultural heritage?	☐ YES ☒ NO
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If the answer to question above is "yes," please explain the reason and how the project will ensure compliance with applicable requirements.

No cultural heritage was observed on the project site prior to the implementation of the landfill (as confirmed in the EIA Report) or the project.

Would the project potentially involve or lead to:

P.4.1.1 	activities adjacent to or within a cultural heritage site?	☐ YES ☐ POTENTIALLY ☒ NO
P.4.1.1 	significant excavations, demolitions, movement of earth, flooding or other environmental changes?	☐ YES ☐ POTENTIALLY ☒ NO
P.4.1.1 	alterations to landscapes and natural features with cultural significance?	☐ YES ☐ POTENTIALLY ☒ NO
P.4.1.1 	adverse impacts to sites, structures, or objects with historical, cultural, artistic, traditional or religious values or intangible forms of culture (e.g., knowledge, innovations,	☐ YES ☐ POTENTIALLY

	practices)? (Note: projects intended to protect and conserve Cultural Heritage may also have inadvertent adverse impacts)	☒ NO
P.4.1.2 	utilisation of tangible and/or intangible forms (e.g., practices, traditional knowledge) of Cultural Heritage for commercial or other purposes?	☐ YES ☐ POTENTIALLY ☒ NO
P.4.1.2 	If answer to question above is "YES" or "POTENTIALLY" - are the communities made aware of their right under the law, scope and nature of proposed development and its potential consequences?	☐ YES ☐ NO ☒ NA
P.4.1.3 	If answer to question above is "YES" - does the project provide equitable sharing of benefits from commercialisation of such knowledge, innovation, or practice, consistent with their customs and traditions?	☐ YES ☐ NO ☒ NA
P.4.1.4 	If answer to question above is "YES" - are opinions and recommendations of an Expert Stakeholder(s) not sought and demonstrated as being included in the project design?	☐ YES ☐ NO ☒ NA
P.4.1.4 	If answer to question above is "YES", has project design been changed, modified, updated considering opinions and recommendations of an Expert Stakeholder?	☐ YES ☐ NO ☒ NA

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

No cultural heritage was observed on the project site prior to the implementation of the landfill (as confirmed in the EIA Report) or the project. Given the nature of the project activity (which encompasses exclusively landfill gas collection and destruction/utilization in an already existent landfill), an expert opinion is not deemed necessary for the stakeholder consultation process.

[P.4.2 |Forced Eviction and Displacement](#)

P.4.2.1 	Does the project involve any risks related to involuntary relocation of people?	☐ YES ☒ NO
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If the answer to question above is "yes," please explain the reason and how the project will ensure compliance with applicable requirements.

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).

Would the project potentially involve or lead to:

P.4.2.1 	risk of forced evictions or involuntary relocation of people?	☐ YES ☐ POTENTIALLY ☒ NO
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P.4.2.2 	temporary or permanent and full or partial physical displacement (including people without legally recognisable claims to land)?	☐ YES ☐ POTENTIALLY ☒ NO
P.4.2.2 	economic displacement (e.g., loss of assets or access to resources due to land acquisition or access restrictions – even in the absence of physical relocation)?	☐ YES ☐ POTENTIALLY ☒ NO
P.4.2.2 	If answer to question above is “YES” or “POTENTIALLY”, - has the project developed Resettlement Action Plan or Livelihood Action Plan in consultation and agreement with affected individual, group or community? - has the project integrated Resettlement Action Plan or Livelihood Action Plan into the Project design?	☐ YES ☐ NO ☒ NA
P.4.2.3 	If answer to question above is “YES” - are opinions and recommendations of an Expert Stakeholder(s) not sought and demonstrated as being included in the project design?	☐ YES ☐ NO ☒ NA
P.4.2.3 	If answer to question above is “YES”, have project design been changed, modified, updated considering opinions and recommendations of an Expert Stakeholder?	☐ YES ☐ NO ☒ NA

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

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). Given the nature of the project activity (which encompasses exclusively landfill gas collection and destruction/utilization in an already existent landfill), an expert opinion is not deemed necessary for the stakeholder consultation process.

[P.4.3 | LAND TENURE AND OTHER RIGHTS](#)

P.4.3.1 	Does the project involve any risks related to identifying and managing legitimate tenure rights that may be affected by the project?	☐ YES ☒ NO
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If the answer to question above is "yes," please explain the reason and how the project will ensure compliance with applicable requirements.

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.

Would the project potentially involve or lead to:

P.4.3.1 	impacts on or changes to land tenure arrangements and/or community-based property rights/customary rights to land, territories and/or resources?	☐ YES ☐ POTENTIALLY ☒ NO
P.4.3.1 	uncertainties with regards to land tenure, access rights, usage rights or land ownership?	☐ YES ☐ POTENTIALLY

	Examples include, but are not limited to water access rights, community-based property rights and customary rights.	☒ NO
P.4.3.2 	Changes in legal arrangements, if yes, are the changes done in line with relevant laws and regulations?	☐ YES ☐ NO ☒ NA
P.4.3.2 	Changes in legal arrangements, if yes, are these changes agree with free, prior and informed consent of the involved stakeholders?	☐ YES ☐ NO ☒ NA
P.4.3.3 	Does some other entity (other than the project developer) hold uncontested land title for the entire Project Boundary?	☐ YES ☐ NO ☒ NA
P.4.3.4 	Are opinions and recommendations of an Expert Stakeholder(s) not sought and demonstrated as being included in the project design?	☐ YES ☐ NO ☒ NA
P.4.3.4 	If answer to question above is "YES", have project design been changed, modified, updated considering opinions and recommendations of an Expert Stakeholder?	☐ YES ☐ NO ☒ NA
P.4.3.5 	Have project developer in consultation with stakeholders established a functioning mechanism to receive, process, resolve, communicate and record grievances?	☐ YES ☐ NO ☒ NA

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

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. Given the nature of the project activity (which encompasses exclusively landfill gas collection and destruction/utilization in an already existent landfill), an expert opinion is not deemed necessary for the stakeholder consultation process. As further detailed in the Stakeholder Consultation Report, appropriate procedures to receive and address any grievances received from stakeholder was established by the project developer. Orizon Valorização de Resíduos S.A. is the sole owner of the project activity and the property where the Ecoparque Candeias landfill is located and the project activity is implemented.

[P.4.4 | INDIGENOUS PEOPLES](#)

P.4.4.1 	Does the project involve Indigenous People within the Project area of influence who may be affected directly or indirectly by the Project?	☐ YES ☒ NO
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If the answer to question above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

There are no indigenous people or group identified within the area of influence of the Project, as confirmed in the EIA Report for the landfill.

Would the project potentially involve or lead to:

P.4.4.1 	affect areas where indigenous peoples are present (including project area of influence)	☐ YES ☐ POTENTIALLY ☒ NO
P.4.4.1 	affect areas, land and territory claimed by indigenous peoples?	☐ YES ☐ POTENTIALLY ☒ NO
P.4.4.1 	impacts (positive or negative) to the human rights, lands, natural resources, territories, and traditional livelihoods of indigenous peoples?	☐ YES ☐ POTENTIALLY ☒ NO
P.4.4.7 	If answer to above questions is "YES" or "POTENTIALLY", - Is it determined that the proposed project may affect the rights, lands, resources, or territories of indigenous people? - Has an "Indigenous People Plan" (IPP) or "Indigenous People Plan Framework" been elaborated and included in the project documentation? - Was the plan developed in accordance with the effective and meaningful participation of indigenous peoples and in accordance with UNDP Guidelines?	☐ YES ☐ NO ☒ NA
P.4.4.3 	risk of forcibly removing indigenous people from their lands and territories?	☐ YES ☐ POTENTIALLY ☒ NO
P.4.4.4 	utilisation and/or commercial development of natural resources on lands and territories claimed by indigenous peoples? Consider, and where appropriate ensure, consistency with the answers under Principle 4.1 above	☐ YES ☐ POTENTIALLY ☒ NO
P.4.4.5 P.4.4.6 	If answer to question above is "YES" or "POTENTIALLY" - Did the project obtain free, prior and informed consent from indigenous people before taking their cultural, intellectual, religious, and/or spiritual property? - Does the project ensure that the indigenous people receive an equitable sharing of benefits resulting from the use of their traditional knowledge and practices? ? - Does the project ensure that the sharing of benefits resulting from the use of indigenous peoples' traditional knowledge and practices is culturally appropriate and inclusive?	☐ YES ☐ NO ☒ NA

	- Does the project ensure that the provision of equitable sharing of benefits does not impede land rights or equal access to basic services including health services, clean water, energy, education, safe and decent working conditions, and housing?	
P.4.4.8 	Does the project lack appropriate feedback and grievance channels for Indigenous Peoples and their representatives?	☐ YES ☐ NO ☒ NA
P.4.4.8 	Has a grievance mechanism not been established at the beginning of programme or project implementation with due consideration given to customary dispute settlement mechanisms among the Indigenous Peoples concerned and will it remain operational throughout the project cycle?	☐ YES ☐ NO ☒ NA
P.4.4.9 	Are opinions and recommendations of an Expert Stakeholder(s) not sought and demonstrated as being included in the project design?	☐ YES ☐ NO ☒ NA
P.4.4.9 	If answer to question above is "YES", have project design been changed, modified, updated considering opinions and recommendations of an Expert Stakeholder?	☐ YES ☐ NO ☒ NA

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

There are no indigenous people or group identified within the area of influence of the Project, as confirmed in the EIA Report for the landfill. Given the nature of the project activity (which encompasses exclusively landfill gas collection and destruction/utilization in an already existent landfill), an expert opinion is not deemed necessary for the stakeholder consultation process.

P.5 | CORRUPTION

P.5.1.1 	Does the project involve, or is it complicit in, contributing to or reinforcing corruption or corrupt projects?	☐ YES ☒ NO
P.5.1.1 	Does the project have a risk of encouraging bribery, kickbacks, or other unethical behavior?	☐ YES ☒ NO

If the answer to any of the questions above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

The project does not involve and is not complicit in any kind of corruption.

ECONOMIC SAFEGUARDING PRINCIPLES

P.6 | ECONOMIC IMPACTS

P.6.1 | LABOUR RIGHTS AND WORKING CONDITIONS

P.6.1.1 	Does the project involve, facilitate, or condone forced labor, or pose a potential risk of forced labor?	☐ YES
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		☒ NO
P.6.1.1 	Does the project violate any labor or health and safety laws, international obligations, or ILO conventions?	☐ YES ☒ NO
P.6.1.2 	Does the project violate the principles of equal opportunity and fair treatment in its employment decisions?	☐ YES ☒ NO
P.6.1.3 	Does the project violate national laws, if available regarding non-discrimination in employment?	☐ YES ☒ NO
P.6.1.4 P.6.1.5 	Does the project allow child labor?	☐ YES ☒ NO
P.6.1.7 P.6.1.8 	Does the project have insufficient processes and measures in place to ensure the safety and health of project workers?	☐ YES ☒ NO
P.6.1.9 	Does the project have insufficient measures to safeguard and support vulnerable project workers, such as women, people with disabilities, migrant workers, and young workers, and to prevent any kind of harassment, abuse, bullying, or exploitation, including gender-based violence (GBV)?	☐ YES ☒ NO
P.6.1.10 	Does the project have no grievance mechanism available for workers to voice workplace concerns? Is information about this mechanism not provided to workers at the time of recruitment, or is it not easily accessible?	☐ YES ☒ NO

If the answer to any of the questions above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

The project developers are committed to applying 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 (CLT)⁶⁴, 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.

Would the project potentially involve or lead to:

(NOTE: APPLIES TO BOTH PROJECT AND CONTRACTOR WORKERS)

P.6.1.1 	use of forced labour?	☐ YES ☐ POTENTIALLY ☒ NO
P.6.1.1 	working conditions that do not meet national labour laws and international commitments?	☐ YES ☐ POTENTIALLY ☒ NO
P.6.1.1 	working conditions that may deny freedom of association and collective bargaining?	☐ YES ☐ POTENTIALLY

⁶⁴ https://www.planalto.gov.br/ccivil_03/decreto-lei/del5452.htm

		☒ NO
P.6.1.1 	absence of documented working agreements with all individual workers <i>if such agreements do not exist, or do not address working conditions and terms of employment, the project developer shall provide reasonable working conditions and terms of employment.</i>	☐ YES ☐ POTENTIALLY ☒ NO
P.6.1.1 	use of migrant workers? <i>if engaged, the developer shall ensure that they are engaged substantially equivalent terms and conditions to non-migrant workers carrying out similar work.</i>	☐ YES ☐ POTENTIALLY ☒ NO
P.6.1.1 	having no arrangements for basic services ⁶⁵ for workers? <i>the project developer shall put in place and implement policies on the quality and management of the accommodation and provision of basic services in a manner consistent with the principles of non-discrimination and equal opportunity. Workers' accommodation arrangements should not restrict workers' freedom of movement or of association</i>	☐ YES ☐ POTENTIALLY ☒ NO
P.6.1.2 	any form of discrimination or harassment based on factors unrelated to job requirements, such as gender, race, nationality, ethnicity, social or indigenous origin, religion or belief, disability, age, or sexual orientation?	☐ YES ☐ POTENTIALLY ☒ NO
P.6.1.2 	any form of discrimination in any aspect of employment, such as recruitment, compensation, working conditions, training, job assignment, promotion, termination, or discipline?	☐ YES ☐ POTENTIALLY ☒ NO
P.6.1.2 	harassment, intimidation, and/or exploitation, especially in regard to women?	☐ YES ☐ POTENTIALLY ☒ NO
P.6.1.3 	discriminatory working conditions and/or lack of equal opportunity where national law provides provision to address non-discrimination in employment?	☐ YES ☐ POTENTIALLY ☒ NO
P.6.1.4 	use of child labour? (including third-party engaged workers)	☐ YES ☐ POTENTIALLY ☒ NO
P.6.1.4 	inadequate and verifiable mechanisms for age verification?	☐ YES

⁶⁵ Basic services requirements refer to minimum space, supply of water, adequate sewage and garbage disposal system, appropriate protection against heat, cold, damp, noise, fire, and disease-carrying animals, adequate sanitary and washing facilities, ventilation, cooking and storage facilities and natural and artificial lighting, and in some cases basic medical services.

		☒ NO
P.6.1.7 	no processes and measures in place for the safety and health of project workers?	☐ YES ☒ NO
P.6.1.7 	No provision of safety and health training provisions, including on the proper use and maintenance of personal protective equipment conducted by competent persons and the maintenance of training records?	☐ YES ☒ NO
P.6.1.7 	No provision to record and document accidents, diseases, incidents, and any resulting injuries, illnesses, or deaths?	☐ YES ☒ NO
P.6.1.8 	occupational health and safety risks due to physical, chemical, biological and psychosocial hazards (including violence and harassment) throughout the project life-cycle?	☐ YES ☒ NO
P.6.1.9 	No measures to protect vulnerable project workers from harassment, exploitation, and gender-based violence (GBV)? This includes women, people with disabilities, migrant workers, and young workers.	☐ YES ☒ NO
P.6.1.10 	No grievance mechanism available for workers to voice workplace concerns.	☐ YES ☒ NO
P.6.1.11 	No measures for due diligence and the establishment of policies and procedures to manage and monitor the performance of third-party employees in the project?	☐ YES ☒ NO

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

The project participants 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 (CLT).⁶⁶, 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. The rights to establish and join labour organizations or unions are protected by Brazilian Labour Laws. The project fully respects the employees' rights in accordance with all labour related laws endorsed in Brazil.

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. Brazil has published laws for the protection of children.⁶⁷, 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.

⁶⁶ https://www.planalto.gov.br/ccivil_03/decreto-lei/del5452.htm

⁶⁷ https://www.planalto.gov.br/ccivil_03/leis/l8069.htm

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 participants ensure the use of appropriate equipment, training of workers, documentation and reporting of accidents and incidents, and emergency preparedness and response measures.

P.6.2 | NEGATIVE ECONOMIC CONSEQUENCES

P.6.2.1	Is there a risk of project failure during implementation or after project certification due to a lack of financial resources?	☐ YES ☒ NO
P.6.2.2	Does the project have potential negative impacts or pose a risk to the local economy?	☐ YES ☒ NO
P.6.2.2	Are there any potential risks or negative impacts this project may have on vulnerable or marginalised social groups, despite the benefits it may bring?	☐ YES ☒ NO

If the answer to any of the questions above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

The Project does not cause negative economic consequences.

Would the project involve or lead to:

P.6.2.2	economic impacts (negative/detrimental) to the local economy?	☐ YES ☐ POTENTIALLY ☒ NO
P.6.2.2	negative economic consequences during and after project implementation, e.g., for vulnerable and marginalised social groups in targeted communities?	☐ YES ☐ POTENTIALLY ☒ NO

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

The Project does not cause negative economic consequences.

P.7 | CLIMATE AND ENERGY

P.7.1 | GHG EMISSIONS

P.7.1.1	Does the project have a risk of increasing greenhouse gas emissions over the Baseline Scenario?	☐ YES ☒ NO
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If the answer to question above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

The project will reduce greenhouse gas emissions as it avoids methane from being freely emitted into the atmosphere and it also displaces equivalent amount of electricity that would be otherwise generated from fossil fuel fired power plants.

Would the project involve or lead to:

P.7.1.1	increase greenhouse gas emissions over the Baseline Scenario?	☐ YES ☐ POTENTIALLY ☒ NO
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If the answer is "yes" or "potentially" to the above question, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

The project will reduce greenhouse gas emissions as it avoids methane from being freely emitted into the atmosphere and it also displaces equivalent amount of electricity that would be otherwise generated from fossil fuel fired power plants.

P.7.2 | ENERGY SUPPLY

P.7.2.1	Does the project pose a risk to the availability and reliability of energy supply to other users?	☐ YES ☒ NO
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If the answer to question above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

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. Moreover, as a renewable energy project which is connected to the electricity grid and thus had to adhere to all the national and local requirements applicable for electricity producers, it does not pose any risk to the availability and reliability of energy supply to other users.

Would the project involve or lead to:

P.7.2.1	negative impact on the availability and reliability of energy supply to other users?	☐ YES ☐ POTENTIALLY ☒ NO
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If the answer is "yes" or "potentially" to the above question, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

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. Moreover, as a renewable energy project which is connected to the electricity grid and thus had to adhere to all the national and local requirements applicable for electricity producers, it does not pose any risk to the availability and reliability of energy supply to other users.

P.8 | WATER

P.8.1 | IMPACT ON NATURAL WATER PATTERNS/FLOWS

P.8.1.1	Does the project increase water usage to a level that will not allow for the maintenance of environmental flows?	☐ YES ☒ NO
P.8.1.1	Does the project result in the discharge of wastewater that does not meet the required standard for beneficial reuse and could therefore negatively impact the environmental flow?	☐ YES ☒ NO
P.8.1.1	Does the project have the potential risk to exceed the rate of recharge for the groundwater source?	☐ YES ☒ NO
P.8.1.1	Does the project involve any processes or activities that could contaminate the groundwater and render it unsuitable for use?	☐ YES ☒ NO

If the answer to any of the questions above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

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.

Would the project involve or lead to:

P.8.1.1	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?	☐ YES ☐ POTENTIALLY ☒ NO
P.8.1.1	Wastewater discharge of quality that does not meet the required standard for beneficial reuse?	☐ YES ☐ POTENTIALLY ☒ NO
P.8.1.1	significant extraction, diversion of ground water? For example, construction of dams, reservoirs, river basin developments, groundwater extraction	☐ YES ☐ POTENTIALLY ☒ NO
P.8.1.2	Are opinions and recommendations of an Expert Stakeholder(s) not sought and demonstrated as being included in the project design?	☐ YES ☐ NO ☒ NA

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

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.

P.8.2 | EROSION AND/OR WATER BODY INSTABILITY

P.8.2.1 	Does the project have a risk of negatively impacting the catchment and has it been assessed and addressed?	☐ YES ☒ NO
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If the answer to question above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

The impact of the project on erosion and/or in the water body is negligible. As also 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.

Would the project involve or lead to:

P.8.2.2 	negatively impact on the catchment area?	
P.8.2.5 	<i>If yes, Erosion prevention measures, including soil and slope protection measures, must be implemented before project commencement. These measures should involve natural terracing, infiltration strips, permanent ground cover, hedge and tree rows, and effective slope length assessment. Regular reassessment of these measures is necessary.</i>	☐ YES ☐ POTENTIALLY ☒ NO
P.8.2.6 	Are opinions and recommendations of an Expert Stakeholder(s) not sought and demonstrated as being included in the project design?	☐ YES ☐ NO ☒ NA

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

The impact of the project on erosion and/or in the water body is negligible. As also 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.

P.9 | ENVIRONMENT, ECOLOGY AND LAND USE

P.9.1 | LANDSCAPE MODIFICATION AND SOIL

P.9.1.1 	Is there any risk of soil resource degradation or loss of ecosystem services provided by soils in the project?	
P.9.1.3 	<i>If yes, the project shall maintain healthy soils by minimising negative impacts on soil health, productivity, structure, and</i>	☐ YES ☒ NO

	<i>water retention. Steps to minimise soil degradation include crop rotation, composting, using N-fixing plants, and reducing tillage and ecologically harmful substances.</i>	
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If the answer to question above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

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.

Would the project involve or lead to:

P.9.1.4 	production, harvesting, and/or management of living natural resources by small-scale landholders and/or local communities?	☐ YES ☐ POTENTIALLY ☒ NO
P.9.1.4 	if answer to above question "yes" or "potentially", does project adopt appropriate and culturally sensitive sustainable resource management practices?	☐ YES ☐ NO ☒ NA

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

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.

[P.9.2 | VULNERABILITY TO NATURAL DISASTER](#)

P.9.2.1 	Does the project have any risks associated with natural or man-made hazards that could result from land use changes due to the project?	☐ YES ☒ NO
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If the answer to question above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

The Project is not susceptible to and does not lead to increased vulnerability to extreme climatic conditions.

Would the project involve or lead to:

P.9.2.2 	any potential risks that require emergency preparedness and response planning?	☐ YES ☐ POTENTIALLY ☒ NO
P.9.2.2 	if answer to above question "yes" or "potentially", did the project developer disclose appropriate information about emergency preparedness and response to affected communities?	☐ YES ☐ NO ☒ NA

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

The Project is not susceptible to and does not lead to increased vulnerability to extreme climatic conditions.

P.9.3 | BIOSAFETY AND GENETIC RESOURCES

P.9.3.1	Does the project involve the transfer, handling, and use of genetically modified organisms/living modified organisms that may result in adverse effects on biological diversity?	☐ YES ☒ NO
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If the answer to question above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

The project activity is an LFG collection and destruction/utilization project with no involvement genetically modified organisms or GMOs.

Would the project involve or lead to:

P.9.3.1	the transfer, handling and use of genetically modified organisms/living modified organisms (GMOs/LMOs) that result from modern biotechnology	☐ YES ☐ POTENTIALLY ☒ NO
P.9.3.1	If answer to above question is "yes" has a risk assessment by a competent Expert stakeholder been carried out in accordance with Annex iii of the Cartagena protocol on biosafety to the convention on biological diversity?	☐ YES ☐ NO ☒ NA
P.9.3.2	If answer to above question is "yes" has any risks identified in the risk assessment?	☐ YES ☐ NO ☒ NA
P.9.3.3	Forestry (for example Afforestation/Reforestation) involving GMO planting? <i>Note - Forestry projects (for example Afforestation/Reforestation) involving GMO planting are not eligible for Certification under Gold Standard for the Global Goals.</i>	☐ YES ☐ NO ☒ NA

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

The project activity is an LFG collection and destruction/utilization project with no involvement genetically modified organisms or GMOs.

P.9.4 | RELEASE OF POLLUTANTS

P.9.4.1	Does the project have a risk of releasing pollutants to air, water, and land in routine, non-routine, or accidental circumstances?	☐ YES ☒ NO
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If the answer to question above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

As an LFG collection and destruction/utilization project, it actually reduces emissions of pollutants to the atmosphere.

Would the project involve or lead to:

P.9.4.1	any potential risk of pollutant release that cannot be avoided?	☐ YES ☐ POTENTIALLY ☒ NO
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P.9.4.3 	If answer to above question is "Yes" or "potentially", has the project identified all potential pollution sources that may degrade the quality of soil, air, surface, and groundwater in the project area?	☐ YES ☐ NO ☒ NA
P.9.4.2 	If answer to above question is "Yes" or "potentially", do the pollution prevention and control technologies and practices applied during the project life cycle align with national regulations or international best practices?	☐ YES ☐ NO ☒ NA
P.9.4.3 	If answer to above question is "Yes", is there a monitoring plan to ensure that mitigation measures are implemented, and resources are protected?	☐ YES ☐ NO ☒ NA

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

As an LFG collection and destruction/utilization project, it actually reduces emissions of pollutants to the atmosphere.

[P.9.5 | HAZARDOUS AND NON-HAZARDOUS WASTE](#)

P.9.5.1 	Does the project involve the generation of waste materials (both hazardous and non-hazardous)?	☐ YES ☒ NO
P.9.5.3 	Does the project involve risk of release of hazardous materials resulting from their production, transportation, handling, storage, or use?	☐ YES ☒ NO
P.9.5.5 	Does the project involve the use of any chemicals or materials subject to international bans or phase-outs?	☐ YES ☒ NO

If the answer to any of the questions above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

The project does not involve the manufacture, trade, release, and/or use of hazardous and non-hazardous chemicals and/or materials.

Would the project involve or lead to:

P.9.5.1 	the generation and management of waste materials?	☐ YES ☐ POTENTIALLY ☒ NO
P.9.5.1 	treatment, destruction, or disposal of waste material?	☐ YES ☐ NO ☒ NA
P.9.5.1 	If answer to above question is "Yes", does the project involve an environmentally friendly method that includes appropriate control of emissions and residues resulting from the handling and processing of waste material?	☐ YES ☐ NO ☒ NA
P.9.5.3 	risk of release of hazardous materials resulting from their production, transportation, handling, storage, or use?	☐ YES ☐ NO ☒ NA

P.9.5.3 	If answer to above question is "yes", does project has measures in place to address health risks?	☐ YES ☐ NO ☒ NA
P.9.5.4 	Involve manufacture, trade, and use of chemicals and hazardous materials subject to international bans or phase-outs due to their high toxicity to living organisms, environmental persistence, potential for bioaccumulation, or potential for depletion of the ozone layer	☐ YES ☐ POTENTIALLY ☒ NO

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

The project does not involve the manufacture, trade, release, and/or use of hazardous and non-hazardous chemicals and/or materials.

[P.9.6 | PESTICIDES & FERTILISERS](#)

P.9.6.1 	Does the project involve the use of chemical pesticides?	☐ YES ☒ NO
P.9.6.5 	Does the project involve purchase, store, manufacture, trade or use products that fall in Classes IA (extremely hazardous) and IB (highly hazardous)	☐ YES ☒ NO
P.9.6.6 	Does the project use fertilisers, and if so, are measures being taken to minimise their use and nutrient losses to the environment?	☐ YES ☒ NO

If the answer to any of the questions above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

The Project does not involve the application of pesticides and/or fertilizers.

Would the project involve or lead to:

P.9.6.1 	chemical pesticides use for pest management?	☐ YES ☐ POTENTIALLY ☒ NO
P.9.6.4 	If answer to question above is "yes" or "potentially", does project has documented Chemical Pesticides Policy in place?	☐ YES ☐ NO ☒ NA
P.9.6.5 	purchase, store, use, manufacture, or trade in Class II (moderately hazardous) pesticides?	☐ YES ☐ POTENTIALLY ☒ NO
P.9.6.5 	If answer to question above is "yes" or "potentially", does project has appropriate controls on manufacture, procurement, or distribution and/or use of these chemicals?	☐ YES ☐ NO ☒ NA

If the answer is "yes" or "potentially" to any of the above questions, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

The Project does not involve the application of pesticides and/or fertilizers.

P.9.7 HARVESTING OF FORESTS		
P.9.7.1 	Does the project have a risk of unsustainable forest management, including timber harvesting?	☐ YES ☒ NO
P.9.7.1 	Does the project pose a risk of depleting biodiversity and ecosystem functionality in areas where improved forest management is undertaken?	☐ YES ☒ NO
P.9.7.1 	Does the project risk not meeting requirements for environment-friendly, socially beneficial, and economically viable plantations using native species whenever possible?	☐ YES ☒ NO
If the answer to any of the questions above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements. The project does not involve the harvesting of forests.		
P.9.8 FOOD SECURITY		
P.9.8.1 	Does the project involve the risk of negatively influencing access to and availability of food for people affected?	☐ YES ☒ NO
If the answer to the question above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements. The Project does not modify the quantity or nutritional quality of food available such as through crop regime alteration or export or economic incentives.		
Would the project involve or lead to:		
P.9.8.1 	modification of the quantity or nutritional quality of food available such as through crop regime alteration or export or economic incentives?	☐ YES ☐ POTENTIALLY ☒ NO
If the answer is "yes" or "potentially" to the above question, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements. The Project does not modify the quantity or nutritional quality of food available such as through crop regime alteration or export or economic incentives.		
P.9.9 ANIMAL WELFARE		
P.9.9.1 	Does the project involve any risks to animal welfare?	☐ YES ☒ NO
	Animal welfare shall be ensured by providing access to water and food, appropriate environment, humane treatment, and staff training. Evidence of mistreatment will be treated as an immediate non-conformity.	
P.9.9.2 	Does the project involve any potential risk of excessive or inadequate use of veterinary medicines?	☐ YES ☒ NO
P.9.9.4 	Does the project involve the risk of administering synthetic growth promoters, including hormones?	☐ YES ☒ NO
If the answer to any of the questions above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements. The project does not involve animal husbandry.		

Would the project involve or lead to:		
P.9.9.1 	animal husbandry or harvesting of fish populations or other aquatic species? ⁶⁸	☐ YES ☐ NO ☒ NA
P.9.9.1 	limiting access for animals to basic needs like drinking water, adequate food, daylight, appropriate shelter etc.?	☐ YES ☐ POTENTIALLY ☒ NO
P.9.9.3 	inadequate measures to isolate sick animals and control the spread of disease, especially zoonotic diseases?	☐ YES ☐ NO ☒ NA
P.9.9.5 	inadequate low-stress methods, equipment, and facilities that facilitate calm animal movement.	☐ YES ☐ NO ☒ NA
P.9.9.6 	inadequate measures to ensure that animals are exposed to the least stress possible during transportation and slaughtering?	☐ YES ☐ NO ☒ NA
P.9.9.7 	inappropriate spacing per animal and stocking rates per land unit?	☐ YES ☐ NO ☒ NA
P.9.9.8 	inadequate measures to address the specific needs of aquatic animals?	☐ YES ☐ NO ☒ NA
P.9.9.9 P.9.9.10 	primary production of living natural resources such as animal husbandry, aquaculture, and fisheries? If the answer is yes, implement industry-standard sustainable management practices in line with to one or more relevant and credible standards and utilise available technologies.	☐ YES ☐ NO ☒ NA
If the answer is "yes" or "potentially" to any of the above question, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.		
The project does not involve animal husbandry.		
P.9.10 HIGH CONSERVATION VALUE AREAS AND CRITICAL HABITATS		

⁶⁸ 'Involve' means if the project mechanism and/or impact(s) are achieved via changing animal husbandry practices in some way.

P.9.10.1	Does the project have the risk of negatively impacting HCV areas and/or critical habitats?	☐ YES ☒ NO
P.9.10.2	Does the project in the project area or area of downstream impacts have risks to the following: native tree patches, individual native trees, freshwater resources (including rivers, lakes, swamps, temporary water bodies, and wells), habitats of rare, threatened, and endangered species, and biodiversity-enhancing areas?	☐ YES ☒ NO
If the answer to any of the questions above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements. 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, landscapes, key biodiversity areas or sites identified.		
Would the project involve or lead to:		
P.9.10.1	identified habitats as HCV areas and or Critical habitats?	☐ YES ☐ POTENTIALLY ☒ NO
P.9.10.1	If answer to above question is "yes", does the project have any risks that could negatively impact the catchment, project success, and surrounding HCV and ecological assets, as well as any measurable adverse impacts on the criteria or biodiversity values for which the critical habitat was designated, and on the ecological processes supporting that biodiversity?	☐ YES ☐ NO ☒ NA
P.9.10.1	If answer to above question is "yes", is a robust, appropriately designed, and long-term Habitats and Biodiversity Action Plan absent which will make the project unable to achieve net gains of those biodiversity values for which the critical habitat was designated?	☐ YES ☐ NO ☒ N/A
P.9.10.2	Does the project area or area of downstream impacts have native tree patches, individual native trees, freshwater resources (including rivers, lakes, swamps, temporary water bodies, and wells), habitats of rare, threatened, and endangered species, and biodiversity-enhancing areas?	☐ YES ☐ POTENTIALLY ☒ NO
P.9.10.2	If the answer to the above question is "yes", will the project have any adverse effects on these areas?	☐ YES ☐ No ☒ NA
P.9.10.3	If the answer to above question is "yes", does the project has opportunities to minimise unwarranted conversion or degradation of the habitat and to enhance the habitat as part of its development?	☐ YES ☐ No ☒ NA
P.9.10.4	Is the project applying Land Use & Forest Activity Requirements and managing a minimum 10% of the project area to protect or enhance the biological diversity of native ecosystems following HCV approach as per the given requirements?	☐ YES ☐ No ☒ NA
P.9.10.5	Are opinions and recommendations of an Expert Stakeholder(s) not sought and demonstrated as being included in the project design?	☐ YES ☐ NO

		☒ NA
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If the answer is "yes" or "potentially" to any of the above question, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

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, landscapes, key biodiversity areas or sites identified.

P.9.11 | ENDANGERED SPECIES

<u>P.9.11.1 </u>	Does the project lead to the reduction or negative impact on any recognised Endangered, Vulnerable or Critically Endangered species?	☐ YES ☒ NO
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If the answer to question above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

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

Would the project involve or lead to:

<u>P.9.11.2 </u>	distortion of habitats of endangered species?	☐ YES ☐ POTENTIALLY ☒ NA
<u>P.9.11.2 </u>	If answer to the above question is "yes", does the project plan to protect and enhance them?	☐ YES ☐ POTENTIALLY ☐ NO ☒ N/A
<u>P.9.11.2 </u>	Are opinions and recommendations of an Expert Stakeholder(s) not sought and demonstrated as being included in the project design?	☐ YES ☐ NO ☒ NA

If the answer is "yes" or "potentially" to any of the above question, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

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

P.9.12 | INVASIVE ALIEN SPECIES

P.9.12.1 	Does project introduce any alien species (not currently established in the country or region of the project) into new environments?	☐ YES ☒ NO
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If the answer to question above is "yes," please explain project situation and how the project will ensure compliance with applicable requirements.

The project activity does not involve introduction of species and it does not promote any impact towards existing species.

Would the project involve or lead to:

P.9.12.1 	risk of introducing any alien species with a high risk of invasive behaviour regardless of whether such introductions are permitted under the existing regulatory framework?	☐ YES ☐ POTENTIALLY ☒ NO
P.9.12.1 	risk of potential accidental or unintended introductions including the transportation of substrates and vectors (such as soil, ballast, and plant materials) that may harbour alien species.	☐ YES ☐ POTENTIALLY ☒ NO
P.9.12.2 	risk of spreading alien species into areas in which they have not already been established?	☐ YES ☐ POTENTIALLY ☒ NO

If the answer is "yes" or "potentially" to any of the above question, please provide a brief description of the project situation below. Also, provide justification and/or evidence as necessary to demonstrate compliance with applicable requirements.

The project activity does not involve introduction of species and it does not promote any impact towards existing species.

APPENDIX 2 - CONTACT INFORMATION OF PROJECT DEVELOPER(S)

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
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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

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

APPENDIX 4 - DESIGN CHANGES

A4.1. Details of proposed or actual design change

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Not applicable. There are no design changes valid for the GS project activity.

A4.2. Describe the impacts of design change on the following

a. Additionality

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Not applicable. There are no design changes valid for the GS project activity.

b. Applicability of methodology and other methodological regulatory documents with which the project activity has been certified

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Not applicable. There are no design changes valid for the GS project activity.

c. Compliance with the monitoring plan of the applied methodology

>>

Not applicable. There are no design changes valid for the GS project activity.

d. Level of accuracy and completeness in the monitoring of the project activity compared with the requirements contained in the registered monitoring plan

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Not applicable. There are no design changes valid for the GS project activity.

e. Scale of the project activity

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Not applicable. There are no design changes valid for the GS project activity.

f. Stakeholder consultation

>>

Not applicable. There are no design changes valid for the GS project activity.

g. Sustainable development criteria

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Not applicable. There are no design changes valid for the GS project activity.

h. Safeguarding assessment

>>

Not applicable. There are no design changes valid for the GS project activity.

i. Compliance with applicable legislation

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Not applicable. There are no design changes valid for the GS project activity.

j. Only for LUF Projects: Transparent summary of all approved changes in Project Area, Eligible Area and accompanying changes in ex-ante emissions removals.

DATE OF APPROVED DESIGN CHANGE (MM/DD/YYYY)	PROJECT AREA (HA)		ELIGIBLE AREA (HA)		EX-ANTE ESTIMATE (TCO2E)	
	INCREASE OR DECREASE ?	VALUE (HA)	INCREASE OR DECREASE?	VALUE (HA)	INCREASE OR DECREASE ?	PERCENTAG E (%)

DOCUMENT HISTORY

Version	Date	Remarks
1.5	29 June 2023	Editorial changes to match V2.1 of the Safeguarding Principles Requirements
1.4	21 June 2023	Editorial changes to match V2.0 of the Safeguarding Principles Requirements
1.3	14 April 2023	Integrated the design change memo as annex of the document. Editorial changes
1.2	14 October 2020	Hyperlinked section summary to enable quick access to key sections Improved clarity on Key Project Information Inclusion criteria table added Gender sensitive requirements added Prior consideration (1 yr rule) and Ongoing Financial Need added Safeguard Principles Assessment as annex and a new section to include applicable safeguards for clarity Improved Clarity on SDG contribution/SDG Impact term used throughout Clarity on Stakeholder Consultation information required Provision of an accompanying Guide to help the user understand detailed rules and requirements
1.1	24 August 2017	Updated to include section A.8 on 'gender sensitive' requirements
1.0	10 July 2017	Initial adoption