



**Verified Carbon
Standard**

Joburg Landfill Gas to Energy Project

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Client	Energy Joburg RF (PTY) LTD
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Prepared By	AENOR INTERNACIONAL S.A.U.
Contact	Génova 6. 28004 Madrid- Spain. Telephone +34 914326000 jfuentes@enor.com ellorente@enor.com

	www.aenor.com
Approved by	Jose Luis Fuentes
Work carried out by	Lead Auditor: Elena Llorente Auditor: Richard Gonzales Auditor in trainee: Asis Arranz Technical Reviewer: Luis Javier Arribas

Summary:

The “Joburg Landfill Gas to Energy Project” is a landfill gas project located in the Johannesburg landfill sites in Johannesburg, South Africa.

The project consists of two stages: first LFG is captured and destroyed using an LFG flare, and then the captured LFG is fed to the LFG flare and modular electricity generation plants. The Project involves the destruction/utilization of methane emissions as well as the displacement of electricity from the South African coal-based grid, resulting in a consequent reduction in CO₂e emissions. Prior to implementation of the project activity, the LFG was being freely emitted into the atmosphere resulting in GHG emissions, and electricity would have been produced in the fossil fuel based South African grid resulting in CO₂ emissions.

The purpose of the validation for the renewal of the crediting period was the independent evaluation of the project’s compliance with the VCS Standard v4.3 and ISO 14064-2 2019 and the requirements of the GHG program selected, also the validation applied a strategic and risk analysis required in the norm ISO 14064-3: 2019. The process was performed through a combination of desk review, and communications with relevant personnel and remote audit.

During the validation 2 CLs and 2 CARs were reported. All these issues were appropriately closed by means of corrections, more clear explanations, and other supported documents.

AENOR carried out a final validation report and deems with reasonable level of assurance that the project complies with the criteria for VCS for validation of the renewal of the crediting period. The assessment team has no restrictions or uncertainties with respect to the compliance of the project with the validation criteria.

Hence, the audit team concludes that the net GHG emission reductions for the landfill gas project included in the project boundary at validation stage has been quantified in accordance with VCS rules. AENOR assessed the calculations and can confirm that the estimated GHG emission reductions are correct. The project expects the emission reductions of 6,374,231tCO₂e for the second crediting period ,27/05/2021 to 26/05/2031. The average annual GHG removal is 637,423 tCO₂e/year.

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1 INTRODUCTION

1.1 Objective

The purpose of the validation for the renewal of the crediting period was to conduct an independent assessment of the project in order to determine whether the project complies with the validation criteria, as set out in the guidance documents listed in Section 1.2 of this report.

1.2 Scope and Criteria

Validation Scope for the renewal of the crediting period: The scope of the validation audit is to validate the emissions reductions of the proposed project activity in South Africa against the Verified Carbon Standard, the identified methodology and associated tools, for the crediting period from 27/05/2021 to 26/05/2031.

For the renewal of the crediting period only the validity of the baseline, estimated emissions reductions and the monitoring plan using an approved baseline and monitoring methodology are validated.

The objectives of this audit include the validation of the emission reductions calculations in accordance with the Verified Carbon Standard requirements.

The scope was defined as follows:

- The project and its baseline scenarios.
- The GHG sources, sinks and/or reservoirs those are applicable to the project.
- The types of GHGs that are applicable to the project.
- The project crediting period.

In accordance with Section 4.1.8 of the VCS Standard, the criterion for validation was the VCS Version 4, including the following documents:

- VCS Standard v4.3 /2/
- VCS Program Guide v4.2/3/
- ACM0001 Version 19, “Large-scale Consolidated Methodology Flaring or use of landfill” /4/
- TOOL02 “Combined tool to identify the baseline scenario and demonstrate additionality” (Version 07.0) (hereafter also referred to as “Additionality tool”)./5/
- TOOL03 “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” (Version 03.0)./6/
- TOOL04 “Emissions from solid waste disposal sites” (Version 08.0)./7/
- TOOL05 “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (Version 03.0). /8/

- TOOL06 “Project emissions from flaring” (Version 04.0). /9/
- TOOL08 “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0) :/10/
- Tool09 “Determining the baseline efficiency of thermal or electric energy generation systems (Version 03.0). /11/.
- TOOL 7 “Tool to calculate the emission factor for an electricity system” (Version 7.0) /12/
- TOOL 11 “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” version 3.0.1 /13/

Unless otherwise indicated, the assessment was performed against the most recent version of the relevant VCS documents.

1.3 Level of Assurance

The assessment was conducted to provide a reasonable level of assurance of conformance against the defined audit criteria and materiality thresholds within the audit scope. Based on the audit findings, a positive evaluation statement reasonably assures that the project GHG assertions are materially correct and is a fair representation of the GHG data and information.

All the versions of the validation report were subjected to an independent internal technical review before being submitted to the client to confirm that all validation activities had been completed according to the pertinent AENOR instructions required. The technical review was performed by a technical reviewer(s) qualified in accordance with AENOR’s qualification scheme for VCS validation and verification.

Name	Role in the Team
Elena Llorente	Lead auditor
Richard Gonzales	Auditor
Asis Arranz	Auditor in trainee
Luis Javier Arribas	Technical reviewer

1.4 Summary Description of the Project

The “Joburg Landfill Gas to Energy Project” is a landfill gas project located in the Johannesburg landfill sites in Johannesburg, South Africa.

The project consists of two stages: first LFG is captured and destroyed using an LFG flare, and then the captured LFG is fed to the LFG flare and modular electricity generation plants. The Project involves the

destruction/utilisation of methane emissions as well as the displacement of electricity from the South African coal-based grid, resulting in a consequent reduction in CO₂e emissions. Prior to implementation of the project activity, the LFG was being freely emitted into the atmosphere resulting in GHG emissions, and electricity would have been produced in the fossil fuel based South African grid resulting in CO₂ emissions.

The Robinson Deep flare was commissioned on 27 May 2011 and electricity generation was commissioned on 26 November 2016. The Marie Louise landfill site flare was commissioned on 04 May 2012 and electricity generation was commissioned on 25 January 2018. The Goudkoppies flare and electricity generation components were commissioned on 25 April 2017.

The second crediting period is 10 years, from 27/05/2021 to 26/05/2031.

2 VALIDATION PROCESS

2.1 Method and Criteria

The validation was performed through a combination of document review, interviews with relevant personnel and remote audit, as discussed in Sections 2.2 through 2.4 of this report. At all times, the project was assessed for conformance to the criteria described in Section 1.2 of this report. As discussed in Section 2.5, findings were issued to ensure that the project was in full conformance to all requirements.

2.2 Document Review

The Project Description Document submitted by the Project Proponent (PP) was reviewed against the approved consolidated methodology and against VCS requirements. Additional background documents related to the baseline and monitoring plan were also made available before and during the remote audit.

To address the corrective actions and clarification requests that arose from the desk review, the PP revised the initial project description document and developed a final version 8.1.

The supporting documents that were reviewed are all listed in Appendix 1 of this report. AENOR cross-checked and compared then with the relevant sections of the PD.

2.3 Interviews

The AENOR validation team conducted interviews with a selection of the stakeholders, that was sampled by AENOR, through videocalls and written testimonies to confirm selected information and to resolve issues identified in the document review. The list of the interviewed people is below detailed.

Due to the COVID-19 pandemic situation, interviews were carried out through videoconference on 29th September 2022.

Name	Title/Organization/Community
David Cornish	General Manager ENERGY Systems SA (PTY) LTD
Ledswaba	Community Member and part of the Marie Louise Environmental Monitoring Committee member
Genis	Pikitup Regional Security Risk Manager
MR Richard	Thebhe Promotions/Community member
Ngomane	Community Member and part of the Marie Louise Environmental Monitoring Committee
Malange	Pikitup Office assistant ,Community member and Environmental Monitoring Committee member
Fortune Mathunrini	Community member/manager of ZamQANYA MUSIC
Amos Mofokeng	Environmental Monitoring Committee team
Khaukanani Ishmael	Naturena Primary School Principal
Hannis Genis	Pikitup Regional Security Risk Manager
Mbadaliga Ranwedzi	School beneficiary/Goza Primary school
Mr Makena	Principal and school beneficiary /Livhuwani Primary School
Webster Thangwane	Security systems technician/ Silumi Holdings
Mashudu Luruli	IT Technician /Mveledzo

2.4 Site Inspections

Since the VCS Programs does not explicitly mandate site visits and considering that a reasonable level of assurance was achievable by means of documentary review, cross check of documents and the remote audit where and risk assessment was undertaken. AENOR as VVB proposed to carry out a remote verification audit can ensured the achievement of the assurance level required by the VCS program.

The remote audit was based on the following auditing techniques:

- Document review and cross checks between the information provided in the PD, and supporting information and evidence provided by the PP Emissions calculations, and supporting information and evidence provided.
- Review, based on the selected methodologies, tools and the other applied methodological regulatory documents, of the appropriateness of formulae and accuracy of calculations.

- Telephone, teleconference and/or e-mail interviews for the implementation of project activities and the elaboration of project's documents.

As stated in section 2.3, AENOR validation team conducted interviews with project developers and relevant stakeholders via remote audit to confirm selected information and to resolve issues identified in the document review. Due to the COVID-19 pandemic situation, interviews were carried out through videoconference on 29th September 2022.

2.5 Resolution of Findings

A total number of 2 CARs and 2 CLs were raised during this validation process.

All findings issued by the AENOR audit team for this validation process have been closed. In accordance with Sections 4.1.13 and 4.1.14 of the VCS Standard v4.3, all findings issued during the validation process, and the inputs for their closure, are described in Appendix 2 of this report.

2.5.1 Forward Action Requests

No FARs were raised to the PP during the validation process.

3 VALIDATION FINDINGS

3.1 Project Details

3.1.1 Project type, technologies and measures implemented, and eligibility of the project

The Joburg Landfill Gas to Energy Project developed by ENER-G Systems Joburg (Pty) Ltd is a landfill gas (LFG) collection and utilization project located at the Johannesburg landfill sites in South Africa

The assessment team has checked all sections of the updated PD and confirms that the valid version of the applicable PD form, PD template v4.1 /26/ listed in VERRA website have been applied.

The project type and technologies implemented are the same ones that the ones used in the first crediting period.

The assessment team also checked the information transferred to the final version of the VCS PD, Jhb LFG VCS PD v8.1 /1/, against the approved CDM PDD v12 26/09/2020 /17/ registered in UNFCCC website and VCS PD v04 21January 2014 /16/ listed in VERRA website and confirms that the information transferred is materially the same.

3.1.2 Project design

This project is not a Grouped Project. It is a single Project Activity with five sites. The project continues to be with the same design as in the first crediting period.

The assessment team has checked all sections of the updated PD and confirms that the valid version of the applicable PD form, PD template v4.1 /26/ listed in VERRA website have been applied.

The assessment team also checked the information transferred to the final version of the VCS PD, Jhb LFG VCS PD v8.1 /1/, against the approved CDM PDD v12 26/09/2020 /17/ registered in UNFCCC website and VCS PD v04 21January 2014 /16/ listed in VERRA website and confirms that the information transferred is materially the same.

3.1.3 Project proponent and other entities involved in the project

The project proponent is Energy Joburg RF (PTY) LTD. It is the same one as in the PDD of the first crediting period.

The assessment team has checked all sections of the updated PD and confirms that the valid version of the applicable PD form, PD template v4.1 /26/ listed in VERRA website have been applied.

The assessment team also checked the information transferred to the final version of the VCS PD, Jhb LFG VCS PD v8.1 /1/, against the approved CDM PDD v12 26/09/2020 /17/ registered in UNFCCC website and VCS PD v04 21January 2014 /16/ listed in VERRA website and confirms that the information transferred is materially the same.

3.1.4 Ownership

Energy Joburg RF (PTY) LTD has the project ownership. It is the same one as in the PDD of the first crediting period.

The assessment team has checked all sections of the updated PD and confirms that the valid version of the applicable PD form, PD template v4.1 /26/ listed in VERRA website have been applied.

The assessment team also checked the information transferred to the final version of the VCS PD, Jhb LFG VCS PD v8.1 /1/, against the approved CDM PDD v12 26/09/2020 /17/ registered in UNFCCC website and VCS PD v04 21January 2014 /16/ listed in VERRA website and confirms that the information transferred is materially the same.

3.1.5 Project start date

The project start date is 27-05-2011. It is the same one as in the PDD of the first crediting period.

The assessment team has checked all sections of the updated PD and confirms that the valid version of the applicable PD form, PD template v4.1 /26/ listed in VERRA website have been applied.

The assessment team also checked the information transferred to the final version of the VCS PD, Jhb LFG VCS PD v8.1 /1/, against the approved CDM PDD v12 26/09/2020 /17/ registered in UNFCCC website and VCS PD v04 21January 2014 /16/ listed in VERRA website and confirms that the information transferred is materially the same.

3.1.6 Project crediting period

Project crediting period: 10 years.

Start date: 27/05/2021, End date: 26/05/2031

According to Section 3.8.1 of the VCS Standard, the crediting period of Non-AFOLU projects shall be either seven years, twice renewable for a total of 21 years, or ten years fixed. This project activity is ten years fixed. Therefore, the project activity is in line with the length of the crediting period.

AENOR checked the documentation from the CDM Registry, VCS Registry and the e-mail from Verra on 24th August 2022 /25/ where it was confirmed that the eligible crediting period of ten years and that the PP should request a request for a crediting period renewal and concluded that the project is eligible to participate under the VCS Program for the abovementioned reasons.

3.1.7 Project scale and estimated GHG emission reductions or removals

The project is classified as “Large project” according to its scale (Large projects: Greater than 300,000 tonnes of CO₂e per year) since it will remove an average of 637,423 tCO₂e per year during the 10 years of crediting period.

AENOR has checked the project scale against the Joburg LFG PD renewal ex ante Calcs v3 /14/ and deems the calculation correct.

3.1.8 Project location

The project activity sites are located in Johannesburg, in the Gauteng Province of South Africa. It is the same one as in the first crediting period.

The assessment team has checked all sections of the updated PD and confirms that the valid version of the applicable PD form, PD template v4.1 /26/ listed in VERRA website have been applied.

The assessment team also checked the information transferred to the final version of the VCS PD, Jhb LFG VCS PD v8.1 /1/, against the approved CDM PDD v12 26/09/2020 /17/ registered in UNFCCC website and VCS PD v04 21January 2014 /16/ listed in VERRA website and confirms that the information transferred is materially the same.

3.1.9 Conditions prior to project initiation

The conditions prior to the project being initiated was the landfilling of municipal solid waste into a five landfill sites. The same conditions were stated in the first crediting period.

The assessment team has checked all sections of the updated PD and confirms that the valid version of the applicable PD form, PD template v4.1 /26/ listed in VERRA website have been applied.

The assessment team also checked the information transferred to the final version of the VCS PD, Jhb LFG VCS PD v8.1 /1/, against the approved CDM PDD v12 26/09/2020 /17/ registered in UNFCCC website and VCS PD v04 21January 2014 /16/ listed in VERRA website and confirms that the information transferred is materially the same.

3.1.10 Project compliance with applicable laws, statutes and other regulatory frameworks

All the landfill sites under the project comply with all relevant local, regional and national laws, statutes and regulatory frameworks.

The assessment team has checked all sections of the updated PD and confirms that the valid version of the applicable PD form, PD template v4.1 /26/ listed in VERRA website have been applied.

The assessment team also checked the information transferred to the final version of the VCS PD, Jhb LFG VCS PD v8.1 /1/, against the approved CDM PDD v12 26/09/2020 /17/ registered in UNFCCC website and VCS PD v04 21January 2014 /16/ listed in VERRA website and confirms that the information transferred is materially the same.

3.1.11 Participation under other GHG programs

The Joburg Landfill Gas to Energy Project has been registered as a CDM project under the UNFCCC with project registration number 6797 with the registration date being the 12 November 2012.

The project's first crediting period ran from 12 November 2012 – 11 November 2019. The project has been renewed and is currently in its second crediting period, which runs from 12 November 2019 – 11 November 2026.

No CDM CERs have been issued under the second crediting period.

The Joburg Landfill Gas to Energy Project has also been registered under the VCS in 2014, no double counting of emissions has occurred.

The different monitoring periods for issuance, between the CDM and the VCS registered projects, proves that no double counting of emission reductions has occurred.

AENOR checked the documentation from the CDM Registry, VCS Registry and the e-mail from Verra on 24th August 2022 /25/ where it was confirmed that the eligible crediting period of ten years and that the PP should

request a request for a crediting period renewal and concluded that the project is eligible to participate under the VCS Program for the abovementioned reasons.

3.1.12 Other forms of credit

GHG removals generated by the project will not be used for compliance with binding limits to GHG emissions since South Africa does not have GHG emission compliance nor trading programs in place.

3.1.13 Additional information relevant to the project

Leakage management for AFOLU projects:

There is no leakage applicable to this project activity.

Commercially sensitive information:

No commercially sensitive information has been excluded from the public version of the project description.

3.2 Safeguards

3.2.1 No Net Harm

As per the legal requirements for projects of this type, an environmental impact assessment was conducted. The environmental impacts were identified in the first crediting period.

The assessment team has checked all sections of the updated PD and confirms that the valid version of the applicable PD form, PD template v4.1 /26/ listed in VERRA website have been applied.

The assessment team also checked the information transferred to the final version of the VCS PD, Jhb LFG VCS PD v8.1 /1/, against the approved CDM PDD v12 26/09/2020 /17/ registered in UNFCCC website and VCS PD v04 21January 2014 /16/ listed in VERRA website and confirms that the information transferred is materially the same.

3.2.2 Local Stakeholder Consultation

According to section 2.2 of the PD, Local stakeholder consultations were undertaken during the course of the Environmental Impact Assessment (EIA) undertaken for the project activity.

For the renewal of the second crediting period the on-going local stakeholder consultation has been taken into account.

Stakeholder engagements are held on a regular basis where matters raised by stakeholders are recorded and required actions also documented.

Procedure and method for engagements: Ener-G Systems Joburg is involved in various, ongoing local stakeholder consultations related to the respective landfill sites. The primary method for consultations relates to the periodic Landfill Monitoring Committee meetings at each site.

The Landfill Monitoring Committees comprise voluntary interested and affected parties, including both individuals, representatives of organisations and government departments.

The Landfill Monitoring Committee meetings are scheduled to take place at least once a year or more frequently.

Therefore, the PP has taken due account of all inputs received during stakeholder consultation and AENOR considers correct the project proponent's responses to the local people, - Steering Committee Minutes August 2022 /21/

There is not project design change for the project that result from the local stakeholder consultation.

The participants encouraged to provide continuous inputs throughout the whole duration of the project. Joburg is in charge of the communication to stakeholders the process of VCS program validation and verification, the results of monitoring the risks, costs and benefits the project may bring to local stakeholders and all the relevant laws and regulations covering.

AENOR considers that the project proponent communicated information about the project design and implementation, risks, costs and benefits, relevant laws and regulations and the process of VCS Program validation are correct.

3.2.3 Environmental Impact

The Project actively collects and combusts LFG, thereby improving overall LFG management and reducing adverse global and local environmental effects of uncontrolled releases of LFG.

The assessment team has checked all sections of the updated PD and confirms that the valid version of the applicable PD form, PD template v4.1 /26/ listed in VERRA website have been applied.

The assessment team also checked the information transferred to the final version of the VCS PD, Jhb LFG VCS PD v8.1 /1/, against the approved CDM PDD v12 26/09/2020 /17/ registered in UNFCCC website and VCS PD v04 21January 2014 /16/ listed in VERRA website and confirms that the information transferred is materially the same.

3.2.4 Public Comments

There is no requirement to list the updated PD on the Verra portal for public consultation during the renewal of the crediting period.

3.2.5 AFOLU-Specific Safeguards

For non-AFOLU projects, this section is not required.

3.3 Application of Methodology

3.3.1 Title and Reference

The large-scale methodology ACM0001 Version 19, “Large-scale Consolidated Methodology Flaring or use of landfill gas” has been employed in the project activity.

Furthermore, the project makes use of the following tools, which are referred to in ACM0001, Ver. 19:

- TOOL02 “Combined tool to identify the baseline scenario and demonstrate additionality” (Version 07.0) (hereafter also referred to as “Additionality tool”).
- TOOL03 “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” (Version 03.0).
- TOOL04 “Emissions from solid waste disposal sites” (Version 08.0).
- TOOL05 “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (Version 03.0).
- TOOL06 “Project emissions from flaring” (Version 04.0).
- TOOL 7: “Tool to calculate the emission factor for an electricity system” (Version 7.0).
- TOOL08 “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0):
- Tool09 “Determining the baseline efficiency of thermal or electric energy generation systems (Version 03.0)
- TOOL11 “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” (Version 03.0.1).

3.3.2 Applicability

The final PD states all evidence used to demonstrate each condition of the applicable methodology. Complete explanations are included in the PD. In opinion of AENOR, the evidence and explanations confirm the fulfilment of the project with the methodology. The assessment was carried out for each applicability criterion and included, among others, the review of evidence and sources provided in the PD and the compliance check of the local project setting with the applicability conditions in regard to baseline setting and eligible project measures as follows:

Applicability of the methodology and related tools

Applicability condition	Compliance
As per paragraph 3.a of ACM0001: 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 instance.	The project design consists of the development of new LFG capture systems. The baseline scenario at all five sites is the atmospheric release of LFG. AENOR checked this by supported documents, including the descriptions in the PD /1/ with 52 pictures of the main equipment /27/ and with the interviews during the remote audit.
As per paragraph 3.b of ACM0001: Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that: The captured LFG was vented or flared and not used prior to the implementation of the project activity instance; and 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 instance and its efficiency is not impacted on by the project system: historical data on the amount of LFG capture and flared is available.	The baseline scenario is the atmospheric release of LFG at all five sites, i.e. all the LFG was vented and not used prior to the implementation of the project activity. The project design consists of the installation of new extraction infrastructure to recover LFG at all five sites. The project therefore complies with criterion (i). Criterion (ii) does not apply because there was no existing active LFG capture system prior to the implementation of the project activity. AENOR checked this by supported documents, including the descriptions in the PD /1/ / and during the remote audit with 52 pictures of the main equipment /27/ an the - Landfill Tonnage report /23/.
As per paragraph 3.c of ACM0001: Flare LFG and/or use the captured LFG in any (combination) of the following ways: Generating electricity; Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace; and/or Supplying the LFG to consumers through a natural gas distribution network; Supplying compressed/liquefied LFG to consumers using trucks	The project design consists of LFG flaring and electricity generation only. The project therefore complies with these criteria, specifically (i). AENOR checked this by supported documents, including the descriptions in the PD /1/ / and during the remote audit with 52 pictures of the main equipment /27/ an the - Landfill Tonnage report /23/.

Applicability condition	Compliance
Supplying the LFG to consumers through a dedicated pipeline.	
As per paragraph 3.d of ACM0001: Do not reduce the amount of organic waste that would be recycled in the absence of the project activity instance.	The project does not reduce the amount of organic waste that would be recycled in the absence of the project activity. Prior to the project being implemented, the organic waste that was brought to the site was sent to landfill and was not used for any purpose. As such there was no diversion of organic waste prior to project implementation. Furthermore, no diversion of organic waste has occurred during the project implementation. The project therefore complies with this criterion. AENOR checked this by supported documents, including the descriptions in the PD /1/ / and during the remote audit with 52 pictures of the main equipment /27/ an the - Landfill Tonnage report /23/.
As per paragraph 4.a of ACM0001: Atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.	In this project the baseline scenario is the total atmospheric release of the gas (see further explanation below) and the in the current project activities, the captured gas is being flared and used to produce electricity. Therefore, the project complies with this criterion. AENOR checked this by supported documents, including the descriptions in the PD /1/ / and during the remote audit with 52 pictures of the main equipment /27/ an the - Landfill Tonnage report /23/.
As per paragraph 4.b of ACM0001: In the case that the LFG is used in the project activity instance for generating electricity and/or generating heat in a boiler, air heater, glass melting furnace or kiln: For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or	The electricity generated from the project activity is supplied to the grid. The generated electricity displaces electricity generated by the fossil fuel fired power plants in the grid. The project therefore complies with these criterion (i). Criterion (ii) does not apply because the project does not generate heat.

Applicability condition	Compliance
For heat generation: that heat would be generated using fossil fuels in equipment located within the project boundary;	AENOR checked this by supported documents, including the descriptions in the PD /1/ / and during the remote audit with 52 pictures of the main equipment /27/ an the - Landfill Tonnage report /23/ and Historic information of Robinson Deep, Marie Louise, Goudkoppies plants /24/.
As per paragraph 4.c of ACM0001: 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.	This criterion is not applicable. The project does not supply LFG to the end-user(s) through a natural gas distribution network, trucks or dedicated pipeline. AENOR checked this by supported documents, including the descriptions in the PD /1/ / and during the remote audit with 52 pictures of the main equipment /27/ an the - Landfill Tonnage report /23/ and Historic information of Robinson Deep, Marie Louise, Goudkoppies plants /24/.
As per paragraph 4.d of ACM0001: In the case of LFG from a Greenfield SWDS, the identified baseline scenario is atmospheric release of the LFG or capture of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.	This applicability criterion does not apply to the project activity instance because the LFG arises from existing SWDSs. Furthermore, there are no requirements to capture LFG or destroy LFG through flaring in order to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons. AENOR checked this by supported documents, including the descriptions in the PD /1/ / and during the remote audit with 52 pictures of the main equipment /27/ an the - Landfill Tonnage report /23/ and Historic information of Robinson Deep, Marie Louise, Goudkoppies plants /24/.
As per paragraph 5 of ACM0001, this methodology is not applicable: In combination with other approved methodologies. If the management of the SWDS in the project activity instance is deliberately changed during	The project only utilises one methodology which is ACM0001 version 19. The project retains the same waste disposal practices for waste and the management of the landfill remains unchanged.

Applicability condition	Compliance
the crediting in order to increase methane generation compared to the situation prior to the implementation of the project activity instance.	AENOR checked this by supported documents, including the descriptions in the PD /1/ and the Landfill Tonnage report /23/.
As per paragraph 2 of TOOL03 “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” (Version 03.0): This tool provides procedures to calculate project and/or leakage CO2 emissions from the combustion of fossil fuels. It can be used in cases where CO2 emissions from fossil fuel combustion are calculated based on the quantity of fuel combusted and its properties. Methodologies using this tool should specify to which combustion process j this tool is being applied.	The project activity complies with this criterion. The tool is applicable to the project as diesel may be used in generators for on-site power backup for the flares. AENOR checked this by supported documents, including the descriptions in the PD /1/ and the Landfill Tonnage report /23/.
As per paragraphs 3.a and 3.b of TOOL04 “Emissions from solid waste disposal sites” (Version 08.0), the tool can be used to determine emissions for the following types of applications: 3 (a) Application A: The project 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” version 19). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex ante estimation of emissions in the project design document (CDM-PDD). The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS); 3 (b) Application B: The project 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	The project activity complies with paragraph 3 (a) Application A because the project mitigates methane emissions from specific existing SWDSs. The tool is applied for the ex-ante estimation of emissions in the project description. Emissions will be monitored during the crediting period using the appropriate approaches referenced in the methodology ACM0001 Version 19.0. The project therefore complies with this criterion. Application B is not applicable because the project mitigates emissions from an existing SWDS, not the avoidance of waste at a SWDS. AENOR checked this by supported documents, including the descriptions in the PD /1/ and the Landfill Tonnage report /23/.

Applicability condition	Compliance
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.	
As per paragraph 4 of TOOL04 “Emissions from solid waste disposal sites” (Version 08.0): These two types of applications are referred to in the tool for determining parameters.	The project activity meets the applicability criterion Application A, as described above. AENOR checked this by supported documents, including the descriptions in the PD /1/ and the Landfill Tonnage report /23/.
As per paragraph 5 of the tool TOOL04 “Emissions from solid waste disposal sites” (Version 08.0): In the case that: (a) different types of residual waste are disposed or prevented from disposal; or that (b) both MSW and residual waste(s) are prevented from disposal, then the tool should be applied separately to each residual waste and to the MSW.	Not applicable because the existing SWDSs are classified as general waste sites, meaning that they comprise of MSW and do not accept residual waste. Therefore the tool is applied only to the MSW in the absence of residual waste. AENOR checked this by supported documents, including the descriptions in the PD /1/ with 52 pictures of the main equipment /27/ and with the interviews and videos during the remote audit.
As per paragraph 5 of TOOL05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (Version 03.0): The tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption: 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;	The tool is applicable to the project since the tool is used to estimate project CO2 emissions associated with the consumption of electricity. Scenario C applies to the project. The landfills may use standby diesel generators (captive power plants) for on-site power backup for the flares. The diesel generators. Hence, the project can be provided with electricity from the captive power plant(s) and the grid. The project therefore complies with this criterion. AENOR checked this by supported documents, including the descriptions in the PD /1/ with 52 pictures of the main equipment /27/ and with the interviews and videos during the remote audit.

Applicability condition	Compliance
Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or 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.	
As per paragraph 6 of TOOL05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (Version 03.0): This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated: Scenario I: Electricity is supplied to the grid; Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.	The project complies with Scenario 1: all generated electricity is supplied to the grid. AENOR checked this by supported documents, including the descriptions in the PD /1/ with 52 pictures of the main equipment /27/ and with the interviews and videos during the remote audit.
As per paragraph 7 of TOOL05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (Version 03.0): This tool is not applicable in cases where captive renewable power generation technologies are	The project complies with this criterion: There are no captive renewable power generation technologies installed to provide electricity in the project activity in the baseline scenario or to sources of leakage. Only CO2 emissions are accounted for.

Applicability condition	Compliance
installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO2 emissions.	AENOR checked this by supported documents, including the descriptions in the PD /1/ with 52 pictures of the main equipment /27/ and with the interviews and videos during the remote audit.
As per paragraph 2 of TOOL06 “Project emissions from flaring” (Version 04.0.0): This tool provides procedures to calculate project emissions from flaring of a residual gas. The tool is applicable to enclosed or open flares and project participants should document in the CDM-PDD the type of flare used in the project activity.	The project complies with this criterion: project emissions are calculated in relation to the flaring of residual gas (LFG). All the flares in the project activity are enclosed flares, as documented in this PDD (see section B.6.1). AENOR checked this by supported documents, including the descriptions in the PD /1/ with 52 pictures of the main equipment /27/ and with the interviews and videos during the remote audit.
As per paragraph 3 of TOOL06 “Project emissions from flaring” (Version 04.0.0): This tool is applicable to the flaring of flammable greenhouse gases where: Methane is the component with the highest concentration in the flammable residual gas; and The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).	The project complies with paragraph 3 (a): methane is the highest component of the residual gas (LFG). 3(b) does not apply. AENOR checked this by supported documents, including the descriptions in the PD /1/ with 52 pictures of the main equipment /27/ and with the interviews and videos during the remote audit.
As per paragraph 4 of TOOL06 “Project emissions from flaring” (Version 04.0.0): 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.	The project complies with this criterion: no auxiliary fuels are used to sustain flare combustion. All the enclosed flares are operated in accordance with the specifications provided by the manufacturer of the flares. AENOR checked this by supported documents, including the descriptions in the PD /1/ with 52 pictures of the main equipment /27/ and with the interviews and videos during the remote audit.
As per paragraph 5 of TOOL08 “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0):	The methodological tool ACM0001 Version 19.0 refers to this tool for measurement of flow and composition of the residual or flared gases to determine baseline and project emissions.

Applicability condition	Compliance
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.	The tool is applicable to the project as the flow and composition of residual or flared gases will be measured for the determination of baseline or project emissions. The gaseous stream that the tool will be applied to is the LFG delivery pipeline to each item of equipment at each site. The greenhouse gas for which the mass flow will be determined is methane. AENOR checked this by supported documents, including the descriptions in the PD /1/ with 52 pictures of the main equipment /27/ and with the interviews and videos during the remote audit.
As per TOOL08 “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0): Methodologies where CO₂ is the particular and only gas of interest should continue to adopt material balances as the means of flow determination and may not adopt this tool as material balances are the cost effective way of monitoring flow of CO₂.	This criterion is not applicable as CO₂ is not the only gas of interest in the project activity. AENOR checked this by supported documents, including the descriptions in the PD /1/ with 52 pictures of the main equipment /27/ and with the interviews and videos during the remote audit.
As per TOOL08 “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0): The underlying methodology should specify: The gaseous stream the tool should be applied to; For which greenhouse gases the mass flow should be determined; In which time intervals the flow of the gaseous stream should be measured; and Situations where the simplification offered for calculating the molecular mass of the gaseous stream (equations (3) or (17)) is not valid (such as the gaseous stream is predominantly composed of a gas other than N₂).	The project complies with these criteria: The tool is applied to the residual gas stream in the respective landfill. The option F of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0) is used to calculate the mass flow of the gaseous stream. The mass flow is determined for methane. Monitoring is continuous. AENOR checked this by supported documents, including the descriptions in the PD /1/ with 52 pictures of the main equipment /27/ and with the interviews and videos during the remote audit.
As per paragraph 3.c of ACM0001: Flare LFG and/or use the captured LFG in any (combination) of the following ways:	The project design consists of LFG flaring and electricity generation only.

Applicability condition	Compliance
Generating electricity; Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace; and/or Supplying the LFG to consumers through a natural gas distribution network; Supplying compressed/liquefied LFG to consumers using trucks Supplying the LFG to consumers through a dedicated pipeline.	The project therefore complies with these criteria, specifically (i). AENOR checked this by supported documents, including the descriptions in the PD /1/ with 52 pictures of the main equipment /27/ and with the interviews and videos during the remote audit.

AENOR, based on records provided including spreadsheets - Joburg LFG PD renewal ex ante Calcs v3 /14/ has verified that applicability conditions of the different tools are complied.

AENOR after conducting the remote audit, and after the reviewed of the documentation, the descriptions in the PD /1/ can conclude that the project activity complies with the applicability conditions of the methodology, and tools or modules selected by the PP.

3.3.3 Project Boundary

The emission sources and greenhouse gases included in the project boundary (in accordance with the applied methodology and the applied tools) are described in the following table:

Source	Gas	Included?	Justification/Explanation
Baseline	CO ₂	No	CO ₂ emissions from decomposition of organic waste are not accounted for.
	CH ₄	Yes	The major source of emissions in the baseline.
	N ₂ O	No	N ₂ O emissions are small compared to CH ₄ emissions from landfills. Exclusion of this gas is conservative.
	CO ₂	Yes	Major emission source as power generation is included in the project activity.
	CH ₄	No	Excluded for simplification. This is conservative.

Source		Gas	Included?	Justification/Explanation
	Emission from heat generation	N ₂ O	No	Excluded for simplification. This is conservative.
		CO ₂	No	No thermal energy generation is planned in the project activity.
		CH ₄	No	Excluded for simplification. This is conservative.
		N ₂ O	No	Excluded for simplification. This is conservative.
	Emissions from the use of natural gas	CO ₂	No	Natural gas use is not included in the project activity.
		CH ₄	No	No LFG will be supplied through natural gas distribution networks, dedicated pipelines or trucks in the project activity.
		N ₂ O	No	Excluded for simplification. This is conservative.
	Project activity	Emissions from fossil Fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO ₂	Yes
CH ₄			No	Excluded for simplification. This emission source is negligible.
N ₂ O			No	Excluded for simplification. This emission source is negligible.
Emissions from electricity consumption due to the project activity. Emissions from flaring		CO ₂	Yes	This is applicable for on-site electricity use, if and when the project activity does not generate electricity from the captured LFG.
		CH ₄	No	Excluded for simplification. This emission source is negligible.
		N ₂ O	No	Excluded for simplification. This emission source is negligible.

Source		Gas	Included?	Justification/Explanation
	Emissions from flaring	CO ₂	No	Emissions are considered negligible.
		CH ₄	Yes	The project emissions from flaring are based on a default flare efficiency of 80%. CH ₄ emissions that are not combusted (due to the efficiency factor of 80%) are therefore accounted for.
		N ₂ O	No	Emissions are considered negligible.
	Emissions from distribution of LFG using trucks and dedicated pipelines	CO ₂	No	Not applicable as the project activity does not include distribution of LFG using trucks or dedicated pipelines.
		CH ₄	No	Not applicable as the project activity does not include distribution of LFG using trucks or dedicated pipelines.
		N ₂ O	No	Not applicable as the project activity does not include distribution of LFG using trucks or dedicated pipelines.

AENOR after conducting the remote audit, also through checking the methodology ACM0001 Version 19 and taking into account the justifications, assumptions and supporting information provided and the design of the project, deems that project boundary is correctly defined and in compliance with the applicable methodology and VCS requirements.

3.3.4 Baseline Scenario

AENOR checked the updated PDD to assess the validity of the original/current baseline for the proposed CDM project activity against the applicable requirements of methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" version 03.0.1. /13/

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

The validity of the baseline has been assessed as per the sub-steps 1.1 – 1.4 of the methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" version 3.0.1 . The assessment was performed as follows:

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

The baseline scenario, as per the project description at registration, is the atmospheric release of the landfill gas and the generation of electricity in existing grid-connected power plants.

As per the regulatory environment at the registration of the project, there is no legislative requirement in South Africa to capture, destroy or use landfill gas. The baseline scenario still complies with all relevant mandatory national and/or sectoral policies which have come into effect after the submission of the project activity for validation.

Since the current baseline complies with all relevant mandatory national and/or sectoral policies which have come into effect after the submission of the project activity, according to the tool, we go to step 1.2.

Step 1.2: Assess the impact of circumstances

Through this step, the audit team could assess that for the renewal of the crediting period, the impact of circumstances existing at the time of requesting renewal of the crediting period on the current baseline emissions is assessed.

Baseline emissions from waste: the waste volumes have been updated to reflect the latest actual waste volume figures disposed of at the respective landfill sites. Additionally, the waste volume projections for future year are based on the estimated population growth of Gauteng which is the province in which the projects are located. The projected waste volumes have also been amended to reflect the regulatory requirements of the 2013 Waste Classification and Management Regulations to reduce the volumes of garden waste accepted on general landfill sites by 50% by 2023.

AENOR could check this against the report Landfill Tonnage /23/ and the link Population. City. 2015. Gauteng · Population. Available at: <http://population.city/south-africa/adm/gauteng/>. Accessed 13 February 2020 /24/.

Baseline emissions relating to displacement of grid electricity: the South African grid emission factor has been calculated using the CDM tool.

AENOR could check this against the Joburg LFG PD renewal ex ante Calcs v3 /14/.

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

Not applicable, no equipment was used in the current baseline as it is the atmospheric release of landfill gas.

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

As determined in Step 1.2 above, the following conditions used to calculate the baseline emissions have changed:

- 1) The project waste volumes for four sites (the Ennerdale; Robinson Deep; Marie Louise and Goudkoppies landfills) were updated with actual waste volumes for the years 2014-2018. Linbro Park Landfill was closed in 2006 and therefore did not require updating of

waste volumes. The 2019 waste volumes were calculated based on monthly average volumes provided for the four sites. The projected future waste deposit values were also updated for these landfill sites, based on an estimated growth rate in the Gauteng province of 1.84%/year (using the 2019 waste volumes as a baseline).

AENOR could check this against the report Landfill Tonnage /23/ and the link Population. City. 2015. Gauteng · Population. Available at: <http://population.city/south-africa/adm/gauteng/>. Accessed 13 February 2020 /24/.

- 2) In the second crediting period, the grid emission factor has been calculated to be 0,9647 tCO₂e/MWh.

AENOR could check this against the Joburg LFG PD renewal ex ante Calcs v3 /14/.

The emission factors have been updated by the project participants for the second crediting period of the project activity accordingly.

The outcome of Step 1.4 indicates that the current baseline needs to be updated with the conditions that have changed since the registration of the project. Step 2 of the methodological tool, “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” version 03.0.1, is therefore applied.

Step 2.-Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

As per the requirement of the sub-step, the update for the power grid emission factor of the second crediting period is based on the steps of the “Tool to calculate the emission factor for an electricity system”, Version 07.0.

Step 2.2: Update the data and parameters

The parameters relating to waste volumes and the grid emission factor have been updated accordingly in the section 4 of the PD and in section 3.3.6 of this report.

Thus, AENOR considers that the identified baseline scenario is correctly justified.

3.3.5 Additionality

In accordance with section 3.8.9 of the VCS Standard v4.3, AENOR has assessed the regulatory surplus status of the project activity.

AENOR has checked that there are no laws in South Africa that require the capture, destruction or use of landfill gas through the following link (<https://www.iwmsa.co.za/resources/faq-legislation>), the below legislation was checked:

- National Environmental Management: Waste Act 2008 (Act 59 of 2008) as amended by the:

- National Environmental Management: Waste Amendment Act (26 of 2014) and the National Environmental Management Laws Amendment Act (25 of 2014)
- Norms and Standards (2013)

Landfills in South Africa are governed by the National Environmental Management: Waste Act, 2008. The objectives of the Act are to provide guidance on norms and standards related to waste disposal activities in South Africa.

AENOR check this against the following link: (https://www.dffe.gov.za/sites/default/files/legislations/nema_amendment_act59_0.pdf). This act was updated to the National Environmental Management: Waste Amendment Act, 2014 (<https://www.gov.za/documents/national-environmental-management-waste-amendment-act>). The revisions in the Waste Amendment Act of 2014 pertain largely to the administration of waste in South Africa (as summarised in preamble to the Act). The Waste Amendment Act of 2014 provides for actions that various levels of government may or may not undertake. Therefore, the Waste Amendment Act of 2014 does not impact the project activity.

South African government also published the Waste Classification and Management Regulations on 23 August 2013, as it was assessed by AENOR through this website: (https://www.gov.za/sites/default/files/gcis_document/201409/36784rg10008gon634.pdf). These regulations aim to provide for the national Norms and Standards for the disposal of waste to landfill in South Africa.

None of these acts or regulations require the capture, destruction or use of landfill gas.

Hence, as per paragraph 3.8.9 of the VCS Standard v4, regulatory surplus has been assessed by AENOR and it is confirmed that the project activity is not mandated by any national law or regulatory framework.

3.3.6 Quantification of GHG Emission Reductions and Removals

The following formulas were followed by the PP as per methodology ACM0001 Version 19 Large-scale Consolidated Methodology Flaring or use of landfill gas.

Baseline Emissions

Baseline emissions are determined according to ACM0001 - equation (1):

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

Where:

$$BE_y = \text{Baseline emissions in year } y \text{ (t CO}_2\text{e/yr)}$$

$$BE_{CH_4,y} = \text{Baseline emissions of methane from the SWDS in year } y \text{ (t CO}_2\text{e/yr)}$$

$$BE_{EC,y} = \text{Baseline emissions associated with electricity generation in year } y \text{ (t CO}_2\text{/yr)}$$

$BE_{HG,y}$ = Baseline emissions associated with heat generation in year y (t CO₂/yr)

$BE_{NG,y}$ = Baseline emissions associated with natural gas use in year y (t CO₂/yr)

Baseline emissions of methane from the SWDS are determined according to equation (2) of the applied methodology:

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

Where:

$BE_{CH_4,y}$ = Baseline emissions of methane from the SWDS in year y (t CO₂e/yr)

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

$F_{CH_4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the project activity in year y (t CH₄/yr)

$F_{CH_4,BL,y}$ = Amount of methane in the LFG that would be flared in the baseline in year y (t CH₄/yr)

GWP_{CH_4} = Global warming potential of CH₄ (t CO₂e/t CH₄)

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

During the crediting period, $F_{CH_4,PJ,y}$ is determined as the sum of the quantities of methane flared and used in power plant(s), boiler(s), air heater(s), glass melting furnace(s), kiln(s) and natural gas distribution, as follows:

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

(Equation 3 of ACM0001, v19)

Where:

$F_{CH_4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the project activity in year y (t CH₄/yr)

$F_{CH_4,flared,y}$ = Amount of methane in the LFG which is destroyed by flaring in year y (t CH₄/yr)

$F_{CH_4,EL,y}$ = Amount of methane in the LFG which is used for electricity generation in year y (t CH₄/yr)

$F_{CH_4,HG,y}$ = Amount of methane in the LFG which is used for heat generation in year y (t CH₄/yr)

$F_{CH_4,NG,y}$ = Amount of methane in the LFG which is sent to the natural gas distribution network and/or dedicated pipeline and/or to the trucks in year y (t CH₄/yr)

For the project activity described in this document, the baseline emissions are derived from methane from the SWDS and electricity generation. There is no heat generation or natural gas use in the baseline. The equation can therefore be reduced to:

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

$F_{CH_4,flared,y}$ is determined as the difference between the amount of methane supplied to the flare(s) and any methane emissions from the flare(s), as follows:

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

(Equation 4 of ACM0001, v19)

Where:

$F_{CH_4,flared,y}$ = Amount of methane in the LFG which is destroyed by flaring in year y (t CH₄/yr)

$F_{CH_4,sent_flare,y}$ = Amount of methane in the LFG which is sent to the flare in year y (t CH₄/yr)

$PE_{flare,y}$ = Project emissions from flaring of the residual gas stream in year y (t CO₂e/yr)

GWP_{CH_4} = Global warming potential of CH₄ (t CO₂e/t CH₄)

The project emissions $PE_{flare,y}$, emissions due to flaring, are accounted for as below:

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

(Project emissions from flaring Equation 15)

Where:

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

Determination of $BE_{CH_4, SWDS, y}$

$BE_{CH_4, SWDS, y}$ is determined using the methodological tool “Emissions from solid waste disposal sites”, version 08.0. The following guidance should be taken into account when applying the tool:

- f_y in the tool shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for in equation (2) of this methodology;
- 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.

The methane generation from the landfill in the absence of the project activity at year y ($BE_{CH_4, SWDS, y}$), is calculated as per the “Emissions from solid waste disposal sites” version 08.0 as follows:

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

(Equation 1 of SWDS Tool, v8)

Where:

φ_y	=	Model correction factor to account for model uncertainties for year y
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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 the year y
GWP_{CH_4}	=	Global warming potential of CH_4 ($tCO_2e/t CH_4$)
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction)
$DOC_{f,y}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring at the SWDS for year y (weight fraction)
MCF_y	=	Methane correction factor for the year y
$W_{j,x}$	=	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (tons)
DOC_j	=	Fraction of degradable organic carbon in the waste type j (weight fraction)
k_j	=	Decay rate for the waste type j (l/yr)
j	=	Type of residual waste or types of waste in the MSW
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 ($x = y$) ($x = 1$) to the year y for which avoided emissions are calculated ($x = y$)
y	=	Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)

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

The baseline emissions associated with electricity generation in year y ($BE_{EC,y}$) are calculated using TOOL05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (Version 03.0".

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

(Equation 2 of Electricity Consumption and Generation Tool, v3)

Where:

$$BE_{EC,y} = \text{Baseline emissions from electricity consumption in year } y \text{ (t CO}_2 \text{ / yr)}$$

$EC_{BL,k,y}$	=	Quantity of electricity that would be consumed by the baseline electricity consumer k in year y (MWh/yr). $EC_{BL,k,y}$ is equivalent to $EG_{PJ,y}$.
$EF_{EF,k,y}$	=	Emission factor for electricity generation for source k in year y (t CO ₂ /MWh)
$TDL_{k,y}$	=	Average technical transmission and distribution losses for providing electricity to source j in year y
k	=	Sources of electricity consumption in the baseline

This project applies the grid emission factor for the South African grid. The applicable value applied is 0.9647 tCO_{2e}/MWh, which was calculated using CDM tool for grid emission factor.

Therefore $EFEF_{k,y} = EF_{grid,CM,y}$.

The OM was calculated using the simple OM approach using Option A1 from the tool. AENOR crosschecked this data against the Eskom data breaking down generation and consumption, historic electricity generation 2020/17/ and primary stations primary energy 2020 /18/. The following formulas are used in the EF spreadsheet:

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

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO₂ emission factor in year y (tCO₂/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (tCO₂/MWh)

$FC_{i,m,y}$ = Amount of fuel type i consumed by power unit m in year y (Mass or volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) of fuel type i in year y (GJ/mass or volume unit)

$EF_{CO2,i,y}$ = CO₂ emission factor of fuel type i in year y (tCO₂/GJ)

The build margin was calculated using Option 1 of the tool . The most recent set of five power units was identified from the Eskom report 2021 /19/. This set was compared with the set of power units that are registered as CDM project activities that comprise 20 per cent of the total generation. The larger of these 2 sets was selected to yield SET_{sample} . Power units that were commissioned more than 10 years ago were excluded from SET_{sample} . The CDM registered projects were then included to form $SET_{sample-CDM}$. This set was still below the 20% threshold of total annual generation. The power units that began generation

more than 10 years ago were included one by one until the total annual generation in the set exceeded the 20% threshold. The build margin was calculated using the equation below applied to the selected set of generation units.

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

Where:

$EF_{grid,BM,y}$ = Build margin CO₂ emission factor in year y (tCO₂/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (tCO₂/MWh)

Applying the steps of the “Tool to calculate the emission factor for an electricity system” (Version 7.0), the build margin was calculated in 0.9303 tCO₂/MWh and the operating margin was calculated in 1.0678 tCO₂/MWh. According to the tool ($W_{BM} = 0.25$, $W_{OM} = 0.75$).

In AENOR's opinion, the PP has documented in the final version of the updated PDD and the spreadsheets, the calculation, data, formulae and information of the estimated GHG emission reductions in accordance with the requirements of the latest approved version of the methodology and tools applied to the determination of the emission reductions.

Project Emissions

The project emissions are calculated in accordance with equation (22) of the applied methodology:

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

Where:

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

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

$PE_{DY,y}$ Emissions from distribution of compressed/liquefied LFG using trucks in year y (tCO₂/y) 0 as no distribution of the gas took place in this monitoring period

$PE_{SP,y}$ = Emissions from the supply of LFG to consumers through a dedicated pipeline, in year y (t CO₂/yr)

PE_{DTy} and PE_{SPy} are not applicable to this project.

Project emissions from electricity consumption $PE_{EC,y}$ are calculated according to the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation, Version 3” using the following equation:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EF,j,y} \times (1 + TDL_{j,y})$$

Where:

- $EC_{PJ,j,y}$ Total electricity consumed
- $EF_{EF,j,y}$ Emission Factor for electricity consumed.
- $TDL_{j,y}$ Transmission and Distribution losses

Project emissions from fossil fuel consumption $PE_{FC,y}$ are calculated as follows:

$$PE_{FC,j,y} = FC_{i,j,y} \times COEF_{i,y}$$

Where:

- $FC_{i,j,y}$ Quantity of fuel type i combusted in process j during year y
- $COEF_{i,y}$ CO2 emission coefficient of fuel type i in year y

$$COEF_{i,y} = NCV_{i,y} \times EFCO2_{i,y}$$

Where:

- $NCV_{i,y}$ Weighted average net calorific value of the fuel type i year y.
- $EFCO2_{i,y}$ Weighted average CO2 emission factor of fuel type i in year y.
- i Fuel types combusted in process j during year y is standard diesel.

Emission reduction

The emission reductions of the project activity are calculated using equation (26) of the applied methodology:

$$ER_y = BE_y - PE_y \quad (\text{Equation 26 of ACM0001, v19})$$

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
2021	346,545	3,523	0	343,022
2022	594,118	5,198	0	588,920
2023	607,640	5,198	0	602,442
2024	621,236	5,198	0	616,038
2025	634,688	5,198	0	629,490
2026	648,334	5,198	0	643,136
2027	662,454	5,198	0	657,256
2028	676,738	5,198	0	671,540
2029	678,862	5,198	0	673,664
2030	681,443	5,198	0	676,245
2031	275,192	2,714	0	272,478
Total	6,427,250	53,019	0	6,374,231

All of the above calculations are contained in the consolidated workbook titled “ - Joburg LFG PD renewal ex ante Calcs v3 /14/

AENOR deems that values are correct and consistent with the sources.

The values and estimates presented in the PD are considered reasonable based on the documentation reviewed, further references and the result of the interviews during the remote audit.

The PD describes in an appropriate way with evidence and justifications how the project activity fulfils with the applicability conditions of the tool.

Based on the information reviewed, it can also be confirmed that the sources used are correctly quoted and interpreted in the PD and supporting documents. All assumptions and data indicated in the PD and all relevant sources were checked and confirmed.

AENOR checked Joburg LFG PD renewal ex ante Calcs v3”/14/ and “tool to calculate emission factor for South Africa Grid” /15/. and compared the formulas with the ones in the large-scale methodology ACM0001 Version 19, “Consolidated baseline and monitoring methodology for landfill gas project activities” and deems that the calculation is in accordance with the relevant methodology.

In essence, the methodology was correctly applied following the requirements. All values in the PD are considered reasonable in the context of the proposed VCS project activity. Data sources are quoted correctly. Hence, the calculation of baseline emissions, project emissions and the estimated net GHG emission reductions are considered correct.

3.3.7 Methodology Deviations

No deviations were detected from the applicable methodology.

3.3.8 Monitoring Plan

The audit team checked that the monitoring plan in the updated PD complies with the applicable requirements in the Project standard, and the valid version of the methodology ACM0001 Version 19 and tools that are applicable to the updated PD.

In AENOR's opinion, PPs have documented, in the monitoring plan of the final version of the updated DD, all requirements established by the latest approved version of the methodology and tools applied to determine the emissions reductions of the project activity.

The assessment team checked all parameters presented in the monitoring plan against the requirements of the methodology.

The list of parameters to be monitored is the following:

Management of SWDS

$Op_{j,h}$, Operation of the equipment that consumes the LFG

$EGP_{j,y} = EC_{BL,k,y}$ Amount of electricity generated using LFG by the project activity in year y

TDL_y Average technical transmission and distribution losses for providing electricity

$TEG_{,m}$ Temperature in the exhaust gas of the enclosed flare in minute m

$EC_{PJ,j,y}$, Quantity of electricity consumed by the project electricity consumption source in year y

$FC_{i,j,y}$, Quantity of fuel type i combusted in process j during the year y

$V_{i,t,wb} = V_{k,t,wb}$ Volumetric fraction of greenhouse gas i in a time interval t on a wet basis

$Mt_{,wb}$ Mass flow of the gaseous stream in time interval t on a wet basis

$Flamem$, Flame detection of flare in the minute m

Monitoring data will be collected and recorded. All data required for verification and issuance will be backed-up and retained for at least two years following the end of the crediting period or the last issuance of carbon credits of the Project, whichever occurs later.

Data collected on-site by ENER-G Systems Joburg will be compiled in an electronic format on a regular basis.

The procedures described in section 5 of the PD were reviewed by the AENOR team and cross-checked against the applicable methodology and associated tools. The audit team found to be in compliance with methodological requirements, and good practice as defined.

In the opinion of the AENOR team, all necessary parameters required by the selected methodology are contained in the monitoring plan. They are clearly described, and the means of monitoring detailed in the plan comply with the requirements of the methodology. Tables in section 5 of the PD detail the different data variable to monitor along with the data unit, recording frequency, purpose of data, QA/QC, etc. Thus, the monitoring plan is in compliance with the applicable methodology.

After the review of evidence provided by the PP, interview and communications with PP, AENOR confirms that monitoring arrangements described in the monitoring plan are feasible within the project design and that the means considered for the implementation, including data management, quality and assurance control procedures, are sufficient to ensure that the GHG emission reductions achieved resulting from the proposed VCS project activity can be reported ex post. Therefore, in opinion of the AENOR team, the PP will be able to implement the monitoring plan.

3.4 Non-Permanence Risk Analysis

For non-AFOLU projects, this section is not required.

4 VALIDATION CONCLUSION

AENOR has performed the validation of the renewal of the crediting period of the “Joburg Landfill Gas to Energy Project” and has validated that the project is in compliance with the Verified Carbon Standard version 4.3 without qualifications or limitations. The project is located in South Africa.

The validation process was performed on the basis of all issues and criteria of VCS. The conclusions of this report show that the project, as it was described in the project documentation, is in line with all criteria applicable for the validation.

The review of the project design documentation and additional documents related to baseline and monitoring methodology; and the subsequent background investigation, follow-up interviews and review of comments by parties have provided AENOR with sufficient evidence to validate the fulfilment of the stated criteria.

In detail the conclusions can be summarized as follows:

- The project is in line with all criteria of the VCS Standard v4.3. section 3.8.8 and 3.8.9.
- The analysis of the baseline emission, project emissions and leakage has been carried out in a transparent and conservative manner.
- The Monitoring Plan is transparent and adequate.
- The project is likely to achieve estimated GHG emission reductions.

Date:06 March 2023



Elena Llorente

Validation Leader

APPENDIX I: LIST OF EVIDENCE PROVIDED

General documents
Project description: -Jhb LFG VCS PD v8.1 /1/ Standards documents: -VCS Standard v4.3 /2/ -VCS Program Guide v4.2 /3/ -ACM0001 Version 19, "Consolidated baseline and monitoring methodology for landfill gas project activities" has been employed in the project activity. /4/ -TOOL02 "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 07.0) (hereafter also referred to as "Additionality tool")./5/ -TOOL03 "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 03.0)./6/ -TOOL04 "Emissions from solid waste disposal sites" (Version 08.0)./7/ -TOOL05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (Version 03.0)./8/ -TOOL06 "Project emissions from flaring" (Version 03.0)./9/ -TOOL08 "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0) /10/. -Tool09 "Determining the baseline efficiency of thermal or electric energy generation systems (Version 02.0)/11/. -Tool 7 "Tool to calculate the emission factor for an electricity system" (Version 7.0) /12/ - Tool 11" Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" version 3.0.1 /13/
Carbon Accounting
Spreadsheets: - Joburg LFG PD renewal ex ante Calcs v3 /14/. -Tool to calculate emission factor for South Africa Grid /15/
Supporting documents
- VCS PD v04 21January 2014 /16/ -CDM PDD v12 26/09/2020 /17/ - Historic Electr Generation 2020 /18/ - Power stations Primary energy 20207/19/ - Eskom Integrated Report 2021 pg 68/20/ - Steering Committee Minutes August 2022 /21/ - Historic information of Robinson Deep, Marie Louise, Goudkoppies plants /22/ - Landfill Tonnage report /23/ - Link Population. City. 2015. Gauteng · Population. Available at: http://population.city/south-africa/adm/gauteng/. Accessed 13 February 2020. /24/ - Email from Verra on 24th August 2022, where it was confirmed that the eligible crediting period of ten years and that the PP should request a request for a crediting period renewal /25/. -VCS PD template v4.1 /26/

Remote Audit Evidences

- 52 Pictures of the main equipment of the project, such as the landfill plants, flare, sensors, meters, etc./27/
- Emails with relevant information regarding to the implementation of the project.

APPENDIX II: FINDINGS

Corrective action requests (CARs)

CAR	01	Date: 11/10/2022
Description of CAR		
The following sections are not in accordance with the VCS PDD template: 1. Section 1.17 does not describe how the project contributes to achieving any nationally stated sustainable development priorities, including any provisions for monitoring and reporting same. 2. Section 2.2 does not include the procedures or methods used for documenting the outcomes of the local stakeholder consultation; the mechanism for on-going communication with local stakeholders; nor how due account of all and any input received during the consultation has been taken. Include details on any updates to the project design or justify why updates are not appropriate. 3. Section 5.3 does not include the organizational structure, responsibilities and competencies of the personnel that will be carrying out monitoring activities; the policies for oversight and accountability of monitoring activities; the procedures for handling non-conformances with the validated monitoring plan; nor any sampling approaches used, including target precision levels, sample sizes, sample site locations, stratification, frequency of measurement and QA/QC procedures.		
Project participant response		Date: 28/10/2022
1. <i>Section 1.17 has been revised to describe how the project contributes to achieving sustainable development impacts.</i> 2. <i>Section 2.2 has been revised to include the procedures and methods for engagements and documenting the outcomes of the local stakeholder consultation. Also, the mechanism for on-going communication with local stakeholders has been included and how due account of inputs will be taken.</i> 3. <i>Section 5.3 has been revised to include the organizational structure, responsibilities and competencies of the personnel that will be carrying out monitoring activities; the policies for oversight and accountability of monitoring activities and the procedures for handling non-conformances with the validated monitoring plan.</i>		
Documentation provided by the Project Participant		
Jhb LFG VCS PD v8.1		
VVB Assessment		Date: 27/12/2022

The PD has been provided and the sections have been modified in accordance with the template, CAR 1 is closed.

CAR	02	Date: 11/10/2022
Description of CAR		
The following errors or misstatements have been found on the PDDParameter GWPCH4 has not been updated in accordance with IPCC AR5		
Project participant response		Date: 28/10/2022
<i>The parameter GWPCH4 has not been updated in accordance with IPCC AR5 in both the PDD and ex ante ER calculations</i>		
Documentation provided by the Project Participant		
- Jhb LFG VCS PD v8.1 - Joburg LFG PD Renewal Ex Ante Calcs v2		
VVB Assessment		Date: 27/12/2022
The PDD and the calculation excel have been updated and the results are correct, CAR 2 is closed.		

Clarification requests (CLs)

CL	01	Date: 11/10/2022
Description of CL		
Please provide evidence of the following: 1. Pictures and videos of the plants 2. Eskom reports used for the calculation of EF		
Project participant response		Date: 28/10/2022
1. <i>Pictures and videos of the plants have been provided</i> 2. <i>Eskom reports used for the calculation of EF have been provided</i>		
Documentation provided by the Project Participant		

CL ID	03	Date: 31/08/2021
Description of CL		
1. Pictures and videos 2. Eskom reports: HistoricElectrGeneration2020 and PowerStationsPrimaryEnergy2020		
VVB Assessment		Date: 10/12/2022
The supporting documents have been provided and the documentation is considered correct, CL 1 is closed.		

CL	02	Date: 11/10/2022
Description of CL		
Section 1.15 clarify the project's history in CDM and provide evidence of no double counting		
Project participant response		Date: 28/10/2022
Section 1.15 has been revised to clarify the project's history in CDM and provide evidence of no double counting.		
Documentation provided by the Project Participant		
Jhb LFG VCS PD v8.1		
VVB Assessment		Date: 27/12/2022
The correct have been provided, and the documentation it is considered correct, CL 2 is closed.		