CATANDUVA LANDFILL GAS PROJECT

Document Prepared by

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VCS Standard Version	4.7
Prepared by	UniCarbo Energia e Biogás Ltda.

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The proposed VCS project activity titled "Catanduva Landfill Gas Project" encompasses the promotion of collection and destruction/utilization of landfill gas (LFG) (rich in methane (CH_4 at the Centro de Gerenciamento de Resíduos (CGR)[1] Catanduva landfill landfill (hereby termed "Catanduva landfill") through destruction of collected LFG in a high temperature open flare and utilization of collected LFG as gaseous fuel in a set of 2 engine-generator sets (to be gradually implemented) which represent the major components of an electricity generation infrastructure with a total combined nameplate installed capacity of about 2.8 MW[2].

LFG has been generated at the Catanduva landfill as a result of anaerobic decomposition of municipal solid waste (MSW) disposed in this solid waste disposal site (SWDS) since year 2013.

By promoting effective and efficient collection and destruction/utilization of LFG at the Catanduva landfill, the proposed VCS project activity thus aims to promote real, permanent and measurable greenhouse gas (GHG) emission reductions. It is assumed that, in the absence of the proposed VCS project activity (baseline scenario), generated LFG (rich in methane) would otherwise be directly emitted into the atmosphere (and thus not destroyed or utilized). The proposed VCS project activity thus promotes real and permanent reduction of CH4 emissions.

Furthermore, while electricity generation using LFG as gaseous fuel by the project's electricity generation infrastructure (which is used to meet the electricity demand of the project activity with the excess of generated electricity being exported to the National Electricity Grid of Brazil) promotes displacement of an equivalent amount of electricity that would otherwise be generated by existing grid-connected power generation facilities (including fossil fuel-fired power plants) and the addition of new power generation sources within the National Electricity Grid of Brazil in the absence of the proposed VCS project activity (baseline scenario), the proposed VCS project activity also promotes CO_2 emission reductions associated with the generation of electricity using a non-conventional renewable energy source.

The Catanduva landfill is a well-managed landfill site located in the municipality of Catanduva in São Paulo State (Southeastern region of Brazil). This landfill site was designed and has been operated by the host-country project proponent and project owner CGR Centro de Gerenciamento de Resíduos Ltda.

[1] Translated into the English language as "Solid Waste Treatment and Management Unit".

[2] One engine-generator set + all ancillary devices and systems for the project's electricity generation infrastructure was completely installed and started operations in June-2023. An additional engine-generator is forecasted be installed in year 2025 as part of the project's gradual/phased implementation.

The pre-project scenario represents LFG generated at the Catanduva landfill (with high content of CH4) being freely and directly emitted into the atmosphere (through the surfaces of the landfill and through a set of pre-project existing LFG venting drains without any management, treatment, collection, continuous combustion, or control (and therefore with no destruction/utilization of LFG being promoted)).

GHG emission reductions to be achieved by the proposed VCS project activity:

By promoting permanent and real mitigations of CH4 and CO2 emissions, the proposed VCS project activity is expected to promote total combined GHG emission reductions of 763,292 tCO2e during its 1st 7-year crediting period[3]. This value is equivalent to an average annual GHG emission reduction of 109,042 tCO2e/year.

1.2 Audit History

Audit type	Period	Program	Validation/verification body name	Number of years
Validation/ verification	01-June-2023 to 31-May-2030	VCS	LGAI Technological Centre S.A. (Applus+)	7 years

1.3 Sectoral Scope and Project Type

Sectoral scope[4]	1; 13
Project activity type	Energy (renewable/non-renewable); Waste handling and disposal The proposed VCS project activity represents a single installation (not a grouped project).

1.4 Project Eligibility

1.4.1 General eligibility

While both the sectoral scopes 1 (Energy (renewable/non-renewable)) and 13 (Waste handling and disposal) are listed as valid sectoral scopes under VCS (by considering the measures and the technologies encompassed by the proposed VCS project activity), the applied CDM baseline and monitoring methodology ACM0001 (version 19.0) is valid/applicable for project activities under such scopes.

[3] Under conformance with applicable VCS rules, the 1st 7-year crediting period for the VCS project activity may be renewed to additional two 7-year crediting periods.

[4] Projects, activities, or methodologies may be developed under any of the 16 VCS sectoral scopes: https://verra.org/programs/verified-carbon-standard/vcs-program-details/#sectoral-scopes

The proposed project activity is thus included under the scope of the VCS Program and it is not excluded as per "Table 1: Excluded Project Activity" of the VCS Standard.

The proposed VCS project activity was listed on the project pipeline with a status of "*under validation*" on XX-XXXXX-202X. The opening meeting with the Validation Body "Applus+ Certification" occurred on XX-XXXXX-202X, thus also meeting the requirement from Section 4.1.5. of the VCS Standard (version 4.7).

1.4.2 AFOLU project eligibility

The project activity is not an AFOLU project.

1.4.3 Transfer project eligibility

The project activity is not requesting transfer from another GHG Program.

1.5 Project Design

☒ Single location or installation

☐ Multiple locations or project activity instances (but not a grouped project)

☐ Grouped project

1.5.1 Grouped project design

The project activity is not a grouped project.

1.6 Project Proponent

Organization name	UniCarbo Energia e Biogás Ltda.
Contact person	Mr. Nuno Barbosa
Title	Managing Director
Address	Av Iraí 79, 72A, São Paulo – SP, Brazil – 040082-000
Telephone	+55 (11) 98596 0950
Email	nuno@unicarbo.com.br

1.7 Other Entities Involved in the Project

Organization name	CGR Centro de Gerenciamento de Resíduos Ltda.

Contact person	Mr. Tadeu Coletti
Title	Manager
Address	Estrada Municipal Catanduva à Palmares Paulista, km 05.
Telephone	(16) 9 8100 9182
Email	tadeu.coletti@cgrcatanduva.com.br

1.8 Ownership

The company CGR Centro de Gerenciamento de Resíduos Ltda. has all required proof of evidence of ownership for the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity, including:

Constitution/registration document for the company/enterprise CGR Centro de Gerenciamento de Resíduos Ltda. (latest version of the company/enterprise registration document "Contrato Social CGR Centro de Gerenciamento de Resíduos Ltda – CNPJ/ME nº 10.330.104/0001-18).

Latest operational licenses for both the Catanduva landfill (license with ref./No 14009984, issued by CETESB – Companhia Ambiental do estado de São Paulo and the infrastructure for promoting LFG utilization for generating electricity (license with ref./No. 14010789, also issued by CETESB – Companhia Ambiental do estado de São Paulo) in the name of the companies CGR Catanduva - Centro de Gerenciamento de Resíduos Ltda and Valorgas Energia Catanduva SPE Ltda., respectively.

The company UniCarbo Energia e Biogás Ltda. is appointed as the VCS project developer.

1.9 Project Start Date

Project start date	01-June-2023
Justification	Commissioning conclusion date and starting of continuous operation of the LFG flaring infrastructure for the proposed VCS project activity.

1.10 Project Crediting Period

Crediting period	☒ *Seven years, twice renewable* ☐ Ten years, fixed

	☐ Other (state the selected crediting period and justify how it conforms with the VCS Program requirements)
Start and end date of first or fixed crediting period	01-June-2023 to 31-May-2030

1.11 Project Scale and Estimated GHG Emission Reductions or Removals

☒ < 300,000 tCO2e/year (project)

☐ ≥ 300,000 tCO2e/year (large project)

Calendar year of crediting period	Estimated GHG emission reductions or removals (tCO_2e)
01-June-2023 to 31-December-2023	56,958
01-January-2024 to 31-December 2024	100,387
01-January-2025 to 31-December 2025	106,072
01-January-2026 to 31-December 2026	108,861
01-January-2027 to 31-December 2027	111,494
01-January-2028 to 31-December 2028	114,002
01-January-2029 to 25-September-2029	116,405
01-January-2030 to 31-May-2030	49,113
Total estimated ERRs during the first or fixed crediting period	**763,292**
Total number of years	**7**
Average annual ERRs	**109,042**

1.12 Description of the Project Activity

The proposed VCS project activity "Catanduva Landfill Gas Project" encompasses the promotion of collection of landfill gas (LFG) (rich in methane) generated at the Catanduva landfill site, its destruction in a high temperature open flare and its utilization as gaseous fuel in 2 engine-generator sets of an electricity generation infrastructure (with final total combined nameplate installed capacity of about 2.8 MW).

The privately owned and operated Catanduva landfill is located in the municipality of Catanduva – São Paulo State, Brazil. The Catanduva landfill started its Municipal Solid Waste (MSW) permanent disposal activities in the year 2013. Since the beginning of its construction and operation, the landfill site was granted all required environmental licenses/permits for its construction and operation. The landfill currently receives about 150,000 of MSW per month, with MSW streams being received from the following municipalities from the state of São Paulo:

> Catanduva, Novais, Santa Adélia, Paraíso, Pindorama, Ariranha, Palmares Paulista, Itajobi, Novo Horizonte, Embaúba, Ibitinga, Uru, Elisiário, Urupês, Tabapuã, Mendonça, Pitangueiras, Pongaí, Promissão, Adolfo, Catiguá, Sales, Lins, Cafelândia, Marapoama, Bebedouro, Sabino, Irapuã, Nova Europa, Bariri, Bocaina, Itapolis.

Pre-project situation at the Catanduva landfill:

Daily Municipal Solid Waste (MSW) disposal at the Catanduva landfill has occurred since 2013. The pre-project situation (situation prior to the occurred implementation and starting operations of the proposed VCS project activity) at the Catanduva landfill represents the non-existence of appropriate equipment/infrastructure and/or practice dedicated to promoting effective LFG management (LFG collection and its destruction/utilization) at this particular landfill site, with LFG being thus directly vented through the surface of the landfill and through previously existent pre-project set of rudimentary and conventional LFG venting drains available across the landfill.

Thus, the pre-project situation at the Catanduva landfill represents the existence of a set of conventional and rudimentary passive LFG venting drains at the landfill's MSW disposal area in order to allow LFG existent in the landfill to be directly vented (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)). This solution represents non-existence of appropriate management of LFG at the Catanduva landfill. This situation is, however, under conformance with applicable valid legal and environmental requirements, but is not deemed an appropriate and environmentally/climate-friendly solution. It is also assumed that under the baseline scenario (absence of the proposed VCS project activity) appropriate infrastructure for promoting effective and efficient LFG collection and destruction/utilization would remain being inexistent at the Catanduva landfill along its lifetime.

The baseline scenario for emissions of methane (CH_4) at the Catanduva landfill thus represents the continuation of the pre-project practice (generated LFG being directly emitted into the atmosphere through the surface of the landfill and through existent rudimentary and conventional passive LFG venting drains). The baseline scenario for emissions of methane at the

landfill site is therefore identical to the scenario existing prior to the occurred implementation of the proposed VCS project activity (pre-project scenario).

The baseline scenario for electricity generation is no electricity being generated through utilization of LFG at the Catanduva landfill, with electricity (in amount equivalent to the amount of electricity to be generated by the proposed project activity) being otherwise generated by existent grid-connected power generation facilities (including fossil fuel-fired power plants) and the addition of new power generation sources within the National Electricity Grid of Brazil.

The previously conceived overall design, operation, and management plan of the Catanduva landfill has not and is not expected to be compromised or changed as a result of the occurred implementation and starting of operations of the proposed VCS project activity. While no practice to increase methane generation has ever been promoted at the Catanduva landfill, none of such practice (to increase methane generation) has occurred and/or is expected to occur after the occurred implementation and starting of operations of the proposed VCS 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 Catanduva landfill during the period to be encompassed by operation of the proposed VCS 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 implementation of appropriate LFG collection, LFG flaring and electricity generation infrastructure (fueled by collected LFG) at the Catanduva landfill as follows:

- LFG collection system composed by set of LFG collection wells installed across the landfill site,
- LFG transportation pipeline network
- 1 high temperature open flare
- 2 engine-generator set of an electricity generation infrastructure (in which collected LFG is utilized as gaseous fuel for electricity generation), to be installed under a gradual/phased implementation schedule and with final total combined nameplate installed capacity of about 2.8 MW[5];

The occurred implementation and start of operation of the proposed VCS project activity has allowed 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.

Furthermore, additional GHG emission reductions are promoted through utilization of collected LFG as gaseous fuel for electricity generation (with generated electricity displacing equivalent

[5] The first engine-generator set started to operate in June-2023 and the second engine-generator set is expected to be installed and operated during the year of 2025.

amount of electricity that would be otherwise generated in existent grid-connected electricity generation sources (including fossil fuel fired power generation sources) and addition of new power generation sources within the National Electricity Grid of Brazil) in the absence of the proposed VCS project activity (baseline scenario).

The project system is to be 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. Monitoring activities is to include continuous measurement of LFG flow to the flare and/or engine-generator sets, continuous monitoring of methane content in collected LFG, continuous monitoring of operational conditions/status of the flares and/or engine-generator sets combusting LFG (project's methane destruction devices).

The amount of electricity generated as well as consumption of electricity by the proposed VCS project activity is also to be measured. Finally, measurements and monitoring required for the determination of project emissions are also to be performed in conformance with the applied CDM baseline and monitoring methodology ACM0001 (version 19.0) and/or applicable CDM methodological tools. In summary, the project technology is environmentally safe and sound.

Project's infrastructure:

LFG flaring equipment:

The design and construction for the proposed VCS project activity encompass the following characteristics/technology that aim to promote combustion of collected LFG through flaring:

- Combustion of LFG under controlled, safe and efficient (with very low CH_4 fugitive emissions) conditions are guaranteed by the utilization of well-designed high temperature open flare.
- Use of best practice safety devices/systems for the flare (such as flame detector(s) and slam shut valve(s) with pneumatic and electrical controls).
- Continuous measurement of the flare status (with the operational status signal of flame detector being processed and recorded every minute).

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 as a requisite for claiming related emission reductions.

The installed high temperature open flare[6] [7] are presented below.

[6] The currently installed flare represents the only equipment combusting LFG installed as part of the proposed VCS project activity for which compliance with applicable operational specifications/requirements (as established by equipment manufacturer) should be monitored as per applicable guidance/requirement of the CDM baseline and monitoring methodology ACM0001 (version 19.0) and applicable CDM methodological tool.

[7] The project proponent CGR Centro de Gerenciamento de Resíduos Ltda. acknowledges that more than 1 high temperature open flare may eventually be temporarily or permanently installed and become under operation as part of the proposed VCS project activity *inter alia* in order to fully accommodate previously projected potential increases in the amount of LFG to be generated at the landfill site and projected potential increase of the amount of generated LFG to be collected as part of the operation of the project activity. This is in accordance with the possible future project design conceptualization (which may eventually consider, if required, gradual installation of additional flare(s) and other equipment (e.g. centrifugal blower(s)) within the project lifetime in order to eventually address forecasted increase in LFG to be flared as part of the operation of the VCS project activity).

This completed VCS PD does not include detailed specifications and/or maintenance requirements for project equipment other than the single high temperature open flare currently installed as part of the VCS project activity (e.g. detailed specifications and/or maintenance requirements for equipment/instruments such as centrifugal blower(s), CH_4 content gas analyzer unit, LFG pressure and temperature sensors, thermocouple(s), etc.). While, as established by the CDM baseline and monitoring methodology ACM0001 (version 19.0) and/or applicable CDM methodological tools, differently than the case of the installed high temperature open flare, compliance of specific maintenance requirements and specifications for such additional project equipment/instruments are not required to be monitored through dedicated monitoring parameters, It is also important to note that such other equipment/instruments may be eventually temporarily or permanently replaced during the project's lifetime (due to expected eventual malfunction, maintenance schedules, calibration events, repair work, etc.). The non-inclusion of specification and maintenance details of such other equipment/instruments in the VCS PD is under conformance with applicable VCS and/or CDM rules and requirements (incl. requirements of the CDM baseline and monitoring methodology ACM0001 (version 19.0) + applicable CDM methodological tool and applicable guidelines for completing the VCS PD for a VCS project activity). Details about such additional ancillary equipment (incl. monitoring instruments/equipment) will be later made available in Monitoring Reports to be completed for regular monitoring periods for the VCS project activity upon its successful registration under VCS/VERRA.

Electricity generation infrastructure:

Collected LFG is utilized as gaseous fuel for electricity generation in the project's electricity generation infrastructure (under its gradual/phased implementation schedule). The whole infrastructure is forecasted to have 2 engine-generator sets when fully implemented. While the 1st engine-generator set (and all required ancillary devices and controls for the electricity generation infrastructure) started continuous operation in June-2023, the 2nd engine-generator set is currently expected to start operating during the year of 2025.

The engine-generator set installed as part of the proposed VCS project activity of Type 4, J 420 series and manufactured by GE Jenbacher GmbH & Co OHG, are fueled uniquely by LFG and have individual nameplate power generation capacity of about 1.4 MW. The 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.).

Figure 2: Engine-generator set currently installed as part of the proposed VCS project activity

The installed engine-generator set is assembled under a container-based modular power generation package set design. Each container includes ancillary equipment (cooling fan, coolant radiator, control & safety systems, etc.).

Consumption of electricity by the proposed VCS project activity:

As per the project design, electricity demand for the proposed VCS project activity is to be met by consumption of grid-sourced electricity and/or by electricity sourced by the project's electricity generation infrastructure.

No backup captive off-grid electricity generator (fueled by diesel) is currently expected to be installed as part of the proposed VCS project activity.

In summary, the project's electricity demand can technically be met by one of the following sources/approaches:

- Imports of grid-sourced electricity, or
- Electricity sourced by the project's electricity generation infrastructure,

Expected lifetime for the proposed VCS project activity:

The expected operational lifetime for the project's LFG collection and destruction/utilization infrastructure is at least 25 years. However, related equipment and infrastructure lifetime may even exceed 25 years if required service and maintenance is performed correctly and in case the proposed VCS project activity is always operated as per recommendation and requirements set by manufacturers/suppliers of included equipment/instruments.

Technology transfer:

While the currently installed and yet to be installed project's high temperature open flare, engine generator sets and some of the monitoring equipment/instruments are imported equipment/instruments, the proposed VCS project activity is expected to also use domestically manufactured components (equipment, instruments, etc.). While all currently existent LFG collection and destruction/utilization initiatives under operation in landfills located in Brazil were implemented (or are currently being implemented/validated) as project-based initiatives under different GHG emission reduction schemes/standards (e.g., CDM, VCS, Gold Standard for Global Goals (GS4GG) and/or under other GHG abatement schemes/standards), such project activities indeed involve and/or potentially promote transfer of technology and improvements in practices for LFG management to the host-country Brazil.

No change in the design and operational conditions of the Catanduva landfill:

The design and operational aspects of the Catanduva landfill have not changed (and are not expected to be changed) during the operational lifetime of the proposed VCS project activity. The Catanduva landfill is expected to still being operated with the application of the same and previously applied MSW landfilling technics and procedures.

The Catanduva landfill was designed and has been operated under conformance with its previously conceived 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 MSW landfilling design and operational pattern for the Catanduva landfill currently represents the best available practices for landfill construction and operation in Brazil.

The whole management and operation plan of the Catanduva landfill was previously approved and has been regularly monitored/surveilled by the competent environmental authority of the São Paulo State.

The Catanduva landfill is regarded as a very well-designed and very well-managed landfill. As established by the valid environmental and operational licenses/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.

1.13 Project Location

Physical/Geographical location of the proposed VCS project activity:

The landfill hosting the project activity is the Catanduva landfill, which is located aside the margins of the Estrada Municipal CTV 020, S/N, Fazenda Santa Fé, Catanduva (city), São Paulo (State), Brazil. The project's geographical coordinates are as follows:

- Latitude: -21°07'23.69"S (-21.123247)
- Longitude: 48°55'41.65" W (-48.928236)

1.14 Conditions Prior to Project Initiation

While the baseline scenario for methane emissions for the proposed VCS project activity represents the pre-project situation at the Catanduva landfill in terms of management and utilization of LFG (LFG being directly emitted into the atmosphere through the surface of the landfill and through existent pre-project conventional LFG venting drains), with no electricity generation being promoted through the utilization of collected LFG (electricity generation (under equivalent amount) occurring in existent electricity generation sources within the National Electricity Grid of Brazil respectively, these pre-project conditions are reflected in the identified baseline scenario for the proposed VCS project activity (identification performed under full conformance with the applied CDM baseline and monitoring methodology ACM0001 (version 19.0) and CDM methodological tool "Positive lists of technologies" (version 4.0)) as outlined in Section 3.4 (Baseline Scenario).

1.15 Compliance with Laws, Statutes and Other Regulatory Frameworks

The demonstration of meeting of applicability conditions of the applied CDM baseline and monitoring methodology ACM0001 (version 19.0) by the proposed VCS project activity and determination of baseline emissions (in Section 3.2 and Section 3.7 respectively) include the identification and demonstration of compliance of the proposed VCS project activity with all and any eventually existent and applicable local, regional and national regulations, laws related to management of LFG in landfills.

While the occurred implementation and starting of operations of the proposed VCS project activity complies with applicable laws and regulations (LFG destruction and utilization is not regionally or nationally forbidden); the situation prior to the occurred implementation and starting of operations of the proposed VCS project activity at the Catanduva landfill (LFG being directly emitted into the atmosphere through the surface of the landfill and through existent pre-project conventional LFG venting drains with no utilization of LFG as gaseous fuel for electricity generation thus occurring) is also under compliance with applicable laws and regulatory framework for landfill operation and management of solid waste in Brazil.

Under conformance with applicable environmental regulations, design, construction and operational aspects for the Catanduva landfill were analyzed through the conduction of an Environmental Impact Assessment (EIA) with construction and operations of the landfill (without the proposed VCS project activity being implemented) being later approved. The whole infrastructure for the proposed VCS project activity is also approved by competent environmental authority[8].

1.16 Double Counting and Participation under Other GHG Programs

1.16.1 No Double Issuance

Is the project receiving or seeking credit for reductions and removals from a project activity under another GHG program?

☐ Yes ☒ No

1.16.2 Registration in Other GHG Programs

Has the project registered under any other GHG programs?

☐ Yes ☒ No

1.16.3 Projects Rejected by Other GHG Programs

Has the project been rejected by any other GHG programs?

☐ Yes ☒ No

[8] Initial version of environmental license/permit Ref./No. 14010789 issued by *Companhia Ambiental do Estado de São Paulo*, CETESB, authorizing the company/enterprise "Valorgas Energia Catanduva SPE Ltda." to implement and operate infrastructure promoting utilization of LFG as gaseous fuel for electricity generation in grid-connected electricity generation infrastructure located within the geographical limits of the Catanduva landfill site (infrastructure which is actually part of the proposed VCS project activity).

1.17 Double Claiming, Other Forms of Credit, and Scope 3 Emissions

1.17.1 No Double Claiming with Emissions Trading Programs or Binding Emission Limits

Are project reductions and removals or project activities also included in an emissions trading program or binding emission limit? See the *VCS Program Definitions* for definitions of emissions trading program and binding emission limit.

☐ Yes ☒ No

The proposed VCS project activity does not aim to reduce GHG emissions from activities that are currently included in an emissions trading program or any other mechanism that includes GHG allowance trading as there are currently none of such program and/or mechanism in the host-country Brazil. Thus, upon conformance with currently valid and applicable climate change regulations in Brazil, GHG emission reductions generated by the proposed VCS project activity are not expected to be used for compliance under such programs and/or mechanisms[9] [10].

1.17.2 No Double Claiming with Other Forms of Environmental Credit

Has the project activity sought, received, or is planning to receive credit from another GHG-related environmental credit system? See the *VCS Program Definitions* for definition of GHG-related environmental credit system.

☐ Yes ☒ No

[9] In case Voluntary Carbon Units (VCUs) to be issued as a result of the implementation and operation of the VCS project activity are used in the context of Paris Agreement Article 6 mechanisms and/or international Paris related programs and/or other programmes (such as The International Air Transport Association (IATA)'s Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), it will be opportunely demonstrated that such VCUs meet relevant requirements established under such mechanisms and programs. If applicable, that will include any requirement relating to double counting and corresponding adjustments. Thus, if applicable, the project proponent and project owner CGR Centro de Gerenciamento de Resíduos Ltda. will demonstrate adherence to such requirements by applying the relevant VCU label to VCUs in the VCS/VERRA Registry.

[10] In case GHG emission reductions from the VCS project activity are included in an emissions trading program and/or any other mechanism (that includes GHG allowance trading) in the future, appropriate evidence will be provided by the project proponent and project owner CGR Centro de Gerenciamento de Resíduos Ltda. that the GHG emission reductions generated by the VCS project activity have not and will not be otherwise counted or used under such program or mechanism (as required by currently applicable VCS rules and procedures). As established by applicable VCS rules, such evidence may *inter alia* include:

(a) a letter from the program operator, Designated National Authority (DNA) or other relevant regulatory authority or comparable authority/entity that emissions allowances (or other GHG credits used in the program) equivalent to the reductions generated by the proposed VCS project activity) have been cancelled from the program or national cap, as applicable/required.

(b) evidence of the effective purchase and cancellation of GHG allowances equivalent to the GHG emissions reductions generated by the VCS project activity related to the program or national cap.

(c) evidence from the program operator, DNA or other relevant regulatory authority or comparable authority/entity stating that the specific GHG emission reductions generated by the proposed VCS project activity were/are/will be not within the scope of such program or national cap.

1.17.3 Supply Chain (Scope 3) Emissions

Do the project activities specified in Section 1.12 affect the emissions footprint of any product(s) (goods or services) that are part of a supply chain?

☐ Yes ☒ No

If yes:

Is the project proponent(s) or authorized representative a buyer or seller of the product(s) (goods or services) that are part of a supply chain?

☐ Yes ☐ No

If yes:

Has the project proponent(s) or authorized representative posted a public statement on their website saying, "Carbon credits may be issued through Verified Carbon Standard project [project ID] for the greenhouse gas emission reductions or removals associated with [project proponent or authorized representative organization name(s)] [name of product(s) whose emissions footprint is changed by the project activities]."

☐ Yes ☐ No

1.18 Sustainable Development Contributions

Environmental and climate change positive aspects of the proposed VCS project activity and contribution of the proposed VCS project activity towards Sustainable Development Goals (SDGs):

SDG 7 – Affordable and clean energy (Ensure access to affordable, reliable, sustainable and modern energy):

The proposed VCS project activity is a renewable energy project activity that has displaced fossil-generated power, thus increasing the share of renewable energy in the energy mix and promoting electricity generation from non-conventional renewable energy source.

The amount of electricity to be generated by the proposed VCS project activity is ex-ante estimated based on the combined installed capacity of the engine-generator sets currently installed and yet to be installed as part of the proposed VCS project activity.

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 identification of the baseline scenario for the proposed VCS project activity (identified as representing same situation prior to the occurred partial implementation of the proposed project activity (under its phased/gradual implementation schedule), no LFG would be

utilized as gaseous fuel generating electricity (since there would be no electricity generation infrastructure at the Catanduva landfill in the absence of the project activity).

Environmental and climate change positive aspects of the proposed VCS project activity and contribution of the proposed VCS project activity towards Sustainable Development locally and in the whole country Brazil:

SDG 8 – Decent work and economic growth (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work):

The proposed VCS project activity has created (and will create) employment opportunities. These job opportunities will require both highly qualified and low qualified people. As a general principle, employment recruitments will be made mostly from the nearby regions and municipalities, especially for the labor-intensive jobs. Monitoring details about the jobs created by the project activity will be presented in the Monitoring Reports.

Regarding the identified baseline scenario (same situation prior to the occurred implementation of the proposed 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 Catanduva landfill in the absence of the proposed VCS project activity.

SDG 13 - Climate Action (Take urgent action to combat climate change and its impacts):

While methane (CH_4) is a powerful greenhouse gas (GHG), the pre-project situation involving direct and uncontrolled emission of LFG (rich in CH_4) into the atmosphere contributes to climate change. Collection and destruction/utilization of LFG promote real and permanent abatement of GHG emissions at the Catanduva landfill.

1.19 Additional Information Relevant to the Project

1.19.1 Leakage Management

While the proposed VCS project activity promotes collection (recovery) of LFG and its destruction/utilization/supply, there is no sources of leakage to be considered.

Furthermore, as per the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), no leakage effects (i.e. leakage sources and leakage emissions) are to be considered by project activities applying this methodology.

1.19.2 Commercially Sensitive Information

There is no commercially sensitive information to be excluded from the public version of this VCS PD.

1.19.3 Further Information

There is no additional relevant legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and/or temporal information that may have a bearing on the eligibility of the project, the net GHG emission reductions or the quantification of net GHG emission reductions for the proposed VCS project activity.

2 SAFEGUARDS AND STAKEHOLDER ENGAGEMENT

2.1 Stakeholder Engagement and Consultation

2.1.1 Stakeholder Identification

Stakeholder Identification	The identification of stakeholders affected by the project activity was performed by considering applicable guidance of the VCS Standard version 4.7. (which was the valid/applicable version at the time of the start of the VCS validation). The following stakeholders were invited to participate on the conducted Local Stakeholder Consultation: (physical meeting performed on 21-May-2024): - Catanduva Mayor's office – Mayor of Catanduva; - City Council; - Environmental agency of São Paulo state (CETESB); - Municipal Secretaries of Catanduva; - Public Ministry – State public prosecutor; - Local scavenger's cooperative – Cooperative representative; - City Hall / Mayor's office from the municipality of Catanduva; Representatives of local communities.
Legal or customary tenure/access rights	By taking into consideration the project type, its design, its location (including economic & social conditions and aspects in the region of influence of the landfill where the proposed VCS project activity is implemented), there are no legal or customary tenure/access rights to territories and resources (including *inter alia* collective and/or conflicting rights held by stakeholders) which would need to be considered.

	Since the project proponent CGR Centro de Gerenciamento de Resíduos Ltda. is the sole owner of the property where the Catanduva landfill and the project activity are implemented and by also considering that there are no indigenous people or local communities that share access rights to the area of the landfill, there are no legal or customary tenure/access rights applicable. An Environmental Impact Assessment (EIA) was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.
Stakeholder diversity and changes over time	No changes are expected to occur over time in the social, economic and cultural diversity within stakeholder groups. By taking into consideration the project type, its design, its location (including economic & social conditions and aspects in the region of influence of the landfill where the proposed VCS project activity is implemented), there are no changes expected to occur over time on the social, economic and cultural diversity within stakeholder groups to be considered. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.
Expected changes in well-being	Since the proposed VCS project activity was implemented in the area of an existing and operational landfill site, there are no negative impacts on the well-being of local stakeholders caused by the implementation of the proposed VCS project activity (under its gradual/phased implementation schedule). In fact, the practice of collecting and utilizing landfill gas (LFG) reduces odors and other potential negative environmental impacts that might affect local communities. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project

	activity. The content of the EIA report confirms the above-mentioned information.
Location of stakeholders	As indicated above, the implementation of the project activity per se, is not expected to cause any negative impacts over local stakeholders. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.
Location of resources	There are no territories or resources owned by local stakeholders nor to which they have customary access. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.

2.1.2 Stakeholder Consultation and Ongoing Communication

Date of stakeholder consultation	21-May-2024
Stakeholder engagement process	Invitations for the conducted local stakeholder (LSC) consultation meeting/event were sent by CGR Centro de Gerenciamento de Resíduos Ltda. to the identified stakeholders via email on 23-April-2024. The conducted LSC meeting/event took place in a meeting room located at the Catanduva landfill. The meeting/event was broadcasted to remote participants through Zoom meeting application. The speakers at the meeting were encouraged to use a language appropriate for all cultures and genders.
Consultation outcome	All parties involved in the implementation and operation of the proposed VCS project activity were presented to the stakeholders. Design and operation details of the proposed VCS project activity were presented (including technological considerations and related

	environmental, economic and social impacts) and discussed among participants. It was also demonstrated how the project is under conformance with relevant national laws and the processes for VCS Validation and Verifications were explained to the participants. The interaction between the project owner and project proponent CGR Centro de Gerenciamento de Resíduos Ltda. and the stakeholders showed that the stakeholders are supportive to the implementation and operation of the proposed VCS project activity, It is the general opinion of most of invited/consulted stakeholders that the proposed VCS project activity will provide employment opportunities, help local economic development, and increase local and regional interest on power generation using non-conventional renewable energy source. In summary, the implementation and operation of the proposal VCS project activity is regarded as beneficial by the local stakeholders.
Ongoing communication	Channels of future ongoing communication between stakeholders and the project proponent were also defined and presented during the LSC meeting/event. A grievance book was made available at the central office of the Catanduva landfill for any stakeholders to present their complaints and questions. Moreover, the contact of the landfill manager (local representative responsible for addressing any issues) was also made available during the meeting.
Stakeholder input	There were no negative inputs from stakeholders regarding the implementation/operation of the proposed VCS project activity. Nonetheless, the project proponent CGR Centro de Gerenciamento de Resíduos Ltda. has created a written procedure for addressing any eventual concerns from the local stakeholders. There are no changes in the project design that require updates to the local stakeholders.

Besides the local representatives who attended the meeting, employees of CGR Centro de Gerenciamento de Resíduos Ltda. were also invited to participate in the LSC meeting/even and were encouraged to give their inputs/comments regarding the project design, its implementation and its operation. The following images present a list of signatures from the attendants of the LSC meeting/event:

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CGR - CATANDUVA

Reunião de Stakeholders/Partes Interessadas

21/05/2024

Projeto de Valorização do Biogás do CGR Catanduva

#	Nome	Contato	Gênero	Assinatura	Empresa/Organização	Comentário
	Vitor Pocci Bolia	(17) 99706-3305	masculino	[illegible]	ESAC	
	Matheus Cappellatti do Amaral	(17) 98133-3283	masculino	Matheus C do Amaral	Ecolive	
	Silvana Zuliani	(17) 99669 1905	Fem.	[illegible]	moradora vizinha	Vila Alexandria
	Marco A. Zuliani	17 99606 7370	MASC	[illegible]	CGR	Vd Vertoni
	Nuno Barros	11 985960850	Masc	NB	Unicarbo	
	Santo Zuliani		Mascu	[illegible]	CGR	
	Marco A. Machado	(17) 996806626	Masc	[illegible]	SAEC	
	Paulo Zago Neto	99403494	masculino	[illegible]	morador vizinho	
	Gilberto A. Motta	(17) 99658062	Masc	[illegible]	Prefeitura Muni.	
	HELDER MARTINS	(17) 997071744	MASCULINO	[illegible]	MORADOR VISINHO	GLORIA II

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Reunião de Stakeholders/Partes Interessadas

21/05/2024

Projeto de Valorização do Biogás do CGR Catanduva

#	Nome	Contato	Gênero	Assinatura	Empresa/Organização	Comentário
	Renan Rodrigues	981219839	masc	[illegible]	Advogado	
	Alexandre Landi	17 997656603	MASC	[illegible]	Prefeitura	
	[illegible]	17991564818	Masc.	[illegible]	Look Som EC	
	Katia L. Goldoni	17996076654	Fem.	[illegible]	Look Som Eventos	
	Walter Tadeu L. Paiva	17991694224	Masc.	[illegible]	CETESB - Rio Preto.	
	EDSON DA SILVA	17-991606298	MASC	[illegible]	IBGE	
	Alonso Silva	17996470793	Masc	[illegible]	Publitec Ambiental	
	Karen Morandin	17-99101-2510	Fem.	Karen Morandin	Sec. Munic. Meio Ambiente Cat.	
	ANA OLÍVIA VARGAS	17 981550950	FEM.	A Vargas	MAANA ARQUITETURA	
	Paulo H. S. VARGA	17 992330770	Masc.	[illegible]	IPIRANGA	

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Projeto de Valorização do Biogás do CGR Catanduva

#	Nome	Contato	Gênero	Assinatura	Empresa/Organização	Comentário
	Cláudio Romagnoli	17 981211150	Masculino	[illegible]	Prefeitura	
	Luciano Vargas	17 981324464	Feminino	[illegible]	Vargas	
	Welma Jon	17 997634660	Feminino	[illegible]	SAEC	
	João Victor	17 99796080	Masculino	J V	Esporte e Saúde	
	Julia D. Araujo	17 997139232	Feminino	[illegible]	Sec. Meio Ambiente e Agricultura.	
	Diego Nolli	17-99736-6337	Masc.	[illegible]	Studio Agro	
	[illegible]	17 98141160	MASC	[illegible]	CGR	
	Fernando C. Braz	17.99763901	Masc.	[illegible]	Sec. Desenvolvimento Catanduva	

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CGR - CATANDUVA

Reunião de Stakeholders/Partes Interessadas 21/05/2024

Projeto de Valorização do Biogás do CGR Catanduva

#	Nome	Contato	Gênero	Assinatura	Empresa/Organização	Comentário
	Camila Mucci	17-988784749	Feminino	[illegible]	SAEC	
	José Vinicius Montes	17-996685628	Masculino	[illegible]	SAEC	
	José Gilberto	17 99716 6875	M	[illegible]	ECOPOWER	
	[illegible] N. Juliani	17-99781-6174	Masculino	[illegible]	CGR	
	Laurinc Facomo	17992717329	Fem.	[illegible]	CGR	
	Lucas de Aquila	17996705276	Masculino	Lucas	R. Mito Norte 125 Glória 5. Bairro Vizinho	
	Vitor A Miguel	17-992072720	Masculino	[illegible]	VMEng	

Figure 3: List of signatures of the attendants of the stakeholder meeting

2.1.3 Free Prior and Informed Consent

Obtaining consent	The project proponent CGR Centro de Gerenciamento de Resíduos Ltda. is the sole owner of the property where the Catanduva landfill is located and the project activity is implemented and there are no indigenous people or local communities that share access rights to the area of the landfill. Moreover, there are no ongoing nor unresolved conflicts with local stakeholders. There is no disrespect by the project proponent CGR Centro de Gerenciamento de Resíduos Ltda. to stakeholders' rights to participate in and/or in terms of consenting to consultation as part of project design and implementation. The project proponent CGR Centro de Gerenciamento de Resíduos Ltda. has respected stakeholders' rights to participate in and consent to consultation as part of project design, its implementation and its so far occurred continuous operation.
Outcome of FPIC	Not applicable as explained above.

2.1.4 Grievance Redress Procedure

Development process	The written procedure in place for addressing stakeholder's grievances comprises the following steps: 1. **Identification:** Complaints and suggestions will be classified according to their seriousness and potential impact on the project's objectives. Priority classification will determine the response deadlines and subsequent actions. 2. **Responsibility for Response:** The Landfill Operation Manager and the UTE (Thermoelectric Power Plant) Operation Manager will be responsible for periodically reviewing the means available for stakeholder communication. After analyzing the complaints and suggestions presented in the media, the responsible managers will coordinate the response activities, involving the relevant parties as necessary. 3. **Investigation and Analysis:** The responsible team will conduct a detailed investigation to fully understand the nature of the complaint or

	suggestion. Potential impacts and possible solutions will be assessed. 4. **Communication with the Stakeholder:** The stakeholder who submitted the complaint or suggestion will be kept informed of the progress of the investigation. Communication will be carried out in a clear and timely manner. 5. **Resolution and Implementation of Improvements:** Based on the analysis, necessary corrective or preventive actions will be identified. The proposed improvements will be implemented in a coordinated manner. 6. **Feedback and Learning:** After the resolution, feedback will be sought from the stakeholder to assess the effectiveness of the actions taken. The lessons learned will be documented in order to continuously improve the process. 7. **Continuous Monitoring:** The management system will be monitored continuously to identify patterns and trends in complaints and suggestions. 8. **Review and Update:** The procedure will be reviewed periodically to ensure its effectiveness and relevance.
Grievance redress procedure	The written procedure for addressing stakeholder's grievances is described above.

2.1.5 Public Comments

Comments received	Actions taken
The proposed VCS project activity was open for comments during the period from XX/XX/2025 to XX/XX/2025. No comments were received during such period nor after this period through the available channels of communication.	-

2.2 Risks to Stakeholders and the Environment

2.2.1 Management Experience

Before starting at the project activity, all employees and their supervisors underwent initial training in human resources integration, safety and the integrated management system, which ensures that the requirements of quality, environmental and occupational safety management are correctly met both inside and outside the organization. In addition, employees are constantly taking part in training involving the aforementioned topics to ensure that working conditions are as good as possible.

2.2.2 Risk Assessment

	Risks identified	Mitigation or preventative measure(s) taken
Natural and human-induced risks to stakeholders' wellbeing	No risk identified.	As an LFG recovery and destruction/utilization project, the project does not offer any natural or human induced risk to local stakeholder's wellbeing. An Environmental Impact Assessment (EIA) was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report corroborates this information, affirming the absence of risks to stakeholders' wellbeing, both from natural occurrences and human-induced factors.
Risks to stakeholder participation	No risk identified.	As an LFG recovery and destruction/utilization project, the project does not offer any risk to local stakeholder participation. An EIA was previously undertaken as part of the process to obtain the

		environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.
Working conditions	No risk identified.	There are rigid procedures implemented at both the Catanduva landfill and the project activity, as can be demonstrated in the company's guidelines "Programa de Controle Médico de Saúde Ocupacional" (translated as "Medical Control Program of Occupational Health"), "Programa de Gerenciamento de Riscos" (translated as "Risk Management Program") and "Plano de Atendimento a Emergências" (translated as "Emergency Response Plan"), which are updated every year. These programs and procedures are under conformance with national Labor regulations.
Safety of women and girls	No risk identified.	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. Moreover, the project complies with the requirements of gender equality, as it is under the jurisdiction of Brazilian legislation. Article 5 of the Brazilian

		Constitution[11] 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[12] 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 Labor Laws (CLT)[13], which regulates labor relations in Brazil, prohibits gender-based wage discrimination (Article 461, §1º) and ensures equal rights for men and women in the workplace.
Safety of minority and marginalized groups, including children	No risk identified.	Brazil has published laws for the protection of children[14], which also includes employment regulations. The project requires skilled employees, and it does not employ and is not complicit in any form of child labor. Thus, the project activity offers no risk risks to the safety of minorities and marginalized groups.

[11] http://alerjln1.alerj.rj.gov.br/constfed.nsf/fc6218b1b94b8701032568f50066f926/54a5143aa246be25032565610056c224?OpenDocument

[12] https://www2.camara.leg.br/legin/fed/lei/1980-1987/lei-7356-30-agosto-1985-356970-norma-pl.html

[13] https://www2.camara.leg.br/legin/fed/declei/1940-1949/decreto-lei-5452-1-maio-1943-415500-publicacaooriginal-1-pe.html

[14] https://www.planalto.gov.br/ccivil_03/leis/l8069.htm

		An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.
Pollutants (air, noise, discharges to water, generation of waste, and release of hazardous materials and chemical pesticides and fertilizers)	No risk identified.	The project reduces greenhouse gas emissions as it prevents methane from being freely emitted into the atmosphere. Moreover, LFG contains traces of other air pollutants, such as hydrogen sulfide, which are also destroyed as part of the operation of the project activity. 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 Catanduva landfill (which include treatment of leachate generated at the landfill) are regularly inspected by the local environmental authority. Regarding noise, while the flare and the engine-generator sets produce noise, it does not represent an issue by considering the scale of such produced noise and the distance between the

		project activity and the closest communities. The project does not affect the amount of waste generated in the surrounding municipalities. The project does not involve the manufacture, trade, release, and/or use of hazardous and non-hazardous chemicals and/or materials. The project does not involve the manufacture, trade, release, and/or use of chemical pesticides and fertilizers in the whole process. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.

2.3 Respect for Human Rights and Equity

2.3.1 Labor and Work

	Risks identified[15]	Mitigation or preventative measure(s) taken
Discrimination	No risk identified.	The proposed VCS project activity does not involve and is not complicit in any form of discrimination based on gender,

[15] The identified risks and commensurate mitigation or preventative measure(s) for forced labor, child labor, and human trafficking, must be inclusive of staff and contracted workers employed by third parties.

		race, religion, sexual orientation or any other basis. The project complies with the article 3[16] of the Brazilian Constitution which prohibits any form of discrimination. The project adheres with the National Council on Women's Rights, formed in 1975, which advocated successfully on behalf of including gender conscious legislation in the updated constitution of 1988. To further reinforce this principle, Brazil enacted Law N° 9.029/1995[17], which explicitly prohibits discriminatory practices in employment and the workplace. It is a corporate policy of CGR Centro de Gerenciamento de Resíduos Ltda. (with controls being implemented) not to have any kind of discrimination being promote by employees, collaborator and external parties as part of the operation of the company.
Sexual harassment	No risk identified.	The project adheres to strict anti-sexual harassment policies, aligning with Brazilian legislation. Article 216-A[18] of the Brazilian Penal Code defines and criminalizes sexual harassment, providing a legal framework to protect individuals from such behavior.

[16] https://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm

[17] https://www.planalto.gov.br/ccivil_03/leis/l9029.htm

[18] https://www.planalto.gov.br/ccivil_03/Decreto-Lei/Del2848.htm#art216a

		To reinforce this principle, Brazil implemented Law No. 13,718/2018[19], which specifically targets sexual harassment and rigorously ensures its enforcement. The implementation and operation of both the proposed VCS project activity and the Catanduva landfill site comply with the law N° 14.540[20] of 2023, which established the Program for Preventing and Confronting Sexual Harassment and other Crimes against Sexual Dignity and Sexual Violence within the direct and indirect federal, state, district and municipal public administration.
Equal pay for equal work	No risk identified.	The proposed VCS project activity complies with workplace equality and ensure that all employees are compensated fairly, fostering a more inclusive and just labor market. The project complies with Brazilian legislation on equal pay for equal work that is anchored in the Federal Constitution promulgated on 1988 and further detailed in the Consolidation of Labor Laws (CLT in Portuguese). The Constitution explicitly prohibits any discrimination in wages based on sex, age, color, or marital status on its Article 7[21]. Complementing this, the CLT mandates on its Article 461[22] that

[19] https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2018/lei/l13718.htm

[20] https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2023/lei/l14540.htm

[21] https://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm

[22] https://www.planalto.gov.br/ccivil_03/decreto-lei/del5452.htm

		employees performing identical roles with equivalent skill, productivity, and responsibility must receive equal remuneration. Recent legal reforms have strengthened these provisions, imposing stricter penalties for violations and enhancing mechanisms for reporting and resolving complaints. These measures aim to promote workplace equality and ensure that all employees are compensated fairly, fostering a more inclusive and just labor market in which the VCS project activity compromises.
Gender equity in labor and work	No risk identified.	The implementation and operation of both the proposed VCS project activity and the Catanduva landfill site comply with the requirements of gender equality, as it is under the jurisdiction of Brazilian legislation. Article 5[23] of the Brazilian Constitution 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[24] 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.

[23] https://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm

[24] http://www.planalto.gov.br/ccivil_03/leis/1980-1988/L7353.htm

		It is a corporate policy of CGR Centro de Gerenciamento de Resíduos Ltda. (with controls being implemented) having gender equality being promoted/secured among employees, collaborator and external parties as part of the operation of the company.
Forced labor	No risk identified.	The project respects internationally proclaimed human rights. Brazil has its own legislation[25] in place prohibiting the violation of the human rights principle and it actively enforces the compliance of such principle. Convention No. 105 of the International Labour Organization (ILO) enacted by Decree no. 58.822, of 14-July-1966, which obliges signatory countries to abolish forced labor[26]. Brazil has ratified two UN human rights treaties: - The International Covenant on Civil and Political Rights[27] - The International Covenant on Economic, Social, and Cultural Rights[28].

[25] https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2014/lei/l12986.htm

[26] https://www2.camara.leg.br/legin/fed/decret/1960-1969/decreto-58822-14-julho-1966-399441-publicacaooriginal-1-pe.html#:~:text=Promulga%20a%20Conven%C3%A7%C3%A3o%20n%C2%BA%20105%20concernente%20%C3%A0%20aboli%C3%A7%C3%A3o%20do%20Trabalho%20for%C3%A7ado.

[27] https://treaties.un.org/Pages/ViewDetails.aspx?chapter=4&clang=_en&mtdsg_no=IV-4&src=IND

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

Child labor	No risk identified.	Brazil has published laws for the protection of children[29], which also includes employment regulations. This commitment is reflected in Law No. 3.597[30], which stablishes Brazil's child labor legislation. This law prohibits the employment of minors in hazardous conditions, sets minimum age requirements for work, and ensures that children's rights to education and development are protected. CGR Centro de Gerenciamento de Resíduos Ltda. strictly adheres to these regulations and does not employ or participate in any form of child labor.
Human trafficking	No risk identified.	Brazil upholds strong legal protections against human trafficking. The law N° 13.344[31] of 2016 established the fight against human trafficking, which has increased the prevention and combating of this act. This commitment is reflected in Article 149-A[32] of the Penal Code, which criminalizes human trafficking and prescribes penalties for the crime. CGR Centro de Gerenciamento de Resíduos Ltda. strictly adheres to these regulations and does not employ or participate in any form of human trafficking.

[29] https://www.planalto.gov.br/ccivil_03/leis/l8069.htm

[30] https://www.planalto.gov.br/ccivil_03/decreto/D3597.htm#:~:text=DECRETO%20N%C2%BA%203.597%2C%20DE%2012,17%20de%20junho%20de%201999

[31] https://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2016/Lei/L13344.htm

[32] https://www.planalto.gov.br/ccivil_03/Decreto-Lei/Del2848.htm#art149

2.3.2 Human Rights

Risks identified	Mitigation or preventative measure(s) taken
No risk identified.	No risks related to the recognition, respect, and protection of the rights of indigenous peoples (IPs), local communities (LCs), and customary rights holders have been identified within the influence area of the Catanduva landfill. It has been confirmed that there are no indigenous peoples (IPs) in the area affected by the Catanduva landfill. Therefore, there are no risks related to the protection of indigenous rights in this locality. Furthermore, the project respects internationally proclaimed human rights. Brazil has national legislation[33] that prohibits the violation of human rights principles and actively enforces such principles. Additionally, Brazil has ratified two UN human rights treaties: - The International Covenant on Civil and Political Rights[34] - The International Covenant on Economic, Social, and Cultural Rights[35]. It is a corporate policy of CGR Centro de Gerenciamento de Resíduos Ltda. (with controls being implemented) not having any kind of human right being disrespected for employees, collaborator and external parties as part of the operation of the company.

2.3.3 Indigenous Peoples and Cultural Heritage

Risks identified	Mitigation(s) or preventative measure taken

[33] https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2014/lei/l12986.htm

[34] https://treaties.un.org/Pages/ViewDetails.aspx?chapter=4&clang=_en&mtdsg_no=IV-4&src=IND

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

No risk identified.	There are no IPs nor any sites of cultural heritage in the area of influence of the Catanduva landfill. There are no cultural heritages to be preserved and/or protected consistent with indigenous people practices and/or UNESCO Cultural Heritage conventions as part of the project design, its implementation and its so far occurred continuous operation. An Environmental Impact Assessment (EIA) was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.

2.3.4 Property Rights

Risks identified	Mitigation or preventative measure(s) taken
No risk identified.	There are no legal or customary tenure/access rights to territories, property or resources involving the Catanduva landfill nor the proposed VCS project activity.

2.3.5 Benefit Sharing

Process used to design the benefit sharing plan	The project does not impact property rights. There are no people that were relocated and/or had to be compensated due to the implementation and operation of the proposed VCS project activity. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.
Summary of the benefit sharing plan	The project does not impact property rights. There are no people that were relocated and/or had to be compensated due to the implementation and operation of the proposed VCS project activity.

	An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.
Approval and dissemination of benefit sharing plan	The project does not impact property rights. There are no people that were relocated and/or had to be compensated due to the implementation and operation of the proposed VCS project activity. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.

2.4 Ecosystem Health

	Risks identified	Mitigation or preventative measure(s) taken
Impacts on biodiversity and ecosystems	No risk identified.	An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information. As demonstrated in the EIA Report for the construction of the Catanduva 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. The proposed VCS project activity does not contribute in any manner to soil degradation and soil erosion by converting natural non-degraded

		ecosystems or drain or degrade the hydrological functions of a natural, non-degraded ecosystem.
Soil degradation and soil erosion	No risk identified.	The impact of the project on erosion or soil degradation 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 soil degradation. The proposed VCS project activity does not contribute in any manner to soil degradation and soil erosion by converting natural non-degraded ecosystems or drain or degrade the hydrological functions of a natural, non-degraded ecosystem.
Water consumption and stress	No risk identified.	The project does not affect water consumption and stress and does not contribute in any manner to degrade the hydrological functions of a natural, non-degraded ecosystem. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information

2.4.1 Rare, Threatened, and Endangered Species

Is the project located in or adjacent to habitats for rare, threatened, or endangered species?

☐ Yes ☒ No

Species and habitat	There is no habitat adversely affected by the proposed VCS project activity since it is not located in areas in or adjacent to habitats for rare, threatened, or endangered species.

	An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.
Areas needed for habitat connectivity	There are no areas needed for habitat connectivity affected by the proposed VCS project activity since it is not located in areas in or adjacent to habitats for rare, threatened, or endangered species. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.

	Risks identified	Mitigation or preventative measure(s) taken
Habitats for rare, threatened, and endangered species	No risk identified.	There is no habitat adversely affected by the proposed VCS project activity since it is not located in areas in or adjacent to habitats for rare, threatened, or endangered species. The project proponent implemented security measures like fences and physical barriers to prevent wildlife from entering, thereby reducing the risk of unwanted interactions between the Catanduva landfill and wildlife. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.

Areas for habitat connectivity	No risk identified.	There are no areas needed for habitat connectivity affected by the proposed VCS project activity since it is not located in areas in or adjacent to habitats for rare, threatened, or endangered species. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.

2.4.2 Introduction of Species

The proposed VCS project activity does not involve introduction of species and it does not promote any impact towards existing species.

Species introduced	Classification	Justification for use	Adverse effects and mitigation
N/A.			

Existing invasive species	Mitigation measures to prevent the spread or continued existence of invasive species
N/A.	

	Risks identified	Mitigation or preventative measure(s) taken

Invasive species	No risk identified.	The proposed VCS project activity does not involve the any risk related to invasive species. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information

2.4.3 Ecosystem Conversion

	Risks identified	Mitigation or preventative measure(s) taken
Ecosystem conversion	No risk identified.	The proposed VCS project activity does not involve ecosystem conversion and it does not promote any impact in existing ecosystems. An EIA was previously undertaken as part of the process to obtain the environmental license/permit for both the Catanduva landfill and for all infrastructure encompassed by the proposed VCS project activity. The content of the EIA report confirms the above-mentioned information.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Type (methodology, tool or module).	Reference ID, if applicable	Title	Version
CDM Baseline and monitoring Methodology	ACM0001	Flaring or use of Landfill Gas	19.0
CDM methodological tool	Tool 04	Emissions from solid waste disposal sites	08.1
CDM methodological tool	Tool 05	Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation	03.0
CDM methodological tool	Tool 06	Project emissions from flaring	04.0
CDM methodological tool	Tool 08	Tool to determine the mass flow of a greenhouse gas in a gaseous stream	03.0
CDM methodological tool	Tool 07	Tool to calculate the emission factor for an electricity system	07.0
CDM methodological tool	Tool 32	Positive list of technologies	04.0

3.2 Applicability of Methodology

Methodology ID	Applicability condition	Justification of compliance
ACM0001 - Flaring or use of Landfill Gas (version 19.0)	*"The methodology is applicable under the following conditions:*	The project design encompasses the installation of an active (forced) LFG

	(a) *Install a new LFG capture system in an existing or new (Greenfield) SWDS where no LFG capture system was or would have been installed prior to the implementation of the project activity; or* (b) *Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that:* (i) *The captured LFG was vented or flared and not used prior to the implementation of the project activity; and* (ii) *In the case of an existing active LFG capture system for which the amount of LFG cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project*	capture system partially replacing a previously existent conventional passive LFG combustion system (using conventional passive LFG venting/combustion drains)[36]. In this sense, condition (b – i) of the quoted applicability criteria is met. Under the pre-project situation (situation prior to the implementation of the proposed VCS project activity), were no pre-project active/forced LFG capture system that has been in operation at the Catanduva landfill The project design encompasses collection of LFG and its destruction/utilization through combustion in the high temperature open flare(s) and utilization of LFG as gaseous fuel for electricity generation in the engine-generator sets of the project's electricity generation infrastructure. Thus, the proposed VCS project activity also fully fulfills condition (c-i). As a result of the implementation of the

[36] The installed active (forced) LFG capture system as part of the project activity encompasses entirely new equipment (centrifugal blowers, flare, etc.). By assuming that the project activity replaces the previously existent pre-project passive LFG venting and combustion system (using conventional passive LFG venting/combustion drains), in the particular context of the demonstration of meeting of applicability criteria for the CDM baseline and monitoring methodology ACM0001 (version 19.0), it is assumed that condition (a) is not applicable and condition (b – i) is applicable.

	system: historical data on the amount of LFG capture and flared is available; *(c) Flare the LFG and/or use the captured LFG in any (combination) of the following ways:* *(i) Generating electricity;* *(ii) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace; and/or* *(iii) Supplying the LFG to consumers through a natural gas distribution network;* *(iv) Supplying compressed/liquefied LFG to consumers using trucks;* *(v) Supplying the LFG to consumers through a dedicated pipeline;* *(d) Do not reduce the amount of organic waste that would be recycled in the absence of the project activity."*	proposed VCS project activity, no quantitative, qualitative, procedural or regulatory change are expected to occur in terms of MSW management activities and policies valid for the Catanduva landfill and/or applicable in any other potential waste treatment or disposal facility under the area of influence of this particular landfill (that would be potentially promoted or triggered by the proposed VCS project activity) in comparison with what would occur in the absence of the proposed VCS project activity (baseline scenario). It is crucial to note that, mainly by taking into consideration the nature of the proposed VCS project activity and aspects related to recycling of organic fraction of MSW in the region of the Catanduva landfill and in the rest of the host-country Brazil, the implementation and operation of the proposed VCS project activity per se has not promoted or triggered (and is not expected to promote or trigger) any quantitative or qualitative change in waste disposal activities undertaken at this landfill site.

		Furthermore, no quantitative or qualitative changes in terms of waste management practices are expected to be promoted or triggered in any other existent or potentially new waste disposal or waste treatment facility(ies) (located or to be located in the region of influence of the Catanduva landfill) as a direct outcome or consequence of the implementation and starting of operation of the proposed VCS project activity. Thus, the implementation and starting of operations of the proposed VCS project activity does not promote or trigger (and are not expect 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 and/or reused in the region of influence of the Catanduva landfill (e.g. no prevention by the proposed VCS project activity of the implementation or and non-promotion of any reduction of activity in an eventually existent or hypothetical waste composting facility that would promote reuse/recycling of waste in the region (for example)).

		As demonstrated in the applicable construction, design and operational requirements valid for the Catanduva landfill, this particular landfill site is not expected to include any activity or initiative promoting relevant recycling or reuse of organic fraction of waste disposed at this landfill (i.e. such as implementation of a large-scale waste sorting or waste composting facility for example). Without any relevant organic waste recycling activity or initiative being under operation within the limits of the Catanduva landfill, it is thus clearly not expected that the implementation and starting of operations of the proposed VCS project activity could per se eventually reduce organic waste recycling activities in the Catanduva landfill and/or surrounding areas. It is imperative to note that overall design, construction and operational aspects for the Catanduva landfill were previously defined in accordance with the commercial agreements and common practice that the project proponent and project owner CGR Centro de

		Gerenciamento de Resíduos Ltda currently holds in the position of the current operator and owner of the Catanduva landfill and as regional waste management company (service provider) providing MSW disposal services. Furthermore, currently there is not even any existent or planned large-scale MSW sorting, recycling or utilization facility for organic fraction of MSW (e.g. a large-scale waste composting plant) with comparable size/capacity which is located (or is planned to be installed) in the region of influence of the Catanduva landfill either. As a matter of fact, recycling and reuse of organic fraction of MSW is still not being a common practice in the whole country of Brazil. In this sense, the occurred implementation and starting of operations of the proposed VCS project activity per se do not represent any perverse incentive or driver for the promotion of any supposed quantitative or qualitative reduction or prevention of waste recycling related activities (or initiatives for any type of organic fraction of solid waste or solid residues)

		that would occur in the region of influence of this landfill in the absence of the proposed VCS project activity[37]. The same is also applicable for recycling of inert waste material. Furthermore, regardless of the non-existence of any MSW recycling or utilization facility with comparable capacity that could eventually somehow compete with the Catanduva landfill as disposal site for organic fraction of MSW waste, aspects and actions related to promotion of recycling or utilization of organic fraction of solid waste are to be seen as fully dependent on regional and/or national public service policies in the case of Brazil (including policies, laws, regulations and programs) and such aspects and actions are to be defined/triggered by competent governmental authorities (under a regional and national level) and/or to be eventually implemented/operated by practitioners of waste recycling. In Brazil, the administrations of municipalities typically are

[37] Additional Information regarding the waste recycling scenario in Brazil are included in a Box in Section 3.4.

		the entities responsible for all MSW management services. In this context, waste management companies such as CGR Centro de Gerenciamento de Resíduos Ltda normally acts as service providers, providing MSW collection and disposal services as per directives and contractual requirements set by the municipalities from which generated MSW are to be managed (collected and disposed). In this sense, in the position of a MSW management company operating a LFG collection and destruction initiative in the landfill it operates and owns, CGR Centro de Gerenciamento de Resíduos Ltda. is not under a position to trigger, establish or promote any reduction or prevention of organic waste recycling in the region where it operates. Finally, the implementation of the proposed VCS project activity has not represented (and it is not expected to represent) any incentive or driver for involved municipalities, any other public entity or any other relevant recycling practitioner for the promotion of changes in policies and practices related to recycling of inert or

		organic solid waste in the region of influence of the Catanduva landfill (or even beyond such region). As outlined in Sections 3.4 and 3.7, so far, there are still no legal restrictions or requirements for LFG gas collection and its destruction using high temperature open flare and/or utilization in Brazil. Moreover, there are still no legal restrictions nor requirement for venting and/or combustion of LFG in conventional passive LFG destruction systems either. There are no applicable regulations that deal with LFG management in Brazil at all. Thus, the implementation of more appropriate and environmentally safe management of LFG at the Catanduva landfill (as a direct outcome of the implementation of the proposed VCS project activity) per se does not represent any driver or incentive to dispose incremental amount of MSW in the Catanduva landfill (when compared to the situation that would occur in the absence of the proposed VCS project activity) either. In this sense, under no circumstance, the proposed VCS project activity per se

		potentially is expected to promote any displacement of volumes of organic waste stream from treatment/utilization being performed in an existent or hypothetical MSW recycling/utilization facilities (e.g. a MSW composting plant for example) in order to be disposed at the Catanduva landfill as a direct result of the implementation of the proposed VCS project activity. Therefore condition (d) is also satisfied.
ACM0001 - Flaring or use of Landfill Gas (version 19.0)	*"The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is* *(a) Atmospheric release of LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons; and* *(b) In the case that the LFG is used in the project activity for generating electricity and/or generating*	As further outlined in Section 3.4, the most plausible baseline scenario for methane emissions at the Catanduva landfill is the release (direct emission) of LFG from the SWDS directly into the atmosphere and through pre-project passive LFG venting drains (with no share of generated LFG being destroyed). The application of the procedure to identify the baseline scenario thus falls into (a). While the project design encompasses utilization of LFG as gaseous fuel for electricity generation, (b-i) is thus also applicable. While the proposed VCS project

		heat in a boiler, air heater, glass melting furnace or kiln; *(i) For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or* *(ii) For heat generation: that heat would be generated using fossil fuels in equipment located within the project boundary."* *(c) In the case of LFG supplied to the end-user(s) through natural gas distribution network, trucks or the dedicated pipeline, the baseline scenario is assumed to be displacement of natural gas.* *(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*	activity does not encompass heat generation, supply of LFG to the end-user(s) through natural gas distribution network, trucks or the dedicated pipeline, conditions (b-ii) and (c) are thus not applicable. While the Catanduva landfill does not represent a Greenfield SWDS, (d) is not applicable.

	SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons."	
ACM0001 - Flaring or use of Landfill Gas (version 19.0)	*"This methodology is not applicable:* *(a) In combination with other approved methodologies. For instance, ACM0001 cannot be used to claim emission reductions for the displacement of fossil fuels in a kiln or glass melting furnace, where the purpose of the CDM project activity is to implement energy efficiency measures at a kiln or glass melting furnace;* *(b) If the management of the SWDS in the project activity is deliberately changed in order to increase methane generation compared to the situation prior to the implementation of the project activity."*	Neither options (a) and/or (b) occur. The only GHG emission reductions claimed by the proposed VCS project activity are due to destruction of methane through combustion (in high temperature open flare and in internal combustion gas). After the implementation and starting of operations of the proposed VCS project activity, the landfill operator has continued (and is expected to continue) with MSW disposal activities at the Catanduva landfill as per its normal and previously planned/defined operation conditions and practices. MSW disposal practices and management at the Catanduva landfill have not changed (and are not expected to change) after the occurred implementation and starting of operations of the

		proposed VCS project activity[38]. The quoted applicability condition is thus satisfactory met.
Tool 06 – Project Emissions from flaring (version 04.0)	*"This tool provides procedures to calculate project emissions from flaring of a residual gas, where the component with the highest concentration is methane. The source of the residual gas is biogenic (e.g. landfill gas or biogas from wastewater treatment) or coal mine methane.* *(…)* *This tool provides procedures to calculate project emissions from flaring of a residual gas. The tool is applicable to enclosed or open flares and project participants should document in the CDM-PDD the type of flare used in the project activity.* *This tool is applicable to the flaring of flammable greenhouse gases where:* *(a) Methane is the component with the highest concentration in the*	LFG, whose component with the highest concentration is methane, is combusted by the project's methane destruction devices. The CDM baseline and monitoring methodology ACM0001 (version 19.0) requires that, as part of the determination of baseline emissions, project emissions from flaring are to be determined. LFG is a flammable gas generated from the anaerobic decomposition of organic waste material disposed in the Catanduva landfill. LFG is thus a gas from a biogenic source. Methane is the component with the highest concentration in LFG. No auxiliary fuel is required to make the flammability of LFG sufficiently enough to be combusted in the project's methane destruction devices.

[38] The operation of the Catanduva landfill in terms of disposal of MSW (practices of waste disposal, covering, levelling, compacting, leachate management, etc.) has not changed and is not expected to change as a consequence of the implementation and starting of operations of the VCS project activity. Thus, there is no valid action promoting increase in methane generation (like e.g. through addition of liquids, pre-treating waste, changing the shape of the landfill) that would be triggered or promoted by the implementation of the VCS project activity at the Catanduva landfill (when compared to the situation prior to its implementation).

	flammable residual gas; and *(b) The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).* *The tool is not applicable to the use of auxiliary fuels and therefore the residual gas must have sufficient flammable gas present to sustain combustion. For the case of an enclosed flare, there shall be operating specifications provided by the manufacturer of the flare.* *This methodological tool refers to the latest approved version of "TOOL08: Tool to determine the mass flow of a greenhouse gas in a gaseous stream".*	As demonstrated bellow, the applicability conditions for the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" are sufficiently met. Thus, the quoted applicability conditions defined in the CDM methodological tool are sufficiently met.
Tool 08 - 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 the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), this tool is applied as per the methodology for determining the mass flow of CH_4 which is sent to the project's methane destruction devices (flare(s) and engine-generator sets). The applicability condition of the CDM methodological tool is thus met.

Tool 05 - Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)	*"This tool provides procedures to estimate the baseline, project and/or leakage emissions associated with the consumption of electricity, and procedures to monitor the amount of electricity generated by the project power plant.* *(…)* *If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption:* *(a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer;* *(b) Scenario B: Electricity consumption from (an) off-grid fossil fuel*	As established by the CDM baseline and monitoring methodology ACM0001 (version 19.0), consumption of electricity by the proposed VCS project activity is to be accounted as project emissions. Electricity demand of the proposed VCS project activity is expected to be met through imports of grid-sourced electricity or electricity sourced by the project's electricity generation infrastructure (which uses LFG as fuel). Moreover, the project activity does not encompass any backup off-grid electricity generators (fuelled by fossil fuels). Thus, Scenario A of the tool is applicable. In summary, the quoted applicability criteria defined in the CDM methodological tool are sufficiently met.

	fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or *(c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid."*	
Tool 04 – Emissions from solid waste disposal sites (version 08.1)	*"This tool provides procedures to calculate baseline, project or leakage emissions of methane from solid waste disposed or*	The proposed VCS project activity mitigates methane emissions from a landfill. The applicability of the CDM methodological tool is thus

	prevented from disposal at a solid waste disposal site (SWDS)." *"The tool can be used to determine emissions for the following types of applications:* a) *Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. "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*	met. Application A in the CDM methodological tool is selected and applied in the context of calculations of ex-ante estimates of emission reductions to be achieved by the proposed VCS project activity as established by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0). *Thus, the quoted applicability criteria defined in the CDM methodological tool is sufficiently met.*

	captured from the SWDS); *b) Application B: The CDM project activity avoids or involves the disposal of waste at a SWDS. An example of this application of the tool is ACM0022, in which municipal solid waste (MSW) is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS. The methane is generated from waste disposed or avoided from disposal during the crediting period. In these cases, the tool can be applied for both ex-ante and ex post estimation of emissions. These project activities may apply the simplified approach detailed in 0 when calculating baseline emissions."*	
Tool 07 - Tool to calculate the emission factor for an electricity system (version 07.0)	*This methodological tool determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the "combined margin" emission*	Project emissions due to the consumption of grid-sourced electricity by the proposed VCS project activity and baseline emissions for electricity generation are both determined by applying

	factor (CM) of the electricity system. *(…)* *The CM is the result of a weighted average of two emission factors pertaining to the electricity system: the "operating margin" (OM) and the "build margin" (BM). The operating margin is the emission factor that refers to the group of existing power plants whose current electricity generation would be affected by the proposed CDM project activity. The build margin is the emission factor that refers to the group of prospective power plants whose construction and future operation would be affected by the proposed CDM project activity.* *(…)* *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).*	applicable guidance of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (of which the applied CDM baseline and monitoring methodology 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 project emissions in case where a project activity consumes electricity from the grid. The CO_2 emission factor for the electricity grid which sources electricity to the proposed VCS project activity is determined as the

	(…) *In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country."*	combined margin CO_2 emission factor[39]. The electricity grid (to which the proposed VCS project activity is connected) is not located partially or totally in an Annex I country. The relevant applicability conditions of the CDM methodological tool are thus fully met.
Tool 32 – Positive list of technologies (version 04.0)	*"This methodological tool contains lists of technologies and associated conditions that confer automatic additionality to CDM project activities and CDM PoAs that apply such technologies and meet specified conditions (hereinafter referred to as positive lists).* *The methodological tool specifies the validity, process for update and timelines for the update of the positive list (see appendix of this document).* *The use of this methodological tool is not mandatory for the project participants of a CDM project activity or CDM PoA for*	The applied CDM baseline and monitoring methodology ACM0001 (version 19.0) defines that project proponents for the proposed VCS project activity may apply the Simplified procedures (as described in section 5.3.1 of the referred methodology) for both the identification of baseline scenario and assessment and demonstration of additionality of the proposed VCS project activity. In this case, as also defined by ACM0001 (version 19.0), applicable guidance from the

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

	demonstrating their additionality. *This methodological tool shall be applied in conjunction with a small-scale or large-scale methodology which refers to this tool."*	CDM methodological tool "Positive lists of technologies" (version 4.0) is therefore directly applied for the identification of the baseline scenario. Among the technologies listed in the referred CDM methodological tool, the following is applicable to this project activity: *"Landfill gas recovery and its gainful use* *The project activities and PoAs at new or existing landfills (greenfield or brownfield) are deemed automatically additional, if it is demonstrated that prior to the occurred implementation of the project activities and PoAs the landfill gas (LFG) was only vented and/or flared (in the case of brownfield projects) or would have been only vented and/or flared (in the case of greenfield projects) but not utilized for energy generation, and that under the project activities and PoAs any*

		of the following conditions are met: *(a) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW;* *(b) The LFG is used to generate heat for internal or external consumption;* *(c) The LFG is flared."* While, as demonstrated in Sections 3.4 and 3.5, the above-summarized conditions are met by the proposed VCS project activity, the applicability conditions of the CDM methodological tools are thus confirmed as being met.

3.3 Project Boundary

The boundary for the proposed VCS project activity includes the landfill site where LFG (rich in methane) is captured and destroyed/utilized. Under conformance with applicable guidance from the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), the table below provides a summary of the delineation of greenhouse gases (GHG) and sources included and excluded from the project boundary:

Source		Gas	Included?	Justification/Explanation
Baseline	Emissions from decomposition	CO_2	No	CO2 emissions from decomposition of organic waste are not accounted since the CO_2 is also released under the project activity.

Source		Gas	Included?	Justification/Explanation
	of waste at the SWDS site	CH_4	Yes	The major source of GHG emissions in the baseline.
		N_2O	No	N_2O emissions are very small when compared to CH_4 emissions from SWDS (in tCO_2e). This is conservative.
		Other	No	No emissions from GHG other than CH_4 are considered in the context of determination of baseline emissions from waste decomposition at the SWDS site.
	Emissions from electricity generation	CO_2	Yes	Major emission source.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
		Other	No	No emissions from GHG other than CO_2 are considered in the context of determination of baseline emissions from electricity generation by the proposed VCS project activity.
Project	Emissions from consumption of grid-sourced electricity by the proposed VCS project activity	CO_2	Yes	May be an important/material emission source.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
		Other	No	No emissions from GHG other than CO_2 are considered in the context of determination of project emissions from consumption of grid-sourced electricity by the proposed VCS project activity
	Emissions from flaring[40]	CO_2	No	Excluded for simplification. Emissions are negligible.
		CH_4	Yes	May be an important emission source.

[40] 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).

Source		Gas	Included?	Justification/Explanation
		N_2O	No	Excluded for simplification. Emissions are negligible.
		Other	No	No emissions from GHG other than CO_2 are considered in the context of determination of project emissions from flaring

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

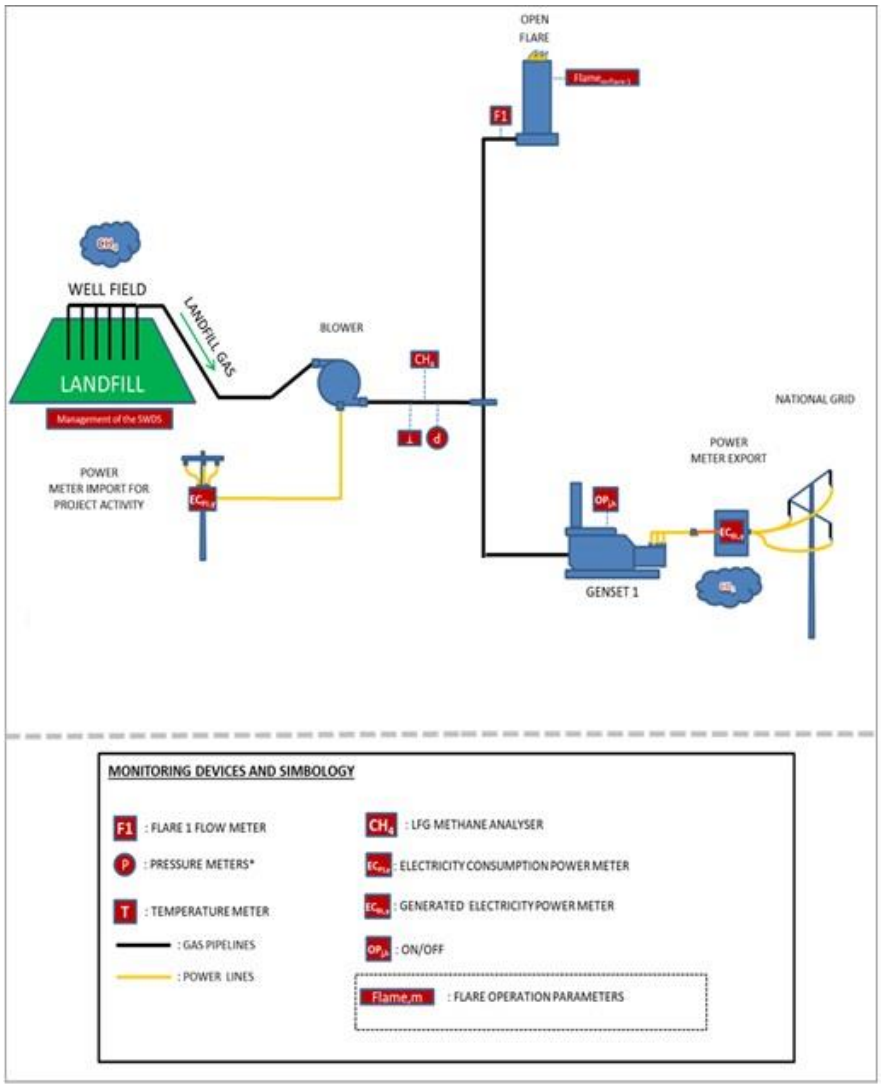

Figure 6 - Diagram summarizing the project boundary and delineating the proposed VCS project activity (equipment, parameters to be monitored, and GHG included in the project boundary).

3.4 Baseline Scenario

The applied CDM baseline and monitoring methodology ACM0001 – Flaring or use of landfill gas (version 19.0) defines that project proponents for the proposed VCS project activity may either apply the Simplified procedures (as described in section 5.3.1 of the referred methodology) or the provisions from the CDM methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" (as described in section 5.3.2 of the same methodology) for both the identification of its baseline scenario and assessment and demonstration of additionality of the proposed VCS project activity.

The project proponents decided to use the simplified procedures for this project activity. In this case, as also defined by ACM0001 (version 19.0), applicable guidance from the CDM methodological tool "Positive lists of technologies" (version 4.0) is therefore directly applied for the identification of the baseline scenario. Among the technologies listed in the referred CDM methodological tool, the following is applicable to this project activity:

> *"Landfill gas recovery and its gainful use*
>
> *The project activities and PoAs at new or existing landfills (greenfield or brownfield) are deemed automatically additional, if it is demonstrated that prior to the occurred implementation of the project activities and PoAs the landfill gas (LFG) was only vented and/or flared (in the case of brownfield projects) or would have been only vented and/or flared (in the case of greenfield projects) but not utilized for energy generation, and that under the project activities and PoAs any of the following conditions are met:*
>
> *(a) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW;*
>
> *(b) The LFG is used to generate heat for internal or external consumption;*
>
> *(c) The LFG is flared."*

In the particular case of the identification of baseline scenario + assessment and demonstration of additionality of the proposed VCS project activity, the following is too valid/applicable:

- Prior to the occurred implementation and starting of operations of the proposed VCS project activity, all generated LFG was vented (with no combustion of LFG occurring).
- The proposed VCS project activity encompass collection of LFG, flaring of collected LFG in a high temperature open flare and utilization of collected LFG as gaseous fuel for electricity generation (with the project's electricity generation infrastructure having total combined nameplate installed capacity below 10 MW).

Thus, the proposed VCS project activity fully meets the applicable requisites from both the CDM methodological tool "Positive lists of technologies" and the Simplified procedures (as described in section 5.3.1 of ACM0001 (version 19.0)) and the proposed VCS project activity is therefore automatically regarded as additional. Under such circumstance the following is automatically defined for the project VCS project activity in terms of definition of its baseline scenario:

In accordance with ACM0001 (version 19.0) paragraphs 21, 22 and 23 (which refer to the simplified procedure to identify baseline scenario of the methodological tool "Positive lists of technologies" (version 04.0)), the baseline scenario for methane emissions for the proposed VCS project activity is directly identified as the atmospheric release of generated LFG (with minor share of generated LFG, if applicable, being eventually or captured and combusted in order to comply with applicable regulatory or contractual requirements in order to address safety and odor concerns, or for other reasons). In the particular context of the proposed VCS project activity, as further demonstrated in Section 4.1 (determination of baseline emissions) under determination of calculation parameter $F_{CH4,BL,y}$, it is correctly assumed that in the absence of the proposed VCS project activity LFG would have been released/emitted into the atmosphere with no share of generated LFG being collected and destroyed in the absence of the proposed VCS project activity.

Furthermore, the baseline scenario for electricity generation for the proposed VCS project activity is directly identified as electricity generation (in the same amount as the amount generated by the proposed VCS project activity) occurring in existing electricity generation sources (including fossil fuel fired power plants) and addition of new power generation sources connected to the electricity grid the proposed VCS project activity is connected to (i.e. National Electricity Grid of Brazil)[41].

Box 1 – Additional Information regarding the waste recycling scenario in Brazil:

As per the Brazilian Federal Law 12.305/10 (passed in year 2010), waste recycling is defined as a process of transformation of waste material and residues through promotion of changes in their physical, chemical or biological properties in order to allow and promote use/utilization of such materials as raw material or even as new products. Although waste recycling is being regarded in the national sector directives for waste management as a priority goal in the whole country, solid waste recycling initiatives in Brazil are still being quite limited (especially in the case of organic fraction of MSW) mainly due to economic restrictions. As outlined in the publication "*Panorama dos Resíduos Sólidos no Brasil – 2020*" (title translated into English language as "*Outlook of Solid Waste Sector in Brazil – year 2020"* and available online at: https://abrelpe.org.br/panorama-2020/), solid waste recycling initiatives in Brazil have encompassed mainly the following by-products/waste types with higher economic value:

- aluminum (mainly beverage aluminum cans),

[41] In the particular context of the VCS project activity, besides the fact that no methane was combusted at the Catanduva landfill under the pre-project situation (prior to the occurred implementation and starting of operations of the VCS project activity), the following aspects related to the eventual existence of any requirement to destroy methane or existence of LFG capture and destruction system at the landfill under such pre-project scenario are relevant:

While it is demonstrated in Section 3.7 (in the context of the determination of calculation parameter ($F_{CH4,BL,y}$), that there are no requirement to destroy methane and there are no existing LFG capture and destruction system at the Catanduva landfill, it is confirmed/assumed that, like occurring prior to the occurred implementation and starting of operations of the VCS project activity, no LFG (rich in methane) would be required to be collected and combusted at the Catanduva landfill in any existent or new LFG capture and destruction system requirement (with none of such system confirmed as existent) in order to eventually address any requirement to destroy methane at the landfill of regulatory or other nature.

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

The "*Panorama dos Resíduos Sólidos no Brasil*" is a publication annually published by the Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais – ABRELPE (translated into English language as "Brazilian Association for Municipal Solid Waste and Special Waste") and has represented one of the most credible annual outlook and statistics source for the solid waste management in the country. The most recent Greenhouse Gases Emissions National Inventory (published by the Brazilian Ministry of Technology and Science in 2010 and available online at: http://www.mct.gov.br/upd_blob/0213/213909.pdf) also confirms that non-conventional MSW treatment alternatives (such as composting of organic fraction of MSW and waste incineration) are not meaningful practices in Brazil (including the region where the proposed VCS 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*" (title translated into English language as "Diagnostics of Urban Solid Waste Management - 2017" and available online at: http://www.snis.gov.br/diagnostico-residuos-solidos/diagnostico-rs-2017). Like the Report "*Panorama dos Resíduos Sólidos no Brasil – 2020*", this Government official publication also includes relevant and detailed statistics for MSW management for the main municipalities, States and regions in Brazil. Available statistics includes prevailing practices in terms of waste management practices (collection, disposal and re-use/recycle).

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

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

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

Thus, in the particular case of the Catanduva landfill, both under the baseline and project scenarios (with or without the implementation of the proposed VCS project activity), no organic fraction of solid waste stream that has been directed to this particular landfill would be expected to be collected and

directed to any type of recycling facility (e.g. composting facility) after or prior its disposal at the landfill site. This situation is expected to remain the practice in the future. In fact, as established by related construction and design documents for the Catanduva landfill, no waste pickers or waste sorting teams have ever operated in the landfill area. No composting plant for organic waste (or any other type of alternative management for MSW organic content) was ever implemented or is expected to be implemented in the area in the future either.

All of the above-summarized facts and aspects confirms that no relevant sorting and collection of recyclable organic material from MSW already disposed in the Catanduva landfill are expected to occur regardless of the implementation of the proposed VCS project activity (under both baseline and project scenarios). Thus, recycling or alternative reuse/utilization of organic fraction from waste already disposed in the landfill are not expected to occur either (regardless of the implementation of the proposed VCS 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 – 2020*" and also based on common practice for waste collection, currently existing very limited and not relevant recycling initiatives in the region of the proposed VCS 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 Catanduva landfill.:

- The current MSW management practice in Brazil (and its trend for the future) represents disposal of collected MSW in existing and new landfills (and still existing open dump sites). This practice currently represents almost all undertaken management for all stream of MSW which is actually collected (in mass basis); with very reduced share of collected MSW in Brazil being currently treated under non-conventional methods such as waste incineration (0.03%) and composting (0.11%) (in mass basis as per data of year 2019 (data organized and published in year 2021)).
- 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 landfill represents a very well designed and very well managed landfill. The main barrier for improving MSW management in Brazil is still being lack of capital and investment capacity from municipalities to face high associated costs for implementing environmentally friendly MSW management operations. Under the region of influence of the landfill, organic fraction of solid waste material that is collected as MSW has been historically disposed by applying landfilling techniques.
- In all geographical regions in Brazil, relative very low share of previously sorted pulp/paper/cardboard (clean and not contaminated) waste materials have been used as recycling material in the region. Materials under such conditions are termed in the available statistics as "dry recyclable material" and are normally not mixed with MSW stream to be sent to landfills or dump sites. It is important to note that the initiatives and businesses involving recycling of previously sorted dry pulp/paper/cardboard materials (clean and not contaminated materials) have their particular dynamics and characteristics and with not so detailed statistics in some cases. However, under no circumstance such activities are to be affected or even influenced by change, improvements or aspects related to MSW disposal activities employing good landfilling technics (for example: in most of the well managed landfills in Brazil, the landfill is implemented in a closed and

controlled area without waste pickers collecting waste from the landfill as a way or living). By taking into consideration the dynamics of initiatives promoting recycling of paper material, it is correct to assume that, differently than for MSW disposal activities; policies, planning and practices related to MSW collection and sorting could indeed under a certain limit play a role such initiatives.

- By merely promoting efficient collection and destruction/utilization of LFG in a landfill (where LFG is generated due to anaerobic degradation of organic fraction of MSW which is to be disposed in the landfill under the framework of contracts for MSW disposal signed with municipalities in the region), the implementation of the proposed VCS project activity and its continuous operation *per se* clearly are not expected to represent any driver or incentive for promoting any change in the MSW management situation in the region where it is implemented (including waste recycling practices or initiatives for organic content of MSW to be disposed in landfills or dump sites).

By taking into account (i) the institutional and regulatory framework for the public service of MSW management; (ii) the dynamics of MSW sector in the region where the proposed VCS 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 proponents CGR Centro de Gerenciamento de Resíduos Ltda. (as the current owner and operator of the Catanduva 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 proposed VCS 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. 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 proposed VCS project activity), the project proponent CGR Centro de Gerenciamento de Resíduos Ltda. 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 Catanduva landfill or at other location in the region.
- The implementation and operation of the project-based VCS initiative promoting collection of LFG and its destruction/utilization at the Catanduva landfill *per se* would not trigger any change in the regional policies and practices for MSW management in the region or outside its region of influence either. As further discussed in Sections 3.4 and 3.7, so far, there is still no legal restriction neither requirement for LFG gas collection and its destruction using high temperature open flare and/or its utilization in any other combustion or supply device in Brazil. Moreover, there is still no legal restriction neither requirement for passive venting of LFG or its

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

In summary, by taking into consideration the nature of project activity and all facts/aspects and information above presented, the proposed VCS 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.

3.5 Additionality

3.5.1 Regulatory Surplus

Is the project located in an UNFCCC Annex 1 or Non-Annex 1 country?

☐ Annex 1 country ☒ Non-Annex 1 country

Are the project activities mandated by any law, statute, or other regulatory framework?

☐ Yes ☒ No

If the project is located inside a Non-Annex 1 country and the project activities are mandated by a law, statute, or other regulatory framework, are such laws, statutes, or regulatory frameworks systematically enforced?

☐ Yes ☒ No

Regulatory surplus:

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

The Brazilian National Policy on Waste Management:

After years of studies and negotiations, the Brazilian Regulation termed National Policy on Waste Management, established by Decree No. 7,404/10 (the Decree) was finally published on 23/12/2010. In force since its publication and with no modifications/complementation since its issuance, this decree regulates the National Policy on Waste Management (PNRS) as established by Federal Law No. 12,305 (the LPNRS) and creates the Steering Committee for the Implementation of Reverse Logistics Systems (Steering Committee) and the PNRS Interministerial Committee. This 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."

Thus, the proposed VCS project activity by any law, statute or regulatory framework, as there are no local nor national requirement, obligation or recommendation for LFG management applicable to the Catanduva landfill.

3.5.2 Additionality Methods

The applied CDM baseline and monitoring methodology ACM0001 – Flaring or use of landfill gas (version 19.0) defines that project proponents for the proposed VCS project activity may either apply the Simplified procedures (as described in section 5.3.1 of the referred methodology) or the provisions from the CDM methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" (as described in section 5.3.2 of the same methodology) for both the identification of its baseline scenario and assessment and demonstration of additionality of the proposed VCS project activity.

The project proponents decided to use the simplified procedures for this project activity. In this case, as also defined by ACM0001 (version 19.0), applicable guidance from the CDM methodological tool "Positive lists of technologies" (version 4.0) is therefore directly applied for the identification of the baseline scenario. Among the technologies listed in the referred CDM methodological tool, the following is applicable to this project activity:

"Landfill gas recovery and its gainful use

The project activities and PoAs at new or existing landfills (greenfield or brownfield) are deemed automatically additional, if it is demonstrated that prior to the occurred implementation of the project activities and PoAs the landfill gas (LFG) was only vented and/or flared (in the case of brownfield projects) or would have been only vented and/or flared (in the case of greenfield projects) but not utilized for energy generation, and that under the project activities and PoAs any of the following conditions are met:

(a) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW;

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

(c) The LFG is flared."

In the particular case of the identification of baseline scenario + assessment and demonstration of additionality of the proposed VCS project activity, the following is to valid/applicable:

- Prior to the occurred implementation and starting of operations of the proposed VCS project activity, all generated LFG was vented (with no combustion of LFG occurring).
- The proposed VCS project activity encompass collection of LFG, flaring of collected LFG in high temperature open flare(s) and utilization of collected LFG as gaseous fuel for electricity generation (with the project's electricity generation infrastructure having total combined nameplate installed capacity below 10 MW).

Thus, the proposed VCS project activity fully meets the applicable requisites from both the CDM methodological TOOL32 ("Positive lists of technologies") and the Simplified procedures (as described in section 5.3.1 of ACM0001 (version 19.0)) and the proposed VCS project activity is therefore automatically regarded as additional.

3.6 Methodology Deviations

There are no deviations from the applied methodology.

4 QUANTIFICATION OF ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Under conformance with the applied CDM baseline and monitoring methodology ACM0001 (version 19.0) and applicable CDM methodological tools, emission reductions (ER_y) to be achieved by the proposed VCS project activity are determined (in tCO_2e) as the difference between baseline emissions (BE_y) and project emissions (PE_y).

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

(a) Baseline methane emissions from the SWDS[42] in the absence of the project activity

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

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

(d) Baseline emissions for natural gas use from existing natural gas network in the absence of the project activity

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

Where:

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

[42] As established by the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1), "SWDS" refers to Solid Waste Disposal Site.

While the VCS project activity promotes mitigation of CH_4 emissions, $BE_{CH4,y}$ is thus applicable in the context of the determination of baseline emissions. While Electricity generation using LFG as gaseous fuel is considered/regarded as an additional GHG abatement/mitigation measure for the VCS project activity, $BE_{EC,y}$ is thus applicable in the context of the determination of baseline emissions for the VCS project activity.

While no collected LFG is currently expected to be upgraded and supplied to consumer(s), $BE_{NG,y}$ is thus not applicable in the context of the determination of baseline emissions for the VCS project activity.

While no collected LFG is currently expected to be used as gaseous fuel for heat generation purposes, $BE_{HG,y}$ is thus not applicable in the context of the determination of baseline emissions for the VCS project activity.

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

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

Determination of baseline emissions of methane from the SWDS ($BE_{CH4,y}$):

Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) is calculated in conformance with the applied CDM baseline and monitoring methodology ACM0001 (version 19.0) + applicable CDM methodological tools respectively by following the approaches presented below, where the determination of $BE_{CH4,y}$ is based on the amount of methane that is actually captured and combusted as a result of the occurred implementation and starting of operation of the proposed VCS 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 proposed VCS 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)[43].

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

Where:

[43] As established by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), the ex-ante determined parameter $OX_{top\text{-}layer}$ is the fraction of the methane that would be oxidized in the top layer of the considered SWDS (i.e. the RAC Saneamento Ltda.) in the absence of the proposed VCS project activity (baseline scenario). As per ACM0001 (version 19.0), it is assumed that for a typical landfill hosting a LFG collection and destruction and/or utilization 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 a LFG capture system under the proposed VCS 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.

OX_{top_layer} Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline scenario (dimensionless)

$F_{CH4,PJ,y}$ Amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* (in tCH_4/yr)

$F_{CH4,BL,y}$ Amount of methane that would be destroyed through flaring of LFG in the baseline scenario (absence of project activity) in year *y* (in tCH_4/yr). Details for the determination of $F_{CH4,BL,y}$ is included below under "*Determination of $F_{CH4,BL,y}$*"

GWP_{CH4} Global warming potential of CH_4 (in tCO_2e/tCH_4)

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

As per the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), the amount of methane which is destroyed by the proposed VCS 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:

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

Where:

$F_{CH4,flared,y}$ Amount of methane which is destroyed through combustion of collected LFG in the flare(s) in year *y* (in tCH_4).

$F_{CH4,EL,y}$ Amount of methane which is destroyed through combustion of collected LFG in the internal combustion gas engines in year *y* (in tCH_4).

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

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

Since, as per the project design, there is no combustion of LFG for thermal application in heat generation devices and there is no supply of collected LFG to consumer(s) through gas distribution network and/or dedicated pipeline and/or to the trucks, the amount of methane which is destroyed by the VCS project activity through combustion of collected LFG in project's

methane destruction devices (high temperature open flare(s) and engine generator sets of the project's electricity generation infrastructure) is therefore to be ex-post determined as follows:

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

Determination of the amount of methane which is destroyed through combustion of collected LFG in the flare(s) ($F_{CH4,flared,y}$)[44]

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

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

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

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

$PE_{flare,y}$ Project emissions from flaring of the residual gas stream in year *y* (in tCO_2e/yr)

GWP_{CH4} Global warming potential of CH_4 (in tCO_2e/tCH_4)

For each individual high temperature open 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" (version 03.0). As per the ACM0001 (version 19.0), the following requirements apply for the determination of $F_{CH4,sent\_flare,y}$:

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

[44] The project proponent CGR Centro de Gerenciamento de Resíduos Ltda. acknowledges that more than 1 high temperature flare may eventually be temporarily or permanently installed and become under operation as part of the proposed VCS project activity *inter alia* in order to fully accommodate previously projected potential increases in the amount of LFG to be generated at the landfill site and projected potential increase of the amount of generated LFG to be collected as part of the operation of the project activity. This is in accordance with the possible future project design conceptualization (which may eventually consider, if required, gradual installation of additional flare(s) and other equipment (e.g. centrifugal blower(s)) within the project lifetime in order to eventually address forecasted increase in LFG to be flared as part of the operation of the VCS project activity).

Determination of the amount of methane in collected LFG which is used for electricity generation ($F_{CH4,EL,y}$)[45]:

$F_{CH4,EL,y}$ 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" (version 03.0), 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 set of the electricity generation facility.
- CH_4 is the greenhouse gas for which the mass flow is determined.
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in the tool).
- The mass flow should be calculated on a hourly basis for each hour *h* in year *y.*
- The mass flow calculated for hour *h* is 0 if the engine-generator set is not working in hour *h* ($Op_{j,h}$ = equipment not working), the accumulated hourly values are then summed to a yearly unit basis.

Applicable guidance of the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" will be applied to determine $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$ [46] by selecting option C of the tool as follows:

Option	Flow of gaseous stream	Volumetric fraction
C	Volume flow wet basis	Wet basis

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

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

with

[45] $F_{CH4,EL,y}$ is determined for each stream of collected LFG which is sent to each engine-generator sets 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" (version 03.0) and by applying requirements defined in ACM0001 (version 19.0).

[46] As per the CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0), the mass flow of greenhouse gas in a gaseous stream (which in the particular case of the proposed VCS project activity are the amount of methane in collected LFG which is sent to the flare(s) ($F_{CH4,sent\_flare,y}$), to the engine-generator sets ($F_{CH4,EL,y}$) is actually represented as $F_{i,t.}$

$$\rho_{i,n} = \frac{P_n * MM_i}{R_u * T_n} \quad (8)$$

Where:

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

$$V_{t,wb,n} = V_{t,wb} * (T_n / T_t) * (P_t / P_n) \quad (9)$$

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)

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" (version 04.0). Since a share of collected LFG is expected to be combusted in high temperature enclosed flares as a result of the operation of the proposed VCS project activity, $PE_{flare,y}$ is thus calculated as the sum of the related emissions for each individual flare (where project emissions from flaring from the flare, if applicable, are calculated separately (as established by the CDM methodological tool)).

For each individual 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 in question ($F_{CH4,RG,m}$). The flare efficiency will be determined for each minute *m* of year *y* based either on monitored data or default values.

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

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

- The CDM methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) shall be applied to the residual gas
- The flow of the gaseous stream shall be measured continuously
- CH_4 is the greenhouse gas *i* for which the mass flow should be determined
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool)
- 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 the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), the flare efficiency value is to be determined for each installed flare. Also, as per ACM0001 (version 19.0), flare efficiency represents the combustion efficiency of LFG in the flare in terms of CH_4 by considering *inter alia* the time and condition that the flare in question is operating.

For determining the combustion efficiency for the open flare in question, the flare efficiency in the minute m ($\eta_{flare,m}$) is 50% when the flame is detected in the minute m ($Flame_m$), otherwise $\eta_{flare,m}$ is 0% as referred in the CDM methodological tool "Project emissions from flaring" (version 04.0).

Step 3: Calculation of project emissions from flaring:

For each individual flare, project emissions from flaring are calculated as the sum of emissions for each minute *m* in year *y*, based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

$$PE_{flare,y} = GWP_{CH4} * \sum_{m=1}^{525,600} F_{CH4,RG,m} * \left(1 - \eta_{flare,m}\right) * 10^{-3} \quad (16)$$

Where:

$PE_{flare,y}$	Project emissions from flaring of the residual gas in year *y* (in tCO_2e)
GWP_{CH4}	Global warming potential of methane valid for the commitment period (in tCO_2e/tCH_4)
$F_{CH4,RG,m}$	Mass flow of methane in the residual gas in the minute *m* (in kg)
$\eta_{flare,m}$	Flare efficiency in minute *m*

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

Ex-ante estimates of $F_{CH4,PJ,y}$ is required to estimate methane baseline emissions from the Catanduva landfill in the context of annual estimates the emission reductions to be achieved by the proposed VCS project activity.

As established by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), $F_{CH4,PJ,y}$ is estimated as follows:

$$F_{CH4,PJ,y} = \eta_{PJ} * BE_{CH4,SWDS,y} / GWP_{CH4} \quad (17)$$

Where:

$BE_{CH4,SWDS,y}$	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (in tCO_2e)

η_{PJ} Efficiency of the LFG capture system installed as part of the proposed VCS project activity

GWP_{CH4} Global warming potential of CH_4 (in tCO_2e/tCH_4)

$BE_{CH4,SWDS,y}$ 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 proposed VCS project activity through combustion of collected LFG in project's methane destruction devices ($F_{CH4,PJ,y}$) during each year y, the calculation of $BE_{CH4,SWDS,y}$ is given by the following formula:

$$BE_{CH4,SWDS,y} = \varphi_y * (1 - f_y) * GWP_{CH4} * (1 - OX) * \frac{16}{12} * F * DOC_{f,y} * MCF_y * \sum_{x=1}^{y} \sum_{j} W_{j,x} * DOC_j * e^{-k_j*(y-x)} * (1 - e^{-k_j}) \quad (18)$$

Where:

$BE_{CH4,SWDS,y}$ Baseline methane emissions occurring in year *y* generated from waste disposal at a SWDS during a time period ending in year *y* (in tCO_2e / yr)

x Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (*x* = 1) to year *y* (*x* = *y*)

y Year of the crediting period for which methane emissions are calculated (*y* is a consecutive period of 12 months)

$DOC_{f,y}$ Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y* (weight fraction)

$W_{j,x}$ Amount of solid waste type *j* disposed or prevented from disposal in the SWDS in the year *x* (t)

φ_y Model correction factor to account for model uncertainties for year *y*. The default value (as per Option 1 of applicable guidance in the CDM methodological tool) is selected. Thus, $\varphi_y = \varphi_{default}$

f_y Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in

year *y*. f_y in the 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_{CH4}	Global Warming Potential of methane
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	Fraction of methane in the SWDS gas (volume fraction)
MCF_y	Methane correction factor for year *y*
DOC_j	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
k_j	Decay rate for the waste type *j* (1 / yr)
j	Type of residual waste or types of waste in the MSW

The value and source of information for each of the variables above are given in Section 5.1. 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). Since the design of the proposed VCS project activity is limited to the promotion of collection and destruction/utilization of LFG at the Catanduva landfill (without promoting any change in the management and operation of this particular landfill), the proposed VCS 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 in Section 5.1 is enclosed to this VCS PD.

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

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 proposed VCS project activity) at the Catanduva 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 proposed VCS 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 proposed VCS 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:

As previously detailed and demonstrated in Sections 3.4 and 3.5, currently there is no legal obligation to promote any kind of capture and/or combustion/destruction/utilization of LFG at the Catanduvas landfill [47].

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

The Brazilian National Policy on Waste Management:

After years of studies and negotiations, the Brazilian Regulation termed National Policy on Waste Management, established by Decree No. 7,404/10 (the Decree) was finally published on 23-December-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 (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. Decree No. 11,043/2022 (the Decree) was finally published in on 14-April-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*

Furthermore, this situation is currently not realistically expected to be changed during the time period to be encompassed by the 1st 7-year crediting period of the project VCS activity. 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.

Non-existence of non-regulatory and non-contractual requirements to destroy methane:

In the particular case of the Catanduva landfill, there is no requirement to destroy methane due to non-regulatory requirements (i.e., due to technical and/or operational requirements as due to safety and odor concerns).

As per the project design and licensing requirements applicable in the particular context of the Catanduva landfill, no LFG is required to be combusted in available LFG venting drains in order to address any kind of odors or safety concerns. The practice of direct venting of LFG through existing LFG venting drains (with no combustion) has been regarded as enough to prevent dangerous accumulation of LFG in the inner section of the landfill.

While as per the methodological approach of the applied CDM baseline and monitoring methodology ACM0001 (version 19.0) applicable for determination of $F_{CH4,BL,y}$, any combustion of LFG in order to address any kind of safety and/or odor concerns would be regarded as an existing requirement to destroy methane. It is thus assumed that, in the particular case of the Catanduva landfill, there is no non-regulatory requirement to destroy methane either.

By taking such assumptions into account, the following is thus valid/applicable for the Catanduva landfill in the absence of the proposed VCS project activity (baseline scenario) in the context of the application of related methodological guidance of ACM0001 (version 19.0):

- Requirement to destroy methane: NO

By taking this assumption into account, thus, Case 2 and Case 4 (which are options/cases associated to existence of requirement to destroy methane in the absence of the proposed VCS project activity) are directly regarded as not applicable for the determination of $F_{CH4,BL,y}$ in the particular case of the proposed VCS project activity (in the particular contexts of both its identification of baseline scenario and determination of baseline emissions).

Thus, the remaining possibly valid alternatives (cases) (after the analysis of existence of non-regulatory and/or non-contractual requirements to destroy methane due to safety and/or odor concerns) are thus Case 1 and Case 3.

Non-Existence of LFG capture and destruction system at the Catanduva landfill:

formalization of contracts between municipalities and collector associations, and the implementation of initiatives for recovering organic waste."

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

Under the baseline scenario (absence of the project), it is assumed that such practice would continue to exist at the Catanduva landfill site. Destruction of a very small and undefined share of generated methane would continue to occur in the absence of the project through the utilization of the previously existent conventional LFG venting/combustion drains (and through additional conventional LFG venting/combustion drains that would otherwise been implemented under the baseline scenario along the landfill lifetime as part of the forecasted expansion of the area of the landfill). It is thus assumed that all pre-project infrastructure encompassing the use of passive and conventional LFG venting/combustion drains would be kept/maintained in the absence of the project activity.

By taking into account the definitions of "*LFG capture system*" and "*existing LFG capture system*" as per ACM0001 (version 19.0) [48], it is thus assumed that there was an "existing LFG capture and destruction system" at the Catanduva landfill in the pre-project scenario (prior to the occurred implementation of the project activity). It is also assumed that such existing LFG capture and destruction system would also be existent along the baseline scenario (scenario in the absence of the project activity).

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

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

- Existing LFG capture and destruction system: Yes

[48] As per the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), "*LFG capture system*" is defined as follows:

> "*A system to capture LFG. The system may be passive, active or a combination of both active and passive components. Passive systems capture LFG by means of natural pressure, concentration, and density gradients. Active systems use mechanical equipment to capture LFG by providing pressure gradients. Captured LFG can be vented, flared or used.*"

As per ACM0001 (version 19.0), "*existing LFG capture system*" is defined as follows:

> "*An existing active LFG capture system is a system that has been in operation in the last calendar year prior to the start of the operation of the project activity.*"

Therefore, Case 1 (which is an option/case associated with the non-existence of LFG capture and destruction in the absence of the proposed VCS project activity) is regarded as a not applicable case for the determination of $F_{CH4,BL,y}$ in the context of both identification of baseline scenario and determination of baseline emissions for the proposed VCS project activity.

Thus, the only remaining possibly valid alternative (case) (after the analysis of Existence of LFG capture and destruction system at the Catanduva landfill) is Case 3.

In summary, the following is thus valid in the context of the application of the stepwise procedure for the determination of $F_{CH4,BL,y}$ for the proposed VCS project activity during its 1st crediting period:

- Requirement to destroy methane = NO
- 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 Catanduva landfill site and also as set by operational requirements for the landfill, in the absence of the project activity (baseline scenario), the set of pre-project rudimentary, passive and conventional LFG venting and combustion drains would remain being the only available infrastructure on-site to promote any type of management of LFG at the landfill (with LFG being assumed as being combusted at such drains (instead of venting of LFG) as a priority).

As per the design and construction of such conventional passive LFG venting/combustion drains, whenever the drains are not lid, LFG is just freely vented into the atmosphere (through the drains). In practical terms, only a very small fraction of total amount of LFG generated at the landfill have been actually combusted in the set of conventional LFG venting/combustion drains prior to the 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-today operational conditions at the Catanduva landfill prior to the occurred implementation of the project activity (where no working staff were ever been required to attempt to ensure continuous combustion of LFG in the drains and/or monitor the conditions/state of such drains (e.g. regular checking whether the drains are alight)), LFG has never been continuously combusted in such pre-project passive LFG venting/combustion drains prior to the occurred implementation and start of operation of the project activity. Thus, in the absence of the VCS 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 Catanduva landfill. It is also important to note that, as the owner and operator of the Catanduva landfill, CGR Centro de Gerenciamento de Resíduos Ltda. would not have any economic or operational incentive/motivation to convert the previously existing LFG venting/combustion drains into more

an appropriate LFG flaring system (passive or active) in the absence of the project activity (baseline scenario).

- It is also important to note that non-continuous and/or non-quantitatively relevant combustion of LFG through conventional LFG venting/combustion drains has been the practice not only at the Catanduva 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).

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

Application of methodological guidance valid for Case 3:

Under Case 3 of the methodological guidance for the determination of $F_{CH4,BL,y}$, the following is applicable as per ACM0001 (version 19.0):

$$F_{CH4,BL,y} = F_{CH4,BL,sys,y} \quad (19)$$

Where:

$F_{CH4,BL,sys,y}$	Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system (t CH_4/yr)

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

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

or

$$F_{CH4,BL,y} = 0.2 * F_{CH4,PJ,y} \quad (14)$$

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

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" (version 03.0).

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" (version 03.0) 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:

$$BE_{EC,y} = \sum_{j} EC_{BL,k,y} * EF_{EL,k,y} * (1 + TDL_{k,y}) \quad (20)$$

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 proposed VCS 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* ($TDL_{k,y}$ = $TDL_{grid,export,y}$)

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" (version 03.0), baseline emissions for electricity generation by the proposed VCS project activity ($BE_{EC,y}$), are determined as follows:

$$BE_{EC,grid,y} = EC_{BL,y} * EF_{EL,grid,y} * (1 + TDL_{grid,export,y}) \quad (21)$$

Where:

$EC_{PJ,grid,y}$ Baseline emissions associated with electricity generation (in tCO_2/yr).

$EF_{EL,grid,y}$ Emission factor for grid sourced electricity in year y (in tCO_2/MWh). $EF_{EL,grid,y}$ is determined as the combined margin (CM) emission factor ($EF_{grid,CM,y}$).

$TDL_{grid,export,y}$ Average technical transmission and distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the VCS 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" (version 03.0) is selected for determining $EF_{EL,k,,y}$. Thus, according to the selected option, the following is applicable:

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

The CDM methodological tool "Tool to calculate the emission factor for an electric system" (version 07.0) indicates that the emission factor of the electricity grid to which the proposed VCS project activity is to be connected is determined by the following 6-step approach:

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

The Combined margin CO_2 emissions factor is calculated in accordance with the CDM methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0). This CDM methodological tool determines the CO_2 emission factor for the displacement of electricity generated by grid-connected power plants, by calculating the combined margin emission factor ($EF_{CM,y}$) of the electricity system. As per the "Tool to calculate the emission factor for an electricity system" (version 07.0), $EF_{CM,y}$ is determined as a weighted average of two CO_2 emission factors pertaining to the electricity system:

- CO_2 operating margin emission factor ($EF_{OM,y}$)
- CO_2 build margin emission factor ($EF_{BM,y}$).

The operating margin emission factor refers to the group of existing power plants whose current electricity generation would be potentially affected by the proposed CDM project activity. The build margin emission factor refers to the group of prospective power plants whose construction and future operation would be potentially affected by the proposed CDM project activity.

The applicable procedures of CDM methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0) are described in the following steps:

- *Step 1. Identify the relevant electricity systems:*

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

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

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

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

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

(a) Simple OM; or

(b) Simple adjusted OM; or

(c) Dispatch data analysis OM; or

(d) Average OM.

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

Therefore, for the OM calculation method, the option (c) dispatch data analysis is preferred, since the Ministry of Science, Technology and Innovation of Brazil has been updated and published annually the information for power units[49].

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

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

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

The dispatch data analysis OM emission factor ($EF_{grid,OM\text{-}DDy}$) is determined based on the grid power units that are actually dispatched at the margin during each hour h where the project is

[49] The Ministry of Science, Technology and Innovation have been calculating the CO_2 emission factor according to the CDM methodology tool "Tool to calculate the emission factor for an electricity system" (version 07.0). The CO_2 emission factor was obtained in the Brazilian DNA website. Source of data used: Tool to calculate the emission factor for an electricity system (version 2.2.0 and more recent versions): The actual value has been calculated by Ministry of Science, Technology and Innovation (MCTI), Brazilian Designated National Authority (DNA). The Emission Factor will be monitored through ex-post calculation, following the latest version of Tool to calculate the emission factor for an electricity system. The Brazilian DNA calculated the value based on the Tool. The Combined Margin is calculated through a weighted-average formula, considering both the $EF_{grid,OM\text{-}DD,y}$ and the $EF_{grid,BM,y}$ and the weights w_{OM} and w_{BM} (default values of 0.25 and 0.75, respectively).

displacing grid electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of $EF_{grid,OM\text{-}DDy.}$, as the MCTI have been done.

The operating margin emission factor is calculated as follows:

$$EF_{grid,OM\text{-}DDy} = \frac{\sum EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}} \quad (22)$$

Where:

$EF_{grid,OM\text{-}DD,y}$	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 VCS-PD 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 1 is selected for the 1st 7-year crediting period of the proposed VCS 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 DNA of Brazil has regularly published an official value for $EF_{grid,BM,y}$ [50]. The latest published value (applicable for year 2023) is thus the value for the ex-ante selected parameter $EF_{grid,BM,y}$ and is calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum EG_{m,y} \cdot EF_{EL,m,y}}{\sum EG_{m,y}} \quad (23)$$

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).
$EG_{PJ,y}$	Total electricity displaced by the project activity in year *y* (in MWh).
M	Power units included in the build margin.
Y	Most recent historical year for which power generation data is available.

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

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM} \quad (24)$$

Where:

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

[50] Details about the determination of values for the CO_2 emission factor for the national electricity grid of Brazil by the DNA of Brazil (year 2023) are made available online in the website of the DNA of Brazil:

https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao

$EF_{grid,OM,y}$ Operating margin CO_2 emission factor in year *y* (tCO_2/MWh).

w_{OM} Weighting of operating margin emissions factor (%).

w_{BM} Weighting of build margin emissions factor (%).

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

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

While values for the parameters $EF_{grid,BM,y}$, w_{OM} and w_{BM} (which are applicable for the whole 1st 7-year crediting period) are selected ex-ante, annual values for $EF_{grid,OM,y}$ within the credting period will be determined ex-post as required by the CDM methodological tool "Tool to calculate the emission factor for an electric system". Thus, during the 1st 7-year crediting period of the proposed VCS project activity, the combined margin CO_2 emission factor will be calculated and updated annually.

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

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

Monitoring of the management of the landfill:

As required by the ACM0001 (version 19.0), the design and operational conditions of the Catanduva 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 Catanduva landfill site should be confirmed not to be modified 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 occurred implementation of the project activity. As required by the ACM0001 (version 19.0), any change in the management of the landfill after the occurred implementation of the project activity should be justified by referring to technical or regulatory specifications and impacts of such changes in the determination of baseline emissions should in this case be taken into account appropriately.

Such monitoring requirement will be used for the determination/confirmation of baseline emissions and/or confirmation of the project's occurred implementation as described in the VCS PD (in terms of operation and management conditions of the landfill from which LFG is destroyed/combusted). Further related monitoring details are included in Sections 5.2 and 5.3 (under parameter "Management of SWDS").

4.2 Project Emissions

Determination of Project Emissions (PE_y):

As established by ACM0001 (version 19.0), project emissions (PE_y) for a proposed VCS project activity promoting LFG collection and destruction/utilization are to be generically calculated (in tCO_2/year) as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} + PE_{SP,y} \quad (20)$$

Where:

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

Since the proposed VCS project activity does not encompasses supply of LFG to consumers through a dedicated pipeline, there are no project emissions from the supply of LFG to consumers

through a dedicated pipeline ($PE_{SP,y}$ = 0). Furthermore, while the proposed VCS project activity does not encompasses distribution of compressed/liquefied upgraded LFG by using trucks, there are no project emissions from the distribution of compressed/liquefied LFG using trucks ($PE_{DT,y}$) to be determined ex-post. Since no fossil fuel is to be consumed by the proposed VCS project activity, there will be no related project emissions either ($PE_{FC,y}$ = 0).

Therefore, the following equation is applicable for the particular case of the proposed VCS project activity:

$$PE_y = PE_{EC,y} \quad (21)$$

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

In the particular case of the project activity, since electricity generated by the backup captive off-grid electricity generator (fuelled by diesel) is the only source of electricity consumed by the project activity, $PE_{EC,y}$ is determined as follows:

$$PE_{EC,y} = PE_{EC,grid,y} \quad (22)$$

Where:

$PE_{EC,grid,y}$ Project emissions from consumption of grid electricity due to the project activity in year *y* (in tCO_2/yr). $PE_{EC,grid,y}$ 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" (version 03.0).

While the proposed VCS project activity fits under Scenario A *(Electricity consumption from the grid)* of this methodological tool, the following is also established by this 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:

"$EC_{PJ,j,y}$ in the tool is equivalent to the amount of electricity consumed by the project activity in year y ($EC_{PJ,y}$)."

In the particular case of the proposed VCS project activity, electricity sources *j* in the tool corresponds to the source of electricity consumed due to the project activity: grid-sourced electricity.

Electricity from the grid is expected to be consumed for the operation of the proposed VCS project activity. No external sources of electricity other than electricity from the grid is expected to be used to meet the project's electricity demand[51].

In the particular case of the proposed VCS project activity, while no electricity has been previously used in the pre-project-implementation (baseline scenario), the determination of the amount of electricity consumed in the baseline scenario (absence of the proposed VCS 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" (version 03.0), project emissions due to electricity consumption by the project activity ($PE_{EC,y}$) are generically calculated as follows:

$$PE_{EC,y} = \sum EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y}) \quad (23)$$

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 generation" (version 03.0) valid for Scenario A (Electricity consumption from the grid)); project emissions due to consumption of grid-sourced electricity by the project activity ($PE_{EC,grid,y}$) are determined as follows:

[51] The proposed VCS project activity may consume minor share of electricity generated by its electricity generation infrastructure as an alternative to consumption of grid-sourced electricity. Under such circumstance, such minor share of generated electricity is not accounted in the determination of baseline emissions due to generation of electricity, thus reducing baseline emissions proportionally and therefore not being considered in the determination of project emissions.

$$PE_{EC,grid,y} = EC_{PJ,grid,y} * EF_{ELj,y} * (1 + TDL_{j,y}) \quad (24)$$

Where:

$EC_{PJ,grid,y}$ Quantity of grid-sourced electricity consumed by the project activity in year y. As detailed in Sections 5.2 and 5.3, 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" (version 03.0).

$TDL_{j,y}$ Average technical transmission and distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the project activity. As detailed in Sections 5.2 and 5.3, the value for $TDL_{j,y}$ 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" (version 03.0).

$EF_{EL,j,y}$ CO_2 emission factor for grid-sourced electricity in year y (in tCO_2/MWh). $EF_{EL,j,y}$ is determined ex-post by following applicable guidance from Option A.1[52] of the CDM methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", where $EF_{EL,j,y}$ 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" (version 07.0) by following the approach summarized Section 4.1 under "*Determination of the combined margin (CM) emission factor ($EF_{grid,CM,y}$ = $EF_{EL,k,y}$)".*

4.3 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).

4.4 Estimated GHG Emission Reductions and Carbon Dioxide Removals

[52] While applying option A.1 as per the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0), $EF_{EL,j,y}$ will be determined ex-post as the CO_2 Combined Margin emission factor for the National Electricity Grid of Brazil ($EF_{grid,CM,y}$). Applicable value(s) will be alternatively determined as the applicable conservative default value(s) as per option A.2 of the same CDM methodological tool which are selected ex-ante. The selection of the calculation approach for the determination of $EF_{EL,j,y}$ (option A.1 and/or A.2) will be done on an ex-post basis during periodic verifications of the proposed VCS project activity within its 1st 7-year renewable crediting period and will take into account whether required data for the determination of the CO_2 Combined Margin emission factor for the National Electricity Grid of Brazil or related calculation results will be made available.

While emission reductions to be achieved by the proposed VCS project activity (ER_y) are determined as the difference between baseline emissions (BE_y) and project emissions (PE_y)[53], the following relevant equations and conditions are applied for the ex-ante estimation of emission reductions to be achieved by the proposed VCS project activity during the period:

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

While the VCS project activity encompasses (i) methane destruction (as its most quantitatively relevant unique GHG abatement measure) and (ii) displacement of grid-sourced electricity (by electricity generated by the project's electricity generation infrastructure); by following the applicable methodological approaches and taking into account assumptions + ex-ante determined values for applicable monitoring parameters (as presented in Sections 4.1 and 5.1 respectively), baseline emissions (BE_y) are thus determined as follows:

$$BE_y = BE_{CH4,y} + BE_{EC,y} \quad (31)$$

Where:

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

$BE_{EC,y}$ Baseline emissions for electricity generation (tCO_2/yr)

Determination of $BE_{CH4,y}$:

$BE_{CH4,y}$ is estimated as follows:

$$BE_{CH4,y} = ((1 - OX_{top\_layer}) * F_{CH4,PJ,y} - F_{CH4,BL,y}) * GWP_{CH4} \quad (32)$$

Where:

OX_{top_layer} Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline. OX_{top_layer} is ex-ante determined as 0.1. Further details about the ex-ante value determination for OX_{top_layer} are made available in Section 5.1.

$F_{CH4,BL,y}$ Amount of methane that would have been captured and destroyed in the baseline scenario (absence of the CDM project activity). As outlined in Section 4.1, $F_{CH4,BL,y} = 20\% * F_{CH4,PJ,y}$.

[53] $ER_y = BE_y - PE_y$

Where:

ERy Emission reductions in year y (in tCO_2e/yr)

BE_y Baseline emissions in year *y* (in tCO_2e/yr)

PE_y Project emissions in year *y* (in tCO_2e/yr)

GWP_{CH4} Global warming potential of CH_4 ($tCO_2e/t\ CH_4$). GWP_{CH4} is ex-ante determined as 28. Further details about the ex-ante value determination for GWP_{CH4} are made available in Section 5.1.

$F_{CH4,PJ,y}$ Amount of methane in the LFG which is combusted in the project's methane destruction devices in year y (tCH_4/yr). In the particular context of the ex-ante estimation of emission reductions to be achieved by the proposed VCS project activity, as established by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), $F_{CH4,PJ,y}$ is determined (in tCH_4/year) as follows:

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

$$F_{CH4,PJ,y} = \eta_{PJ} * BE_{CH4,SWDS,y} / GWP_{CH4} \quad (33)$$

Where:

η_{PJ} Efficiency of the LFG capture system that will be installed as part of the proposed VCS project activity. η_{PJ} is ex-ante determined as 0.9280 or 92.80%. Further details about the ex-ante value determination for η_{PJ} are made available in Section 5.1.

GWP_{CH4} Global warming potential of CH_4 ($tCO_2e/t\ CH_4$). GWP_{CH4} is ex-ante determined as 28. Further details about the ex-ante value determination for GWP_{CH4} are made available in Section 5.1.

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

$$BE_{CH4,SWDS,y} = \varphi_y * (1 - f_y) * GWP_{CH4} * (1 - OX) * \frac{16}{12} * F * DOC_{f,y} * MCF_y * \sum_{x=1}^{y} \sum_{j} W_{j,x} * DOC_j * e^{-k_j * (y-x)} * (1 - e^{-k_j}) \quad (34)$$

For the determination of estimates of $BE_{CH4,SWDS,y}$, the ex-ante determined values for all parameters in the formulae above as well as historical and forecasts of MSW disposal at the Catanduva landfill are applied. Details about such ex-ante determined parameters are made available in Section 5.1.

An emisison reduction calculation spreadsheet is enclosed to this VCS PD. This calculation spreadsheet includes all required related calculations for the ex-ante estimation of $BE_{CH4,y}$ for the 1st 7-year crediting period of the proposed VCS PD.

Determination of $BE_{EC,y}$:

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

$$BE_{EC,y} = EC_{BL,y} * EF_{EL,grid,y} * (1 + TDL_{k,y}) \quad (35)$$

Where:

$EC_{BL,y}$ Net amount of electricity generated using LFG in year *y* (in MWh). In the particular context of ex-ante estimates of emission reductions to be achieved by the proposed VCS project activity within its 7-year renewable crediting period, annual values for $EC_{BL,y}$ are estimated as is estimated as follows:

Year	$EC_{BL,y}$ (MWh)
2023	6,225
2024	10,618
2025	21,236
2026	21,236
2027	21,236
2028	21,236
2029	21,236
2030	8,785

Note: The values applicable for years 2023 and 2030 are valid for the fractions of these years which are encompassed by the 1st crediting period: from 01-June-2023 to 31-December-2023 and from 01-January-2030 to 31-May-2030.

$TDL_{k,y}$ Average technical transmission and distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the project activity. In the particular context of ex-ante estimates of emission reductions to be achieved by the proposed VCS project activity, $TDL_{k,y}$ is ex-ante estimated as being 3% ($TDL_{grid,export,y}$). Selected value represents the applicable conservative default value as per the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0).

$EF_{EL,k,y}$ 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 proposed VCS project activity, $EF_{EL,k,y}$ is estimated as per guidance for scenario A.1 of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0). The following is applicable:

By following procedure and guidance described in Section 3.7, the combined margin CO_2 emission factor ($EF_{grid,CM,y}$) for the elecricity grid of Brazil (SIN grid) is estimated as follows:

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

Where:

w_{OM} Weighting of operating margin emissions factor. w_{OM} is ex-ante determined as 50% (0.50). See Section 5.1 for further details.

w_{BM} Weighting of build margin emissions factor. w_{BM} is ex-ante determined as 50% (0.50). See Section 5.1 for further details.

$EF_{grid,BM,y}$ Build margin CO_2 emission factor in year y. $EF_{grid,BM,y}$ is ex-ante estimated as 0.0467 tCO_2/MWh. Selected value represents the annual average value applicable for year 2023 (the latest published by the DNA of Brazil). Thus, in the particular case of the proposed VCS project activity, $EF_{grid,BM,y} = EF_{grid,BM,2023}$[54].

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

Operational Margin CO_2 emission factor (dispatch analysis calculation method ($EF_{grid,OM-DD,y}$):

In the particular context of ex-ante estimations of emission reductions to be achieved by the proposed VCS project activity, the adopted value for $EF_{grid,OM-DD,y}$ is the value published by the DNA of as being the calculated value which is valid for year 2024 (the latest year for which values are available):

Operating Margin Emission Factor of Brazilian Integrated Electric System for year 2024 (dispatch analysis calculation method)

[54] Details about the determination of the CO_2 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://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao

Operating Margin Emission Factor ($EF_{grid,OM,y}$) (in tCO_2/MWh) – year 2024	
January	0.4164
February	0.3750
March	0.2779
April	0.1946
May	0.2834
June	0.3648
July	0.5503
August	0.6015
September	0.6054
October	0.6477
November	0.5524
December	0.4978

The average value of $EF_{grid,OM-DD,2024}$ is thus calculated as 0.4473 tCO_2/MWh. Values of $EF_{grid,OM-DD,2024}$ are determined and reported by the DNA of Brazil. Further details are available online at the website of the DNA of Brazil.

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

$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y} = 0.50 * 0.4473 + 0.50 * 0.0467 = 0.2470\ tCO_2/MWh$ (where related calculations are summarized in the emission reduction calculation spreadsheet enclosed to this VCS PD).

It is important to note that, as a simplification (only in the particular context of the ex-ante estimation of baseline emissions to be promoted by the proposed VCS project activity, it is assumed that the calculated combined margin grid emission factor ($EF_{grid,CM,y}$) (based on the value of $EF_{grid,OM-DD,2024}$ (valid for year 2024) and the value of $EF_{grid,BM,2023}$) is used for the

determination of ex-ante estimates of emission reductions for all years encompassed by the 1st 7-year crediting period of the proposed VCS project activity (regardless of the fact that annual values for $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ are to be ex-post determined every year, thus potentially later 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 VCS rules[55].

Information related to the determination of the combined margin CO_2 emission factor for the national electricity grid of Brazil is made available on the website/web portal of the CDM's DNA of Brazil[56].

An emission reduction calculation spreadsheet is enclosed to this VCS PD. This calculation spreadsheet includes all required related calculations for the ex-ante estimation of $BE_{CH4,y}$ and $BE_{EC,y}$ for the 1st 7-year crediting period of the VCS PD.

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

[55] In the context of ex-ante estimations of baseline emissions due to consumption of grid electricity by the proposed VCS project activity, it is reasonable to consider as a simplification that significant changes in the average and marginal CO_2 intensity for electricity generated at the national electricity grid of Brazil are not expected to occur during the 1st 7-year crediting period of the VCS project activity due to the following reason:

- As per official domestic electricity generation related information published by the Brazilian Government, "*The system keeps the predominance of renewable and non-greenhouse gases emitting sources, amounting up to 80% of total capacity. The need of additional power capacity to cope with net peak load appears from 2022 onwards, totaling about 13,200 MW in 2027, which could be provided by storage technologies or flexible thermal power plants*". (https://www.epe.gov.br/en/press-room/news/pde-2027-the-ten-year-energy-expansion-plan-2027).

  Thus, no significant/relevant changes in the average and marginal CO_2 intensity of electricity generation in Brazil is expected to occur by considering the high predominance of use of renewable energy sources for the generation of grid sourced electricity in Brazil in recent years.

- Although the project participant acknowledges that, in the particular case of Brazil, calculated annual values for the CO_2 Combined Margin emission factor for the National Electricity Grid of Brazil is somehow heavy influenced by unpredictable aspects such as rain patterns, level of dams in large hydropower plants, capacity factors for non-conventional renewable energy generation facilities (e.g. wind and biomass power plants, etc.), the above-quoted information represents, under a certain limit, a credible reasons for assuming a fixed value for $EF_{grid,CM}$ in the context of the ex-ante estimations of emission reductions to be achieved by the VCS project activity during its 1st 7-year crediting period.

- Regardless of the assumption of a fixed value for $EF_{grid,CM}$ in the context of the ex-ante estimations of emission reductions to be achieved by the VCS project activity during the 1st 7-year crediting period (only in the context of ex-ante estimation of emission reductions), as highlighted in Section 3.7, the CO_2 combined emission factor for the national electricity grid of Brazil will be annually calculated ex-post.

- The ex-ante estimated values for annual project emissions due to consumption of grid electricity represent (in nominal terms) a very low fraction of estimated total annual emission reductions to be achieved by the VCS project activity.

[56] Calculation of CO_2 emission factor for the National Electricity Grid of Brazil: Data source is available online: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao

BE_y	Estimation of $BE_{CH4,y}$ (tCO_2e)	Estimation of $BE_{EC,y}$ (tCO_2e)	Estimation of baseline emissions (tCO_2e)
Year	$BE_{CH4,y} = [(1-OX_{top\_layer}) * F_{CH4,PJ,y} - F_{CH4,BL,y}]* GWP_{CH4}$	$BE_{EC,y} = EC_{BL,y} * EF_{grid,CM,y} * (1+TDL_{grid,export,y})$	$BE_y = BE_{CH4,y} + BE_{EC,y}$
2023	55,414	1,583	56,997
2024	97,751	2,701	100,452
2025	100,735	5,402	106,137
2026	103,524	5,402	108,926
2027	106,157	5,402	111,559
2028	108,665	5,402	114,067
2029	111,068	5,402	116,470
2030	46,906	2,234	49,140
Total	**730,220**	**33,528**	**763,748**

Note: All values applicable for years 2023 and 2030 are valid for the fractions of these years which are encompassed by the 1st crediting period: from 01-June-2023 to 31-December-2023 and from 01-January-2030 to 31-May-2030, respectively.

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

Project emissions to be considered in the context of the determination of emission reductions to be achieved by the proposed VCS project activity are those due to the consumption of grid-sourced electricity. The related ex-ante estimations of the corresponding project emissions are determined as follows:

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

By following the applicable methodological approaches and assumptions + ex-ante determined values, $PE_{EC,grid,y}$ is determined as follows:

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

Where:

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

$EC_{PJ,grid,y}$ Quantity of grid sourced electricity consumed by the project activity in year *y* (in MWh). $EC_{PJ,grid,y}$ is estimated as being 219 MWh per year. Further details are included in Section 5.3. This value is assumed based on the expected nominal power output for the main electrical equipment to be installed as part of the proposed VCS project activity under its final configuration (e.g installed centrifugal blowers + ancillary equipment) and also by assuming that such equipment will work continuously (24 hours a day) under full power during the whole 1st 7-year crediting period of the proposed VCS project activity[57].

$TDL_{grid,y}$ Average technical transmission and/or distribution losses for grid sourced electricity consumed by the project activity in year *y*. For the particular case of estimates of $PE_{EC,grid,y}$, $TDL_{j,y}$ is selected as 20%. Further details are included in Section 5.1.

$EF_{EL,grid,y}$ CO_2 emission factor for grid-sourced electricity in year y (in tCO_2/MWh). In the particular context of ex-ante estimates of emission reductions to be achieved by the proposed VCS project activity, $EF_{EL,grid,y}$ is estimated as per guidance for scenario A.1 of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0). The following is applicable:

The combined margin CO_2 emission factor ($EF_{grid,CM,y}$) for the electricity grid of Brazil (SIN grid) is estimated as follows:

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

Where:

w_{OM} Weighting of operating margin emissions factor. w_{OM} is ex-ante determined as 50% (0.50). See Section 5.1 for further details.

[57] It is important to note that additional power consuming equipment (e.g. additional centrifugal blowers) may be eventually installed as part of the VCS project activity in order to accommodate projected increment in the quantity of LFG to be collected and destroyed by the VCS project activity. In this sense, the conservative approach hereby assumed for estimating $EC_{PJ,grid,y}$ during the 1st 7-year crediting period of the VCS project activity (equipment continuously operating under full power) is appropriate (and under a certain level incorporates an increase in grid electricity consumption by the project activity that may occur).

w_{BM} Weighting of build margin emissions factor. w_{BM} is ex-ante determined as 50% (0.50). See Section 5.1 for further details.

$EF_{grid,BM,y}$ Build margin CO_2 emission factor in year y. In the particular context of ex-ante estimates of emission reductions to be achieved by the proposed VCS project activity, $EF_{grid,BM,y}$ is ex-ante estimated as 0.0467 tCO_2/MWh. Selected value represents the annual average value applicable for year 2023 (as determined and published by the DNA of Brazil). Thus, in the particular case of the proposed VCS project activity, $EF_{grid,BM,y}$ = $EF_{grid,BM,2023}$[58].

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

Operational Margin CO_2 emission factor (dispatch analysis calculation method ($EF_{grid,OM\text{-}DD,y}$):

In the particular context of ex-ante estimations of emission reductions to be achieved by the proposed VCS project activity, the adopted value for $EF_{grid,OM\text{-}DD,y}$ is the value published by the DNA of as being the calculated value which is valid for year 2024 (the latest year for which values are available):

Operating Margin Emission Factor of Brazilian Integrated Electric System for year 2024 (dispatch analysis calculation method)

Operating Margin Emission Factor ($EF_{grid,OM,y}$) (in tCO_2/MWh) – year 2024	
January	0.4164
February	0.3750
March	0.2779
April	0.1946
May	0.2834

[58] Details about the determination of the CO_2 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://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao

June	0.3648
July	0.5503
August	0.6015
September	0.6054
October	0.6477
November	0.5524
December	0.4978

The average value of $EF_{grid,0M\text{-}DD,2024}$ is thus calculated as 0.4473 tCO_2/MWh. Values of $EF_{grid,0M\text{-}DD,2024}$ are determined and reported by the DNA of Brazil. Further details are available online at the website of the DNA of Brazil.

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

$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y} = 0.50 * 0.4473 + 0.50 * 0.0467 = 0.2470\ tCO_2/MWh$ (where related calculations are summarized in the emission reduction calculation spreadsheet enclosed to this VCS PD).

It is important to note that, as a simplification (only in the particular context of the ex-ante estimation of project emissions to be promoted by the proposed VCS project activity, it is assumed that the calculated combined margin grid emission factor ($EF_{grid,CM,y}$) (based on the value of $EF_{grid,0M\text{-}DD,2024}$ (valid for year 2024) and the value of $EF_{grid,BM,2023}$) is used for the determination of ex-ante estimates of emission reductions for all years encompassed by the 1st 7-year crediting period of the proposed VCS project activity (regardless of the fact that annual values for $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ are to be ex-post determined every year, thus potentially later 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 VCS rules[59].

Information related to the determination of the combined margin CO_2 emission factor for the national electricity grid of Brazil is made available on the website/web portal of the CDM's DNA of Brazil[60].

In summary, ex-ante estimations of total project emissions for the proposed VCS project activity during its 1st 7-year crediting period are thus summarized as follows:

PE_y	Electricity consumed from the grid (MWh)	Project emissions due to electricity consumption (tCO_2e)	Total Project emissions promoted the proposed VCS project activity - PE_y (tCO_2e)
Year	$EC_{PJ,grid,y}$	$PE_{EC,y} = (EC_{PJ,grid,y} * EF_{grid,CM,y} * (1+TDL_{grid,import,y}))$	$PE_y = PE_{EC,y}$

[59] In the context of ex-ante estimations of project emissions due to consumption of grid electricity by the proposed VCS project activity, it is reasonable to consider as a simplification that significant changes in the average and marginal CO_2 intensity for electricity generated at the national electricity grid of Brazil are not expected to occur during the 1st 7-year crediting period of the VCS project activity due to the following reason:

- As per official domestic electricity generation related information published by the Brazilian Government, "*The system keeps the predominance of renewable and non-greenhouse gases emitting sources, amounting up to 80% of total capacity. The need of additional power capacity to cope with net peak load appears from 2022 onwards, totaling about 13,200 MW in 2027, which could be provided by storage technologies or flexible thermal power plants*". (https://www.epe.gov.br/en/press-room/news/pde-2027-the-ten-year-energy-expansion-plan-2027).

  Thus, no significant/relevant changes in the average and marginal CO_2 intensity of electricity generation in Brazil is expected to occur by considering the high predominance of use of renewable energy sources for the generation of grid sourced electricity in Brazil in recent years.

- Although the project participant acknowledges that, in the particular case of Brazil, calculated annual values for the CO_2 Combined Margin emission factor for the National Electricity Grid of Brazil is somehow heavy influenced by unpredictable aspects such as rain patterns, level of dams in large hydropower plants, capacity factors for non-conventional renewable energy generation facilities (e.g. wind and biomass power plants, etc.), the above-quoted information represents, under a certain limit, a credible reasons for assuming a fixed value for $EF_{grid,CM}$ in the context of the ex-ante estimations of emission reductions to be achieved by the VCS project activity during its 1st 7-year crediting period.

- Regardless of the assumption of a fixed value for $EF_{grid,CM}$ in the context of the ex-ante estimations of emission reductions to be achieved by the VCS project activity during the 1st 7-year crediting period (only in the context of ex-ante estimation of emission reductions), as highlighted in Section 3.7, the CO_2 combined emission factor for the national electricity grid of Brazil will be annually calculated ex-post.

- The ex-ante estimated values for annual project emissions due to consumption of grid electricity represent (in nominal terms) a very low fraction of estimated total annual emission reductions to be achieved by the VCS project activity.

[60] Calculation of CO_2 emission factor for the National Electricity Grid of Brazil: Data source is available online: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao

2023	128	39	39
2024	219	65	65
2025	219	65	65
2026	219	65	65
2027	219	65	65
2028	219	65	65
2029	219	65	65
2030	91	27	27
Total	**1,533**	**456**	**456**

Note: All values applicable for years 2023 and 2030 are valid for the fractions of these years which are encompassed by the 1st crediting period: from 01-June-2023 to 31-December-2023 and from 01-January-2030 to 31-May-2030, 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 proposed VCS project activity along its 1st 7-year crediting period are summarized as follows:

Vintage period	Estimated baseline emissions (tCO_2e)	Estimated project emissions (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated reduction VCUs (tCO_2e)	Estimated removal VCUs (tCO_2e)	Estimated total VCUs (tCO_2e)
01-June-2023 to 31-December-2023	56,997	39	0	56,958	0	56,958
01-January-2024 to 31-December-2024	100,452	65	0	100,387	0	100,387
01-January-2025 to 31-December-2025	106,137	65	0	106,072	0	106,072
01-January-2026 to 31-December-2026	108,926	65	0	108,861	0	108,861
01-January-2027 to 31-December-2027	111,559	65	0	111,494	0	111,494
01-January-2028 to 31-December-2028	114,067	65	0	114,002	0	114,002
01-January-2029 to 01-September-2029	116,470	65	0	116,405	0	116,405

01-January-2030 to 31-May-2030	49,140	27	0	49,113	0	49,113
Total	**763,748**	**456**	**0**	**763,292**	**0**	**763,292**

Details about all ex-ante determined parameters which are used for the ex-ante estimations of emissions reductions are included in the previous section. An emission reduction calculation spreadsheet with all related calculations for the ex-ante estimations of emission reductions to be achieved by the proposed VCS project activity during its 1st crediting period is enclosed to this VCS PD.

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	**$OX_{top\ layer}$**
Data unit	Dimensionless
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Consistent with how oxidation is accounted for in the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1)
Value applied	0.1
Justification of choice of data or description of measurement methods and procedures applied	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
Comments	-

Data / Parameter	**GWP_{CH4}**
Data unit	tCO_2e/tCH_4
Description	Global warming potential of CH_4
Source of data	In accordance with EB69, Annex 3 and decision 4/CMP.7, Available at: http://cdm.unfccc.int/Reference/Standards/meth/reg_stan02.pdf 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 The applied values are also in accordance with the currently applicable guidelines from VCS for the selection and application of the global warming potential to proposed VCS project activities
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	η_{PJ}
Data unit	Dimensionless
Description	Efficiency of the LFG capture system that will be installed in the proposed VCS project activity
Source of data	Value obtained from technical literature
Value applied	0.9280
Justification of choice of data or description of	Technical literature-based value [61] with design and operational characteristics/aspects of the Catanduva landfill and considered

[61] 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

measurement methods and procedures applied	construction (design, planned layout) and operational characteristics for the implementation of project's LFG collection network being taken into consideration[62].
Purpose of Data	Calculation of baseline emissions
Comments	Selected value can also be represented as percentage, since 0.9280 = 92.80%

Data / Parameter	R_u
Data unit	$Pa.m^3/kmol.K$
Description	Universal ideal gases 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)
Value applied	8,314
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions.
Comments	-

efficiency of 75% based on surveys of industry estimates is commonly used, for example, by the United States Environmental Protection Agency (US EPA). Though few, actual emission measurements indicate substantially higher efficiencies ranging from 85 to 98%."

This document also mentions *"(...) landfill gas collection efficiencies should routinely reach 100%."*

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

The paper "*Measuring landfill gas collection efficiency using surface methane concentration"* is available at https://archives.bape.gouv.qc.ca/sections/mandats/LET-Lachenaie/documents/DB23.pdf

[62] Assumptions for the potential LFG collection efficiency of the 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 more than 15 years of experience and expertise of technicians from UniCarbo Energia e Biogás Ltda. (the CDM consultancy/advisory service providing company in charge of completion of this VCS PD) in design and implementation of LFG collection and destruction/utilization project-based initiatives in different landfill sites in Brazil.

Data / Parameter	MM_i
Data unit	kg/kmol
Description	Molecular mass of greenhouse gas *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 applied	The following values of molecular mass are applicable for CH_4 (the only GHG which is considered): Compound: Methane; Structure: CH_4; Molecular mass (kg/kmol): 16.04
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	MM_k
Data unit	kg/kmol
Description	Molecular mass of gas *k*
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 applied	For considered gases *k* 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" (version 03.0) the following is applicable for the particular case of the proposed VCS project activity: *"The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (k) in the considered gaseous stream. However, as a simplification, only the volumetric fraction of gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. The simplification is not acceptable if it is differently specified in the underlying methodology."* ACM0001 (version 19.0) does not include any restriction to such simplification. Thus, only the volumetric fraction of gases that are greenhouse gases and are considered in related calculations (CH_4 in the particular case of the proposed VCS project activity) and the difference to 100% is just considered as pure nitrogen.

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

Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	**MM_{H2O}**

Data 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 applied	18.0152
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	P_n
Data unit	Pa
Description	Total pressure 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 applied	101,325
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	T_n
Data 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 applied	273.15
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$\Phi_{default}$
Data unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	Default value applicable for determination of baseline emissions as per the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1). Value applicable for both humid/wet or dry conditions as per Application A of the tool.
Value applied	0.75

Justification of choice of data or description of measurement methods and procedures applied	Determined based on default value of table 3 of the referred CDM methodological tool as per Option 1, Application A.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	OX
Data unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Applicable default value as per the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1)
Value applied	0.1
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	F
Data 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 applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	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
Comments	-

Data / Parameter	$DOC_{f,default}$
Data unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	Applicable default value as per the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1), which refers to applicable value as per IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	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): *"The CDM project activity mitigates methane emissions from a specific existing SWDS"* [63].
Purpose of Data	Calculation of baseline emissions
Comments	Application A of the CDM methodological tool "Emissions from solid waste disposal sites" (version 08.1) is the applicable case of the proposed VCS project activity.

Data / Parameter	$MCF_{default}$
Data 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 applied	1.0
Justification of choice of data or description of measurement methods and procedures applied	Value is selected as per Application A of the CDM methodological tool, under the following conditions: *"1.0: for anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste"* The day-to-day MSW disposal activities at the Catanduva landfill encompasses utilization of appropriate MSW landfilling practices

[63] In the particular case of the proposed VCS project activity, the statement is to be interpreted as follows:

"The proposed VCS project activity mitigates methane emissions from a specific existing SWDS", where the existing SWDS is the Catanduva landfill.

	(covering, leveling and mechanical compacting of disposed material, etc.) as part of the operation of this landfill. The Catanduva landfill is regarded as a well-managed landfill site.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	DOC_j
Data unit	-
Description	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
Source of data	Values are selected as per applicable guidance of the 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"[64].
Value applied	

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	15

[64] 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).

	(other than sludge)	
	Textiles	24
	Garden, yard and park waste	20
	Glass, plastic, metal, other inert waste	0
Justification of choice of data or description of measurement methods and procedures applied	The selected values are based on wet waste basis (moisture concentrations in the waste streams as waste is delivered to the SWDS). The IPCC 2006 Guidelines also specifies DOC values on a dry waste basis, which refers to the moisture concentrations after complete removal of all moisture from the waste. However, this selection is not practical for the situation/practice at the Catanduva landfill.	
Purpose of Data	Calculation of baseline emissions	
Comments	-	

Data / Parameter	k_j
Data unit	1/yr
Description	Decay rate for the waste type *j*
Source of data	Values are selected as per applicable guidance of the 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 applied	**Degradation speed**	**Waste type**	**k_j**
	Slowly degrading	Wood, wood products, rubber and leather	0.035

		Pulp, paper and cardboard (other than sludge), textiles	0.07
	Moderately Degrading	other (non-food) organic putrescible Garden, yard and park waste	0.17
	Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.4

Justification of choice of data or description of measurement methods and procedures applied	Parameters are selected in accordance with the climate zone valid for the project site: Mean Annual Temperature (MAT) = 20.5 °C Mean Annual Precipitation (MAP) = 1,492 mm – (wet climate). Aridity index (MAP/PET) = 1 Source of data for mean annual temperature (MAT), mean annual precipitation (MAP) and aridity index: INMET – Instituto Nacional de Meteorologia do Brasil Normais Climatológicas (1991 – 2020) - Precipitação acumulada mensal e anual (mm). INMET – Instituto Nacional de Meteorologia do Brasil Normais Climatológicas (1991 – 2020) - Temperatura média compensada mensal e anual (°C). https://www.confluvio.com/attributes/global-aridity-index
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	W_j
Data unit	-

<table>
<tr><td>Description</td><td>Weight fraction of the waste type j</td></tr>
<tr><td>Source of data</td><td>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.</td></tr>
<tr><td>Value applied</td><td>
<table>
<tr><th>Waste type j</th><th>W_j (% wet waste)</th></tr>
<tr><td>Wood and wood products</td><td>0.0</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>
</td></tr>
<tr><td>Justification of choice of data or description of measurement methods and procedures applied</td><td>-</td></tr>
<tr><td>Purpose of Data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Comments</td><td>No composition analysis for MSW disposed at the Catanduva landfill is currently available.</td></tr>
</table>

Data / Parameter	$EF_{EL,grid,y}$
Data 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" (version 03.0) (by following option A.2 of the underlying methodological tool).
Value applied	1.3 (for consumption of grid-sourced electricity by the project activity) 0.25 (for electricity exported by the project activity through the electricity grid)
Justification of choice of data or description of measurement methods and procedures applied	Data is determined as per applicable guidance from Option A2 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 baseline emissions and project emissions
Comments	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.

Data / Parameter	W_{BM}
Data 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 applied	0.50 (50%) during the 1st 7-year crediting period
Justification of choice of data or description of measurement methods and procedures applied	The applicable value for the 1st crediting period of a VCS project activity 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 and baseline emissions.
Comments	-

Data / Parameter	w_{OM}
Data 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" (version 07.0)
Value applied	0.50 (50%) during the 1st 7-year crediting period
Justification of choice of data or description of measurement methods and procedures applied	The applicable value for the 1st crediting period of a VCS project activity as per the CDM methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0) is selected.
Purpose of Data	Data is used for determination of project emissions due to the consumption of electricity by the proposed VCS project activity.
Comments	Calculation of project emissions and baseline emissions.

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO_2/MWh
Description	Build margin CO_2 emission factor in year *y*
Source of data	Data is determined as per applicable guidance of the CDM methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0).
Value applied	0.0467

Justification of choice of data or description of measurement methods and procedures applied	The selected value considered for all years encompassed by the 7-year crediting period of the proposed VCS project activity in the context of the ex-ante estimation of emission reductions represents the value calculated by the DNA of Brazil and valid for year 2023 (the most recent annual value available). Data is made available online: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

5.2 Data and Parameters Monitored

Data / Parameter	**Management of SWDS**
Data unit	Dimensionless
Description	Management of the SWDS
Source of data	Monitoring performed by the project participants and/or appointed 3rd party. The design and operational conditions of the solid waste disposal site (SWDS) (Catanduva landfill) will be annually monitored on the basis of different sources, including *inter alia*: - 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.
Description of measurement methods and procedures to be applied	Original construction and operational design of the Catanduva 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 proposed VCS project activity. As

	required by the applied CDM baseline and monitoring methodology ACM0001 (version 19.0), any change in the management of the Catanduva landfill after the implementation of the proposed VCS project activity should be justified by referring to technical or regulatory specifications.
Frequency of monitoring/recording	Annually
Value applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the proposed VCS project activity.
Monitoring equipment	No equipment/instrument is expected to be used to monitor the data/parameter.
QA/QC procedures to be applied	Not applicable.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	$V_{t,wb,j}$
Data 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 proponent. Measured as part of the operation of the proposed VCS project activity by applying appropriate LFG flow meters.
Description of measurement methods and procedures to be applied	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.
Frequency of monitoring/recording	Continuous measurements will be recorded and reported with an every-minute frequency.

Value applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the proposed VCS project activity.
Monitoring equipment	Measurements/monitoring performed by the project proponent. Measured as part of the operation of the proposed VCS project activity by applying appropriate LFG flow meters.
QA/QC procedures to be applied	Periodic calibration events for the LFG flow meters will be performed by using a reference primary device provided by a third party independent accredited calibration laboratory. Calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	

Data / Parameter	$V_{CH4,t,wb,j}$
Data 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 participants. Measured as part of the operation of the proposed VCS project activity by applying an appropriate continuous CH_4 content gas analyzer.

Description of measurement methods and procedures to be applied	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.
Frequency of monitoring/recording	Continuous measurements will be recorded and reported with an every-minute frequency.
Value applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the proposed VCS project activity.
Monitoring equipment	Measurements/monitoring performed by the project participants. Measured as part of the operation of the proposed VCS project activity by applying an appropriate continuous CH_4 content gas analyzer.
QA/QC procedures to be applied	Periodic calibration events in the continuous CH_4 content gas analyzer(s) will be performed by utilization of calibration span gas with certified CH_4 content (for span checking/adjustment). Utilization of an inert calibration gas (e.g. N_2) will also occur (for span checking/adjustment). All calibration gases (span gases) must have a certificate provided by the gas supplier and must be under their validity period. Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	This parameter will be monitored in case Option C of the "Tool to determine the mass flow of a greenhouse gas in a gaseous

	stream" (version 03.0) is applied for the determination of $F_{CH4,flared,y}$ and/or $F_{CH4,EL,y}$. 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" (version 03.0) are applied instead.

Data / Parameter	T_t
Data unit	K[65]
Description	Temperature of the LFG stream in time interval *t*
Source of data	Measurements/monitoring performed by the project proponent. Measured as part of the operation of the proposed VCS project activity by applying appropriate LFG temperature sensor(s).
Description of measurement methods and procedures to be applied	Measured to determine the density of methane ρ_{CH4}. No separate monitoring of LFG temperature is necessary when using LFG flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters (by considering standard temperature and pressure (STP) conditions). Instruments with recordable electronic signal (analogical or digital) are required.
Frequency of monitoring/recording	Continuous measurements will be recorded and reported with an every-minute frequency.
Value applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the proposed VCS project activity.
Monitoring equipment	Measurements/monitoring performed by the project proponent. Measured as part of the operation of the proposed VCS project activity by applying appropriate LFG temperature sensor(s). Instruments with recordable electronic signal (analogical or digital) are required.

[65] 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 to be applied	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 to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	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. Under this circumstance, this parameter shall be monitored continuously to assure the applicability condition is indeed met.

Data / Parameter	P_t
Data unit	Pa[66]
Description	Pressure of the LFG stream in time interval *t*
Source of data	Measurements/monitoring performed by the project proponent. Measured as part of the operation of the proposed VCS project activity by applying appropriate LFG pressure sensor(s).
Description of measurement methods and procedures to be applied	Measured to determine the density of methane ρ_{CH4}. No separate monitoring of LFG pressure is necessary when using LFG flow meters that automatically measure temperature and pressure,

[66] 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).

	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.
Frequency of monitoring/recording	Continuous measurements will be recorded and reported with an every-minute frequency.
Value applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the proposed VCS project activity.
Monitoring equipment	Measurements/monitoring performed by the project proponent. Measured as part of the operation of the proposed VCS project activity by applying appropriate LFG pressure sensor(s). Instruments with recordable electronic signal (analogical or digital) are required.
QA/QC procedures to be applied	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 to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	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	$EC_{PJ,grid,y}$

Data unit	MWh
Description	Amount of grid electricity consumed by the project activity during the year *y*
Source of data	Measured as part of the operation of the proposed VCS project activity by applying appropriate electricity meter(s).
Description of measurement methods and procedures to be applied	Authorized electricity meter(s) may be used. Measurement records will be cross-checked against available electricity consumption receipts/invoices (e.g. issued by the local electricity distribution company, if applicable). The parameter $EC_{PJ,y}$ is equivalent to the parameter $EG_{EC,y}$ as indicated in the CDM baseline and monitoring methodology ACM0001 (version 19.0).
Frequency of monitoring/recording	Continuous measurements will be aggregated automatically. Accumulated measurement records will be reported at least once a month.
Value applied	It is estimated that the proposed VCS project activity will consume 219 MWh of grid-sourced electricity per year. In the context of the ex-ante estimation of emission reductions to be achieved by the proposed VCS project activity, it is considered that the project's electricity demand will be met entirely by imports of grid-sourced electricity.
Monitoring equipment	Authorized electricity meter(s) may be used. Measurement records will be cross-checked against available electricity consumption receipts/invoices (e.g., issued by the local electricity distribution company, if applicable).
QA/QC procedures to be applied	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 project emissions*
Calculation method	-
Comments	The value considered in the context of the ex-ante estimation of emission reductions was selected based on the probable nameplate power output for the centrifugal blowers to be installed as part of the proposed VCS project activity. Centrifugal blowers are the most electricity intensive equipment to be installed as part of the proposed VCS project activity. Also, as a conservative assumption, it is considered that the proposed VCS project activity will operate 24 hours a day during its lifetime. Measurement records will be cross-checked against available receipts/invoices/reports for imports and/or purchase of grid-sourced electricity.

Data / Parameter	$EC_{BL,y}$
Data 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 proposed VCS project activity by applying appropriate electricity meter(s).
Description of measurement methods and procedures to be applied	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). In the particular case of share of electricity generated which is exported to the electricity grid, measurement records will be cross-checked against available electricity sales receipts/invoices issued by the local electricity commercialization/distribution company, If applicable.

<table>
<tr><td>Frequency of monitoring/recording</td><td>Continuous measurements will be aggregated automatically. Accumulated measurement records will be reported at least once a month.</td></tr>
<tr><td>Value applied</td><td>It is estimated that the proposed VCS project activity will generate the following amounts of electricity during the years encompassed by the 1st crediting period:

<table>
<tr><th>Year / period</th><th>Estimated annual electricity generated by the project activity (in MWh)</th></tr>
<tr><td>From 01-June-2023 to 31-December-2023</td><td>6,225</td></tr>
<tr><td>From 01-January-2024 to 31-December-2024</td><td>10,618</td></tr>
<tr><td>From 01-January-2025 to 31-December-2025</td><td>21,236</td></tr>
<tr><td>From 01-January-2026 to 31-December-2026</td><td>21,236</td></tr>
<tr><td>From 01-January-2027 to 31-December-2027</td><td>21,236</td></tr>
<tr><td>From 01-January-2028 to 31-December-2028</td><td>21,236</td></tr>
<tr><td>From 01-January-2029 to 31-December-2029</td><td>21,236</td></tr>
<tr><td>From 01-January-2030 to 31-May-2030</td><td>8,785</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Authorized electricity meter(s) may be used.</td></tr>
</table>

QA/QC procedures to be applied	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. 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
Calculation method	-
Comments	-

Data / Parameter	$EF_{grid,OM,y} = EF_{grid,OM\text{-}DD,y}$
Data unit	tCO_2/MWh
Description	Operation margin CO_2 emission factor in year *y* = Dispatch data analysis operating margin CO_2 emission factor in year *y*.
Source of data	Data will be determined as per applicable guidance for dispatch data analysis operating margin CO_2 emission factor as per Option A.1 of the CDM methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0).
Description of measurement methods and procedures to be applied	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" (version 07.0).

Frequency of monitoring/recording	Yearly
Value applied	0.4473 The selected value considered for all years encompassed by the 7-year crediting period of the proposed VCS project activity in the context of the ex-ante estimation of emission reductions represents the value calculated by the DNA of Brazil and valid for year 2024 (the most recent annual value available). Data is made available online: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao
Monitoring equipment	-
QA/QC procedures to be applied	Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed in accordance with detailed working instructions.
Purpose of data	Calculation of baseline emissions and project emissions
Calculation method	-
Comments	-

Data / Parameter	$Op_{j,h}$
Data 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 proposed VCS project activity.

Description of measurement methods and procedures to be applied	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 VCS PD; (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
Frequency of monitoring/recording	Hourly.
Value applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the proposed VCS project activity.
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions
Calculation method	-

Comments	In the particular case of the proposed VCS project activity the only equipment/infrastructure that promotes utilization of LFG are the engine-generator sets of the electricity generation infrastructure.

Data / Parameter	$Flame_m$
Data unit	Flame status "*on*" or flame status "*off*"
Description	Flame detection of flare in the minute *m*
Source of data	Measurements/monitoring for each operational flare performed by the project proponent. 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.
Description of measurement methods and procedures to be applied	Measure for each operational flare using a fixed installation optical flame detector: Ultraviolet detector or Infra-red or both.
Frequency of monitoring/recording	Once per minute.
Value applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the proposed VCS project activity.
Monitoring equipment	Measure for each operational flare using a fixed installation optical flame detector: Ultraviolet detector or Infra-red or both.
QA/QC procedures to be applied	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations.
Purpose of data	Calculation of baseline emissions
Calculation method	-

Comments	Applicable to the flare. The condition will be regularly monitored for the individual high temperature open flare. Periodic calibration events will be performed in the instruments by a third party independent accredited calibration laboratory in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance with appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.

Data / Parameter	$TDL_{grid,y}$
Data unit	-
Description	Average technical transmission and distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the proposed VCS 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" (version 03.0) or use of recent, accurate and reliable data available within the host country.
Description of measurement methods and procedures to be applied	The CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0) 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 proposed VCS project activity) and default value of 3% for baseline electricity consumption sources

	(applicable for the determination of baseline emissions for electricity generation by the proposed VCS 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 proposed VCS project activity and for electricity generation by the proposed VCS project activity (equivalent to electricity consumption of baseline electricity consumption sources when applying the underlaying tool) do not fit under Scenario B and/or Scenario C 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 Scenario A of the CDM methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0) (whichever of these scenarios are applicable for the particular case of the proposed VCS project activity).
Frequency of monitoring/recording	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
Value 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 ($TDL_{grid,import,y}$))
Monitoring equipment	-
QA/QC procedures to be applied	Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed in accordance with detailed working instructions.

Purpose of data	Calculation of baseline emissions and project emissions.
Calculation method	-
Comments	-

Data / Parameter	**Status of biogas destruction device(s)**
Data unit	-
Description	Operational status of biogas destruction device(s)
Source of data	Not applicable.
Description of measurement methods and procedures to be applied	Monitoring and documenting may be undertaken through monitoring of the operation status of the flare(s) and the engine-generators set of the project's electricity generation infrastructure in order to demonstrate the actual destruction of methane in such installed biogas destruction device(s). Emission reductions will not accrue for periods in which the underlying destruction device(s).
Frequency of monitoring/recording	Continuous measurements will be recorded and reported with a least every minute frequency.
Value applied	Not applicable. No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the proposed VCS project activity.
Monitoring equipment	-
QA/QC procedures to be applied	Not applicable.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	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(s). Monitoring the operational status of the engine-generator sets by embedded electronics of the sets may also be considered.

Data / Parameter	Tariff of electricity exported
Data unit	Currency (USD, EUR, etc.)
Description	Tariff of the electricity exported
Source of data	Power purchase agreement
Description of measurement methods and procedures to be applied	Monitoring and documenting may be undertaken through monitoring of the operation of the flare(s) (by means of flame detector in each flare) or engine-generator sets in order to demonstrate the actual destruction of methane in such installed biogas destruction devices. Emission reductions will not accrue for periods in which the underlying destruction device(s) (high temperature enclosed flare(s) or engine-generator sets) is/are not operational.
Frequency of monitoring/recording	At the first issuance request after the project activity (under its revised design configuration) is fully implemented.
Value applied	-
Monitoring equipment	-
QA/QC procedures to be applied	Audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	The monitoring of this parameter is required since the project activity (under its revised design configuration) applies the Simplified procedures (as described in section 5.3.1 of ACM0001 (version 19.0) and applicable guidance from the methodological tool “Positive lists of technologies” for the demonstration of non-undermining of its previously assessed additionality (due to its occurred permanent design change).

Data / Parameter	CAPEX and OPEX

Data unit	Currency (USD, EUR, etc.)
Description	Total investment to implement the project and total cost to operate the project
Source of data	Engineering, procurement and construction contracts; and maintenance contracts
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	At the first issuance request after the project activity (under its revised design configuration) is fully implemented.
Value applied	-
Monitoring equipment	
QA/QC procedures to be applied	Audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	The information provided for CAPEX shall indicate the investment expenditures made: (i) in the project's LFG collection and flaring system (ii) in the project's new grid-connected electricity generation infrastructure (including connection to the grid (if applicable)); and The information supplied for OPEX shall indicate the costs for: (i) staff and maintenance involved in the operation of the project's LFG collection and flaring system; and (ii) staff and maintenance

	involved in the operation of project's new grid-connected electricity generation infrastructure. The monitoring of this parameter is required since the project activity (under its revised design configuration) applies the Simplified procedures (as described in section 5.3.1 of ACM0001 (version 19.0) and applicable guidance from the methodological tool "Positive lists of technologies" for the demonstration of non-undermining of its previously assessed additionality (due to its occurred permanent design change).

5.3 Monitoring Plan

General monitoring:

The following instruments/equipment will be used to monitor required data along the lifetime of the proposed VCS project activity:

Instrument or Source of data	Measurement option	Data monitored	
Appropriate volumetric or mass flow meter(s) (one individual LFG flow meter for each operational high temperature open flare and/or the engine-generator set with separated measurement data being recorded and reported for each one of these methane destruction devices)	Volume flow – wet basis; Volumetric fraction wet basis (Option C)	$V_{t,wb,j}$	Volumetric flow of LFG stream *j* in time interval *t* on a wet basis (in m^3 wet gas/h). *j* = LFG delivery pipeline to each operative high temperature open flare and/or each operative engine-generator set (i.e. each installed methane destruction device)
Continuous CH_4 content gas analyser unit	-	$V_{CH4,t,wb,j}$	Volumetric fraction of methane on the LFG stream directed to the flare(s) and/or to the internal combustion gas engines in a time interval *t* on a wet basis (in m^3 CH_4/m^3 wet gas)
LFG pressure sensor	-	P_t	Pressure of the LFG stream directed to the flare(s) 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 flare(s) and/or to each operative engine-generator set in time interval t (in K or ºC) Note: T_t may not be monitored when using LFG flow meters that automatically consider and measures LFG temperature and LFG pressure, thus expressing LFG volumetric or mass flows in normalized units.
Electricity meters	-	$EC_{PJ,y}$	Amount of grid electricity consumed by the project activity in year y (in MWh)
		$EC_{BL,y}$	Amount of electricity generated using LFG by the project activity in year *y* (in MWh)
Not based on measurements. Monitoring performed in the context of operation/monitoring for the proposed VCS project activity (based on calculations)	-	$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y. (in tCO_2/MWh). Data will be determined by the Brazilian DNA annually.
Not based on measurements. Monitoring performed in the context of operation/monitoring for the proposed VCS project activity (based on calculations)	-	$EF_{grid,CM,y}$	Combined margin CO_2 emission factor in year y. (in tCO_2/MWh). Data will be determined as per applicable guidance of the methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0).
Not based on measurements. Monitoring	-	$EF_{grid,OM,y} = EF_{grid,OM-DD,y}$	Operation margin CO_2 emission factor in year y = Dispatch data analysis

performed in the context of operation/monitoring for the proposed VCS project activity (based on calculations)			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" (version 07.0).
Not based on measurements performed in the context of operation/monitoring for the proposed VCS 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-generators sets). For each engine-generator set *j* combusting LFG, it will be continuously monitored whether the equipment is operating in hour h by monitoring any one the following sub-parameters/conditions: - Amount of electricity generated in hour h

			- Operational status of the engine-generator set during each hour h.
Optical flame detector (using ultra violet or infra-red technology or both	-	**$Flame_m$**	Flame detection of flare in the minute m (Flame "on" or Flame "off"). For each installed high temperature open flare, continuous monitoring of flame detection through use of appropriate installation (e.g. optical flame detector (using ultra violet or infra-red technology or both).
Not based on measurements	Calculated or application of default value	**$TDL_{grid,y}$**	Use of recent, accurate and reliable data available within the host country or selection of the applicable default value as per the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0).
Project participants	-	**Status of biogas destruction device**	Operational status of biogas destruction device. The same procedures as adopted for monitoring parameter $Flame_m$ (in the case of the flare(s)) and for parameter $Op_{j,h}$ (in the case of engine-generator sets). For installed high temperature open flare(s), 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-

			generators sets, continuous monitoring of operational status signal in each unit.
		CAPEX and OPEX	Total investment to implement the project and total cost to operate the project (BRL). Data will be determined as per applicable guidance of the baseline and monitoring methodology ACM0001 (version 15.0). Reported values are to be audited by professional, independent financial auditors.
		Tariff of electricity exported	Tariff of the electricity exported (BRL). Data will be determined as per applicable guidance of the baseline and monitoring methodology ACM0001 (version 15.0). Reported values are to be audited by professional, independent financial auditors.

During the lifetime of the proposed VCS project activity, all continuously measured LFG related parameters as well as measurements related to the parameters related to flare operational conditions of the flare(s) and/or engine-generator set(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 proposed VCS project activity as well as records of electricity consumed by the proposed VCS 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 proposed VCS 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 VCS verification. All data recorded by the data logger / data acquisition system will be made available to the 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 proponent CGR Centro de Gerenciamento de Resíduos Ltda., access to monitoring data will be restricted and controlled. All monitoring records will be kept archived until at least two years after the end of the crediting period or at least two years after the last issuance of VCU's for the proposed VCS 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 proposed VCS 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 proposed VCS 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 sets, 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 are 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 is to be made available as part of the operation of the proposed VCS project activity during its lifetime.

The project's operational and management structure is to rely on trained staff with responsibilities clearly defined. All collaborators and employees involved with operation of project and/or monitoring are to 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 flares.

g) General competence development about utilization of LFG as gaseous fuel for electricity

The monitoring plan is to be implemented and operationalized during the lifetime of the proposed VCS project activity by reflecting the best practice in terms of monitoring efforts for LFG collection and destruction/utilization project-based initiatives under VCS.

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 Catanduva landfill will be monitored along the lifetime of the proposed VCS project activity on the basis of different sources, including *inter alia*:

- Original design of the landfill;

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

During the lifetime of the proposed VCS 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 proposed VCS 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 proposed VCS 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 is to be used for the determination/confirmation of baseline emissions and/or confirmation of the project's implementation as described in the VCS PD (in terms of operation and management conditions of the landfill from which LFG is combusted). Further monitoring details are included in Section 5.2 (under parameter "Management of SWDS").

APPENDIX 1: COMMERCIALLY SENSITIVE INFORMATION

Not applicable, there is no commercially sensitive information included in the project description to be excluded in the public version.