PICHACAY LANDFILL GAS RENEWABLE ENERGY PROJECT

Document Prepared By EPIC Sustainability Services Private Limited

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Summary:

EPIC Sustainability Services Private Limited (hereinafter referred to as EPIC) has been contracted by BGP Ingenieursbureau B.V., to undertake the validation and first periodic independent verification of the project activity titled “Pichacay Landfill Gas Renewable Energy Project” (VCS project id: PL1883 (hereinafter referred to as project activity) for the monitoring period 27th July 2017 to 31st December 2018. The verification was based on the Joint project design document and monitoring report version version 1.0 dated 4th April 2019 other supporting documents made available to the verification team by the client.

The Pichacay is a sanitary landfill owned by the municipality of Cuenca and operated by Empresa Municipal de Aseo de Cuenca (EMAC). Pichacay accepts domestic and commercial waste from the city of Cuenca and surrounding areas. Gas rights are owned by EMAC, which is owned by the municipality of Cuenca. The site opened in 2001 and received approximately 115,000 tonnes of waste annually. The project is a landfill gas to energy project developed by EMAC-BGP ENERGY COMPAÑÍA DE ECONOMÍA MIXTA CEM, located in Santa Ana, city of Cuenca, province of Azuay, Ecuador. The proposed activity involves the collection and utilization of the LFG for generation of electricity. The

amount of gas available from the Pichacay Landfill is currently sufficient to support a medium-sized single spark ignition engine of approximately 1 MW. However, the proposed project will have a total installed capacity of 0.85 MW x 4 by the year 2022 when it accepts more waste and will be implemented in phases, starting with an install capacity of 0.85 MW in the year 2017 (initial phase). The commercial operation of the project started on 27th July 2017. The verification team has reviewed the commissioning letters and accepted the same. The second phase is expected to be commissioned soon. The phase 3 and 4 of the project would be commissioned in 2022. PP is under process of getting the licence for phase 3 and 4. In the absence of the project activity, organic waste at the landfill would be left to decay, thereby emitting LFG to the atmosphere. The project collects LFG that would otherwise be emitted to the atmosphere. By generation of renewable electricity from the LFG, grid demand is reduced, reducing emissions of fossil-based electricity generation.

The proposed VCS project activity has applied the baseline and monitoring methodologies (AMS.III.G Version 10.0) and AMS.I.D v18.0). In summary, it is the opinion of EPIC that the proposed VCS project activity meets the relevant VCS requirements and the estimated GHG reductions from the project would be real, measurable, permanent and additional.

The verification team identified, through the verification process, 3 CARs, 2 CLs and 1 FAR. The PP has taken actions and submitted to EPIC the revised monitoring report and supporting evidence. In summary, it is the opinion of EPIC that the proposed VCS project activity has correctly applied the baseline and monitoring methodology (Methodology Applied: AMS.III.G Version 10.0 and AMS.I.D v18.0 for the project activity and meets the relevant VCS requirements. The estimated GHG reductions from the project would be real, measurable, permanent and additional. The verification team, through the verification process, confirmed that the emission reductions achieved by the project activity during the monitoring period are correctly calculated in the Joint PD and MR, Version 3.2, dated 7th July 2019 based on the approved monitoring methodology. Therefore, EPIC certifies the emission reductions amounting to 38259 tCO2e during the monitoring period.

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1 INTRODUCTION

1.1 Objective

EPIC Sustainability Services Private Limited (hereinafter referred to as EPIC) has been contracted by BGP Ingenieursbureau B.V., to undertake the validation and first periodic independent verification of the project activity titled "Pichacay Landfill Gas Renewable Energy Project" (VCS project id: PL1883 (hereinafter referred to as project activity) for the monitoring period 27th July 2017 to 31st December 2018.

- The purpose of the validation/verification is to perform an independent, third party assessment of whether the project activity confirms to the qualification criteria set in the VCS standard[/1/] v 3.7 and VVS-PA[/1/] v2.0 requirements to attain real, measurable, additional and permanent emission reduction. The verification statement / opinion is a written assurance that the project complies with all the applicable VCS requirements and has the ability to generate the emission reductions stated over the projects crediting period.

- To verify that the actual monitoring system and procedures are in full compliance with the system and procedures described in the Joint PD and MR[/2/], v1.0 dated 4th April 2019 (hereinafter referred to as Initial PD/MR) as well as with the applicable methodology;

- To verify that the data reported were accurate, complete, consistent, transparent and free of material error or omission by checking the monitoring records and the emissions reduction calculation; and

- To verify and certify GHG emission reduction reported for the project for the period from 27th July 2017 to 31st December 2018 (hereinafter referred to as current monitoring period).

1.2 Scope and Criteria

The validation/verification scope includes an independent and objective review of the Joint VCS project description/Monitoring report (PD/MR), the project's baseline study, monitoring plan and other relevant documents. Specifically, the objectives of the verification work involve:

- To verify whether the project activity meets the requirements of VCS standard v3.7 including additionality, proof of title and compliance with local laws.
- To assess whether the baseline and monitoring plan are in conformance with the methodology applied from the VCS approved GHG program.
- To certify that the information presented are complete, consistent, transparent and free of material error.

The Project Description was reviewed against VCS standard and the VCS program guidelines and the applied CDM methodologies. EPIC has performed the validation and verification based on a risk based approach focusing mainly on the significant risks to meet the qualification criteria and the ability to generate VCUs. The work carried out by EPIC is free from any conflict of interest.

The scope of the verification was the independent and objective review and ex-post determination of the monitored reductions in GHG emissions from the project activity. The verification of this CDM project was based on the initial PD/MR and supporting documents made available to the verification team. These documents were reviewed against the requirements of the VCS standard[/1/] v3.7, VCS guidelines[/1/], the CDM Modalities and Procedures, related rules and guidance, and the Validation and Verification standard for project activities[/1/] v2.0. The verification is not meant to provide any consulting towards the client. However, stated request for clarifications and/or corrective actions may provide input for improvement of the project design.

1.3 Level of Assurance

In line with VCS 2007.1 requirements and as per ISO 14064-3:2006 Para A.2.3.2, a reasonable level of assurance has been followed for the verification of the project. Based on the desired level of accuracy EPIC has established an internal quality control process and assures that the information given in the initial PD/MR is materially correct and is a fair representation of the of the actual project details, and is prepared in accordance with the VCS requirements and the applied CDM methodology for information pertaining to additionality, GHG quantification, monitoring and reporting. The verification report is carried out as per this requirement and details are presented in the verification statement in section 4 below.

1.4 Summary Description of the Project

The Pichacay is a sanitary landfill owned by the municipality of Cuenca and operated by Empresa Municipal de Aseo de Cuenca (EMAC). Pichacay accepts domestic and commercial waste from the city of Cuenca and surrounding areas. Gas rights are owned by EMAC, which is owned by the municipality of Cuenca. The site opened in 2001 and received approximately 115,000 tonnes of waste annually. The project is a landfill gas to energy project developed by EMAC-BGP ENERGY COMPAÑÍA DE ECONOMÍA MIXTA CEM, located in Santa Ana, city of Cuenca, province of Azuay, Ecuador. The proposed activity involves the collection and utilization of the LFG for generation of electricity. The amount of gas available from the Pichacay Landfill is currently sufficient to support a medium-sized single spark ignition engine of approximately 1 MW (derated to 0.85 MW since). However, the proposed project will have a total installed capacity of 0.85 MW x 4 by the year 2022 when it accepts more waste and will be implemented in phases, starting with an install capacity of 0.85 MW in the year 2017 (initial phase). The commercial operation of the project started on 27th July 2017. The verification team has reviewed the commissioning letters[/3/] and accepted the same. The second phase is expected to be commissioned soon. The phase 3 and 4 of the project would be commissioned in 2022. PP is under process of getting the licence for phase 3 and 4. The gas engines is/will be derated from 1 MW to 0.85 MW due to altitude. In the absence of the project activity, organic waste at the landfill would be left to decay, thereby emitting LFG to the atmosphere. The project collects LFG that would otherwise be emitted to the atmosphere. By generation of renewable electricity from the LFG, grid demand is reduced, reducing emissions of fossil-based electricity generation.

2 VALIDATION AND VERIFICATION PROCESS

2.1 Method and Criteria

The EPIC validation/verification process consists of the following phases:

- a document review of the project description and preparation of validation/verification protocol;
- on-site visit to the project activity and interviews with project developer, project consultant; and relevant stakeholders
- resolution of outstanding issues and the issuance of final validation/verification report and opinion

In order to ensure transparency, a validation/verification protocol was customised for the project according to the VCS guidelines. The protocol describes the findings, criteria (requirements), means of verification, results from the validating and how the identified criteria, have been met in a transparent manner. The verification protocol serves the following purposes:

- it organizes, details and clarifies the requirements of a VCS project is expected to meet;
- it ensures a transparent validation/verification process where the validator will document how a particular requirement has been validated and the result of the validation.

The protocol consists of Appendix, where findings established during the validation/verification were classified as non-fulfilment of validation/verification protocol criteria or where risks to the fulfilment of project objectives were identified. Corrective Action Request (CAR) was issued, where:

- mistakes have been made that directly impact on the project results; or
- validation protocol requirements have not been met; or
- there was a risk that the project would not be accepted as a VCS project or that emission reductions will not be certified.

The verification team has also raised “Clarification” (CL), where additional information is needed to fully clarify an issue.

APPENDIX : RESOLUTION OF CORRECTIVE ACTION AND CLARIFICATION REQUESTS

Draft report clarifications and corrective action requests by verification team	Ref. to Section of the PD	Summary of project owner response	Verification team conclusion
If the conclusions from the draft Validation are either a CAR or CL, these should be listed in this section.	Reference to the Section of the PD where the relevant CAR or CL is raised.	The responses given by the project participants during the communications with the verification team should be summarized in this section.	This section should summarise the verification team’s responses and final conclusions.

The following team members from EPIC are involved in identifying the following:

Name	Role	Components reviewed
Mr. R. Vijayaraghavan	Lead Auditor	Completeness check, desk review, onsite inspection, Interview with project representatives, issuance of findings, report preparation
Dr. D. Siddaramu	Technical Reviewer	Technical Issues related to project

2.2 Document Review

The initial PD/MR[/2/] version 1.0 submitted by the client and additional backgrounds documents related to the project design and baseline were reviewed as an initial step of the verification process. As a result of review and findings, PP had submitted the PD/MR version 3.2[/4/] dated 7th July 2019 (referred to as final PD/MR).

A desk review was further done to assess the following parameters:

1. Project details as per VCS PD/MR template
2. Applicability and Appropriateness of methodology used
3. Compliance with relevance laws and regulation, operating licences
4. Correctness of application of baseline and monitoring methodology
5. Demonstration of additionality
6. Monitoring Plan
7. Stakeholders' comment
8. Proof of title
9. Supporting documents mentioned in the PD (DPR, approvals)
10. Local stakeholder consultation reports

2.3 Interviews

After the review of the Project description and documents a site visit was carried out from 5th and 6th June 2019. During the site visit physical inspection of the project components followed by interviews with the on-site personnel was carried out to verify the project details. A follow-up meeting was also conducted with the project representatives. The following persons were interviewed.

Name & Designation	Company	Details of Interview
David González Hidalgo (Director)	EMAC-BGP ENERGY COMPAÑÍA DE ECONOMÍA MIXTA CEM	Completeness check, desk review, onsite inspection, Interview with project representatives & stakeholders, issuance of findings, report preparation. Baseline, monitoring plan. Proof of title. Technical Details, Monitoring system, calibration frequency, Infrastructure. Loan Sanction Documents, Power Purchase Agreement, Land Ownership details, Purchase Order details, Overall Project management. Baseline, Additionality, Barrier analysis.
Hendrik Velthuis (General Manager)	BGP Engineers B.V.	
Martijn Vis (Senior Consultant)	BTG Biomass Technology Group B.V.	Technical Details, Monitoring system, calibration frequency, Infrastructure. Loan Sanction Documents, Power Purchase Agreement, Land Ownership details, Purchase Order details, Overall Project management. Baseline, Additionality, Barrier analysis and CER sheets
Guevora	Ministry of the Environment (Cuenca Branch Office Director	Licence of landfills, environmental impact assessment, regulations
Jouier Yepez	Ministry of the Environment (Cuenca Branch	
Paul Cresco	EMAC	Technical Details, Monitoring system, calibration frequency, Power Purchase Agreement
Ealo Vasqua	EMAC	
Santiago Vozquez	EMAC-BGP	
Mourice Hatute	Village President – Santa Ana	Local stakeholder consultation

Artrro Velthuis	Village Santa Ana	
Christian	Village Mosquera	
Victor Pago	Village Mosquera	
Jose	Village El Chorro	
Geonanag	Village Santa Ana	
Marcas	Village El Chorro	
Zoila	Village El Chorro	
Angel Villa	Village Mosquera	
Mirsa Pelote	Village Santa Ana	
Ana Lucia Yunga	Village Santa Ana	
Sonia Paute	Village Santa Ana	
Vicento Vera	Village Santa Ana	
Jose Suerota	Village Mosquera	
Gustav Villa	Village El Chorro	
Oscar Zhumi	Village Santa Ana	
Gabriel Mendocos	Village Santa Ana	
Jenny Ingel	Village Santa Ana	

2.4 Site Inspections

During the site visit, the actual on-site practices adopted and followed for the operation of the project were compared with the description given in the monitoring report. The technical details, manufacturing system, environmental impact aspects, calibration and level of accuracy were examined. The archived data of the energy generated was also reviewed.

An on-site assessment was conducted as a part of validation and verification activity and involved:

1) an assessment of the implementation and operation of the project activity as per the PD/MR

2) a review of information flows for generating, aggregating and reporting of the monitoring parameters

3) interviews with relevant personnel to confirm that the operational and data collection procedures are implemented in accordance with the PD/MR

4) a cross-check between information provided in the PD/MR and data from other sources

5) a review of baseline and additionality of the project

6) a check of the monitoring equipment including calibration performance, and observations of monitoring practices against the requirements of the PD/MR and the applied methodology

7) A review of calculations and assumptions made in determining the GHG data and ERs, and

8) An identification of QA/QC procedures in place to prevent, or identify and correct, any errors or omissions in the reported monitoring parameters.

Resolution of Findings

Resolution of Clarification and Corrective Action Requests

The objective of this phase of the verification was to resolve the corrective action requests and clarifications and any other outstanding issues which needed to be clarified prior to EPIC positive conclusion on the monitoring report and the project design. During the verification process three CARs, 2 CLs and 1 FAR were raised.

All the CARs and CRs were resolved during this phase. In order to ensure the transparency of the validation/verification process, the concerns raised and responses that were given are summarized in Appendix of this report and documented in more detail in the Verification in Appendix . All the corrective actions have been incorporated into the monitoring report.

2.4.1 Forward Action Requests

There is no FAR raised during this verification process.

3 VALIDATION FINDINGS

3.1 Project Details

Project Type	The project is a landfill gas to energy project developed by EMAC-BGP ENERGY COMPAÑÍA DE ECONOMÍA MIXTA CEM, located in Santa Ana, city of Cuenca, province of Azuay, Ecuador. The proposed activity involves the collection and utilization of the LFG for generation of electricity. The proposed project will have a total installed capacity of 0.85 MW x 4 by the year 2022 and will be implemented in phases, starting with an installed capacity of 0.85 MW in the year 2017 (initial phase). The commercial operation of the project started on 27th July 2017. The verification team has reviewed the commissioning letters/3/ and accepted the same. Solid waste generated by households in the city of Cuenca is collected by the EMAC EP and transferred to Pichacay Landfill for treatment and final disposal, which is done with the highest technical and environmental standards. The daily average collection of solid waste is 430 tonnes per day. The Pichacay landfill is located in Santa Ana, 20 km from Cuenca City. Operations began on September 3rd, 2001 in strict fulfillment with the legal regulations for this type of equipment and it had the Environmental License/5/ granted by the Ministry of Environment in 14th December 2002.
Project proponent	The project is a landfill gas to energy project developed by EMAC-BGP ENERGY COMPAÑÍA DE ECONOMÍA MIXTA CEM, located in Santa Ana, city of Cuenca, province of Azuay, Ecuador. The verification team has reviewed the Environment impact assessment report/6/ and its approval/6/, Environment licence/5/ for 2 MW, commissioning letter and accepted. EMAC EP, BGP Engineers B.V, BTG Biomass Technology Group B.V. are other entities involved in the project.
Project start date	The proposed project will have a total installed capacity of 0.85 MW x 4 by the year 2022 and will be implemented in phases, starting with an installed capacity of 0.85 MW in the year 2017 (initial phase). The commercial operation of the project started on 27th July 2017. The verification team has reviewed the commissioning letters/3/ provided by CENACE and accepted the same. As per section 3.7.1 of the VCS

	Standard[1] v3.7, the project start date is the date on which the project began generating GHG emission reductions or removals. Since the project has started to achieve emission reductions on 27th July 2017 , it is accepted as start date of the project.
Project crediting period	The project proponent has chosen a renewable crediting period of 10 years. The crediting period starts from 27 July 2017 (the project start date) to 26 July 2027 (including both days). The crediting period can be renewed 2 x 10 years. Since it is as per section 3.8.1 of the VCS Standard[1] v3.7, it is accepted. The verification team has reviewed the lifetime of the gas engines[20] and accepted the same.
Project scale	Since the estimated annual ER (33237 tCO2e) is less than 300,000 tCO2e, the project is categorised as 'projects'. This is as per section 3.9.1 of VCS standard v3.7. The project is not a fragmented part of a larger project that would otherwise exceed the limits mentioned here. As per section 3.9.2 of the VCS Standard, the project shall be considered a fragmented part of a larger project if within one kilometer of the project boundary there exists another project where: 1) The project proponents for both projects are the same. 2) The sectoral scope and project activity for both projects are the same. 3) The other project has been registered under the VCS or another GHG program within the previous two years. This is not the case here as evident from the onsite visit by the verification team.
Project location	The project is a landfill gas to energy project developed by EMAC-BGP ENERGY COMPAÑÍA DE ECONOMÍA MIXTA CEM, located in Santa Ana, city of Cuenca, province of Azuay, Ecuador. The verification team has reviewed the joint PD/MR and accepted the same as correct.
Conditions prior to project initiation	This is a greenfield project. Hence there is no pre project activity happening in the baseline scenario. There was no power plant prior to the implementation. The verification team has reviewed the images of the particular land before the site preparation of the project and convinced that there is no power plant.
Project compliance with applicable laws, statutes and other regulatory frameworks	The verification team has reviewed the contract[7] referred as Título Habilitante", the scope being construction, installation and operation of the Pichacay landfill gas extraction and electricity generation project, between EBE and CONELEC (ARCONEL). The project

	has received all legal required permissions for the extraction of landfill gas, the installation of the gas engine and the delivery of electricity to the national grid. The verification team has reviewed the environmental licence/5/ for the construction, operation and retirement of the project to generate electricity from landfill gas. The verification team has also reviewed the environmental impact assessment/6/ as well. The verification team has also interviewed the Ministry of the Environment (Cuenca Branch Office Director) and confirmed the above.
Ownership and other programs https://www.vcsprojectdatabase.org/#/pipeline	BGP Engineers B.V. is a private Clean Energy Management company from the Netherlands and part of the Energy Engineering Solutions (ees) International B.V. group. In July 2012, BGP Engineers B.V. became partners with EMAC EP (Empresa Municipal de Aseo de Cuenca). EMAC is the Municipal Waste Management Company of the City of Cuenca, Ecuador. The two companies created a new Joint Venture company called EMAC-BGP Energy CEM (EBE). Final Investment of approx. 51% EMAC - 49% BGP. The verification team has reviewed the public deed of constitution/8/ and accepted the same. EBE's main objective is to contribute in the reduction of Global Warming through the capture and destruction of the methane gas contained in the biogas at the Pichacay Landfill. EMAC-BGP ENERGY COMPAÑÍA DE ECONOMÍA MIXTA CEM is the project owner, which is a joint venture between the Municipal waste processing company of Cuenca EMAC-EMPRESA MUNICIPAL DE ASEO DE CUENCA (in short: EMAC) and BGP Engineers B.V, with the aim to generate electric energy from the biogas obtained from the landfill. Hence accepted. The project was published for Global stakeholder comments under CDM program/9/ in 2012. But the project was never validated further. The project was never rejected in other programs. The project so far has not created any other form of environmental credit. But, the project will not seek for registration under CDM separately. The project meets the general requirements of VCS Version 3 with respect to project start date, project scope and crediting period according to clause 5.1, 5.2 and 5.3. The verification team has also checked the VCS website and found that the project was listed in the VCS pipeline/2/ on 10th April 2019 (Project ID: PL1883). The project status at the time of writing this report is 'Under validation'.

3.2 Participation under Other GHG Programs

The project so far has not created any other form of environmental credit. But, the project will not seek for registration under CDM separately. It still lies dormant after GSCP and it will remains so for the rest of the time. The project has not been rejected under other GHG programme. .

3.3 Application of Methodology

3.3.1 Title and Reference

Applied methodology:

AMS-III.G. Small-scale Methodology: “Landfill methane recovery”[/10/] v10.0 and its associated tools and AMS-I.D Small-scale Methodology: “Grid connected renewable electricity generation”[/10/], v18.0 and its associated tools.

3.3.2 Applicability

Applicable conditions of AMS.III.G[/10/] v10.0	Verification opinion
1.This methodology comprises measures to capture and combust methane from landfills (i.e. solid waste disposal sites) used for the disposal of residues from human activities including municipal, industrial, and other solid wastes containing biodegradable organic matter.	The verification team has reviewed the EIA report[/6/] where it is confirmed that the project captures and combust LFG from the Pichacay landfill. The Municipal solid waste containing biodegradable organic matter from the city of Cuenca is disposed in the landfill. The onsite visit confirms the same. Hence condition is satisfied.
2.Different options to utilise the recovered landfill gas as detailed in paragraph 4 of “AMS-III.H.: Methane recovery in wastewater treatment” (version 19.0) are eligible for use under this methodology. The relevant procedures in AMS-III.H. shall be followed in this regard.	The recovered LFG is used for generating electricity from the gas engine apart from flaring. This is as per para 4a of AMS-III.H.: Methane recovery in wastewater treatment[/11/]” (version 19.0).
3.Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO2 equivalent annually from all Type III components of the project activity.	The estimated annual ER is only 33,237 tCO2e only. Hence condition is satisfied.
4.The proposed project activity does not reduce the amount of organic waste that would have been recycled in the absence of the project activity.	There is no recycling plant available in the region as confirmed at the site visit. Hence condition is satisfied.
5.This methodology is not applicable if the management of the solid waste disposal site (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 (e.g. other than to meet a technical or regulatory requirement). Such changes may include, for example, the addition of liquids to a SWDS, pre-treating waste to seed it with bacteria for the purpose of increasing the rate of anaerobic degradation of the SWDS or changing the shape of the SWDS to increase methane production.	As confirmed at the site, there is no measure implemented with the sole aim for increasing the LFG yield. However, there found to be some technical improvements with a view to capture and destroy Methane in the most efficient manner. Hence this condition is satisfied.

Applicable conditions of Tool-Emissions from solid waste disposal sites v8.0[/13/]	
1.This tool provides procedures to calculate baseline, project or leakage emissions of methane from solid waste disposed or prevented from disposal at a SWDS	The verification team has reviewed the EIA report[/6/] where it is confirmed that the project captures and combust LFG from the Pichacay landfill. The solid waste is being disposed at the landfill. Hence the project can use this tool.
2.The tool can be used to determine emissions for the following types of applications: (a) Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. “ACM0001: Flaring or use of landfill gas”). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex ante estimation of emissions in the project design document (CDM-PDD). The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS); (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. These two types of applications are referred to in the tool for determining parameters.	The proposed VCS project mitigates methane emission from the Pichacay landfill which was opened since 2001. The proposed project captures LFG for electricity. Since the VCS project activity mitigates methane emissions from the existing SWDS by capturing, flaring or combustion, and the methane is generated from waste disposed in the past (from 2001), including prior to the start of the CDM project activity (July 2012), Application A of the emission from solid waste tool applies to the project activity. Application B is not applicable as the project is not about prevention of disposal of waste.
3. 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.	The waste in question is MSW disposed in the landfill. Hence the condition is satisfied.
Applicable conditions of Tool-Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation v3.0[/13/]	
1.If emissions are calculated for electricity consumption,	At the site, it was observed the electricity is

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 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.	purchased from the grid only. Hence scenario A is applicable.
2.This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated: (a) Scenario I: Electricity is supplied to the grid; (b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or (c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.	The electricity generated is sold to the national grid as per the EIA report[/6/], monthly electricity invoices[/12/]. Hence scenario I applies for the project.
3.This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO2 emissions	There is no captive renewable power generation or fossil fuel based power plant inside the project boundary. Hence condition is not applicable.
Applicable conditions of Tool to calculate project or leakage CO2 emissions from fossil fuel combustion v3.0[/13/]	
1.This tool provides procedures to calculate project and/or	There is no fossil fuel based power plant

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.	located inside the project boundary. Hence the condition is not applicable.
Applicable conditions of Tool Project emissions from flaring v3.0/13/	
1.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	Since the flare used is enclosed one, this tool can be applied. PP indicated the type of flare in the VCS PD. Hence the condition is applicable.
2.This tool is applicable to the flaring of flammable greenhouse gases where: (a) Methane is the component with the highest concentration in the flammable residual gas; and (b) The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).	The recovered LFG has 50% methane only, others being inflammable. The source of LFG is from landfills. Hence the condition is applicable.
3.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	There is no auxiliary fuels used in the flare. Hence accepted.
Applicable conditions of Tool to determine the baseline efficiency of thermal or electric energy generation systems v2.0/13/	
1.This tool is applicable to energy generation systems that: (a) Generate only electricity (and no heat); or (b) Produce only thermal energy (and no electricity); or (c) Produce both electricity and thermal energy (cogeneration).	The project produces only electricity. Hence condition a is satisfied.
2.Also, the following conditions apply: (a) The tool is not applicable to waste heat recovery systems; (b) The tool can be applied only if load is the main operating parameter1 that influences the efficiency of the energy generation system. For cogeneration systems, the heat to power ratio may also be considered a main operating parameter	Load is the main operating parameter1 that influences the efficiency of the energy generation system. Hence accepted.
3.Methodologies referring to this tool should specify for which energy generation systems the tool is used and	As per the project design, gas engines are the only energy generation systems. The

whether a load-efficiency function and/or a constant efficiency should be determined	efficiency of gas engine (36%) is constant.
Applicable conditions of tool Positive lists of technologies v1.0[/13/]	
1.The use of this methodological tool is not mandatory for the project participants of a CDM project activity or CDM PoA for demonstrating their additionality.	PP used this tool to demonstrate additionality as specified by the applied methodology AMS.III.G. Hence accepted.
2.This methodological tool shall be applied in conjunction with a small-scale or large-scale methodology which refers to this tool.	This tool is applied in conjunction with AMS.III.G which refers to this tool. Hence accepted.
3.The positive list as contained in section 5 of this tool is valid up to November 2021. Notwithstanding the provisions on the validity of new, revised and previous versions of methodologies and methodological tools in the "Procedure: Development, revision and clarification of baseline and monitoring methodologies and methodological tools", there will be no grace period for the application of this tool and the validity of the positive list after this date, including in cases where further technologies are added to the positive list through revisions of this tool before this date.	The positive list is valid upto November 2021. Hence accepted.
Applicable conditions of AMS.I.D v18.0	
1. This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass: (a) Supplying electricity to a national or a regional grid; or (b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.	The project is generation of electricity which is supplied to the Ecuadorian Public Electricity Grid. This is displacement of electricity that would be provided to the grid by more-GHG-intensive means. As per the definition mentioned in the methodology, generated electricity is renewable energy. Hence accepted.
2.Illustration of respective situations under which each of the methodology (i.e. "AMS-I.D.: Grid connected renewable electricity generation", "AMS-I.F.: Renewable electricity generation for captive use and mini-grid" and "AMS-I.A.: Electricity generation by the user) applies is included in the appendix.	The electricity generated is supplied to the national grid. Hence use of AMS.I.D for this project is valid.
3. This methodology is applicable to project activities that: (a) Install a Greenfield plant; (b) Involve a capacity addition in (an) existing plant(s); (c) Involve a retrofit of (an) existing plant(s); (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s).	The project is installed in a greenfield where there was no existing power plant. Hence condition 3a is satisfied.
4.Hydro power plants with reservoirs that satisfy at least	This is not applicable as this is not hydro

one of the following conditions are eligible to apply this methodology: a)The project activity is implemented in an existing reservoir with no change in the volume of reservoir b)The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m2; (c) The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m2.	power plant.
5.If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	The envisaged installed capacity of the power plant is 4 MW of which 1 MW is already commissioned. Further 1 MW was derated to 0.85 MW due to altitude.
6.Combined heat and power (co-generation) systems are not eligible under this category.	This is not combined power plant. Hence not applicable.
7.In the case of project activities that involve the capacity addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct1 from the existing units.	The project is installed in a greenfield where there was no existing power plant. Hence condition not applicable.
8.In the case of retrofit, rehabilitation or replacement, to qualify as a small-scale project, the total output of the retrofitted, rehabilitated or replacement power plant/unit shall not exceed the limit of 15 MW.	The project is installed in a greenfield where there was no existing power plant. Hence condition not applicable.
9.In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as “AMS-I.C.: Thermal energy production with or without electricity” shall be explored.	The recovered LFG emissions are already applied under AMS.III.G. Since the recovered methane is used for electricity generation for supply to a grid, the baseline for the electricity component is demonstrated in accordance with procedure prescribed under this methodology (AMS.I.D).
10.In case biomass is sourced from dedicated plantations, the applicability criteria in the tool “Project emissions from cultivation of biomass” shall apply.	The project captures and combust LFG from the Pichacay landfill. The onsite visit confirms the same. Hence condition is not applicable.

Applicable conditions of Tool to calculate the emission factor for an electricity system v7.0[1/3/]	
1.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).	The electricity generated from the project is supplied to the grid. Hence this tool can be used for estimation of OM,BM,CM.
2.Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in "Appendix 1: Procedures related to off-grid power generation" should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	Since the emission factor for the project electricity system is calculated for grid power plants only and no off-grid electricity is considered.
3.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.	Ecuador is not an Annex I country. Hence accepted.
4.Under this tool, the value applied to the CO2 emission factor of biofuels is zero.	The value applied to the CO2 emission factor of biofuels is zero

3.3.3 *Project Boundary*

As per para 12 of the applied methodology AMS.III.G[/10/], the project boundary is the physical, geographical site of the landfill where the gas is captured and destroyed/used. As per para 18 of the applied methodology AMS.I.D[/10/], The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to. As the PDD, this project boundary includes Pichacay landfill in where LFG is captured and used it to generate electricity, and the grid-connected system is included in the project boundary as well. Hence accepted by the verification team.

3.3.4 *Baseline Scenario*

The project activity comprises two technology measures namely collection of LFG and combustion of LFG by flaring or generating electricity in gas engines.

For LFG, as per para 14 of the applied methodology AMS.III.G, the baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay within the project boundary, and methane is emitted to the atmosphere, possibly with capture of LFG and destruction through flaring to comply with regulations or contractual requirements. Baseline emissions shall exclude methane emissions that would have to be removed to comply with national or local safety requirements or legal regulations. In addition, the effect of methane oxidation that is present in the baseline and absent in the project shall be taken into account.

For electricity, as per para 19 of the applied methodology AMS.I.D, the baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid. As the generation of electricity of 4 MW using captured LFG as fuel in the gas engines was a voluntary investment which intends to replace equivalent amount of electricity at the grid. PP was not bound by any current national requirements to incur this investment. Hence in the absence of this investment does not lead to any continued baseline practice for PP within their scope whereas the continued operation of the project activity would continue to replace equivalent amount of electricity at the grid. The verification team has concluded that there is no national requirement at the time of requesting registration to invest in the generation of electricity. The baseline for electricity is also in line with para 13b (i) of the applied methodology AMS.III.G.

The verification team has reviewed the contract referred as Título Habilitante[/7/]", the scope being construction, installation and operation of the Pichacay landfill gas extraction and electricity generation project, between EBE and CONELEC (ARCONEL). The project has received all legal required permissions for the extraction of landfill gas, the installation of the gas engine and the delivery of electricity to the national grid. The verification team has reviewed the environmental licence[/5/] for the construction, operation and retirement of the project to generate electricity from landfill gas. The verification team has also reviewed the environmental impact assessment[/6/] as well. The project complies with national policies. The verification team checked that there is no requirement for landfill gas to be captured and flared in Ecuador. The verification team has confirmed that the project activity is voluntary. The verification team has confirmed that there is no landfills available around the region. The only other landfill biogas project in the country is currently in the ‘EL INGA landfill in Quito with average capacity of 1771 tonnes of MSW/day. Since the applied methodologies prescribe the predefined baseline scenario, the verification team has accepted.

3.3.5 *Additionality*

As per para 13a of the applied methodology AMS.III.G, PP can use simplified procedure for additionality demonstration and baseline: by referring to the requirements in methodological tool “Positive lists of technologies”[/13/] v2.0. As per para 11 of the tool, 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 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.

The verification team has reviewed the EIA report[/6/] and confirmed that the landfill was opened in 2001 and landfill gas would have been only vented and/or flared but not utilized for energy generation. The installed capacity of the project is only 4 MW. Hence the project is additional.

From the onsite visit, the verification team has understood from the interview of PP that since 2001, EMAC EP has had financial autonomy by collecting the income for its normal operation and development based on the "Ordinance that establishes the criteria for the determination and collection of the rate of waste collection and cleaning service". The rate uses the electric energy consumption as a mechanism for calculating the subsidy of the monthly tariff for each user. This ordinance empowers the EMAC-EP through agreements signed with the Central Electric Company of the South Center (EERCS) to charge the rate of waste collection and cleaning service together with the electric energy service payroll.

The value of the rate is adjusted monthly and 80% of the residential sector receives a subsidy from the higher strata and the commercial/industrial sectors. This mechanism has allowed the company to have no budget deficit. EMAC EP does not receive contributions or economic subsidies from the Central Government or the Municipality of Cuenca. This situation may change in the near future given a new law for the public service of electric energy, which in general terms prohibits the collection or inclusion in the electric energy bill amounts for other services such as waste collection and cleaning service. This new legal scenario puts at risk the economic and financial sustainability of EMAC EP which is currently analyzed by its administration and board members.

3.3.6 *Quantification of GHG Emission Reductions and Removals*

Particulars	Verification opinion
Emission reduction achieved by the project activity ($ER_{project,y}$)	The verification team has checked whether PP has estimated the emission reductions in line with the latest approved version of the applied methodology The verification team checked if all the assumptions and data used by the project participants are listed in the joint PD/MR[/2/], including their references and sources, all documentation used is relevant for establishing the emission reductions and correctly quoted and interpreted in the joint PD/MR[/2/], assumptions and data used in the estimation of emission reductions are justified appropriately, supported by evidence and can be deemed reasonable. Emission reduction achieved by the project activity consists of emission reduction due to methane component ($ER_{methane,y}$) and emission reduction due to electricity component ($ER_{electricity,y}$). $ER_{project,y} = ER_{methane,y} + ER_{electricity,y}$ The verification of the same is detailed below.
Emission reduction achieved by methane component ($ER_{methane,y}$)	As per para 19 of AMS.III.G[/10/] v10, the emission reduction achieved by the project activity can be estimated ex ante in the project design document (PD) by the following. $ER_y = BE_y - PE_y - LE_y$ Where Where BE_y -Baseline emissions in year *y* PE_y -Project emissions in year *y* LE_y-Leakage emissions in year y The verification details of BE_y, PE_y and LE_y is detailed below.
Baseline emissions in year y (BE_y)	As per para 14 of AMS.III.G[/10/] v10, the baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay within the project boundary, and methane is emitted to the atmosphere, possibly with capture of LFG and destruction through flaring to comply with regulations or contractual requirements. Baseline emissions shall exclude methane emissions that would have to be removed to comply with national or local safety requirements or legal regulations. In addition, the effect of methane oxidation that is present in the baseline and absent in the project shall be taken into account. The verification team has understood that baseline emissions of methane from the SWDS is calculated as amount of methane that is

	captured under the project activity and the amount that would be captured and destroyed in the baseline and effect of oxidation as applicable is also accounted. $BE_y = \eta_{PJ} \times BE_{CH4,SWDS,y} - (1\text{-}OX) \times F_{CH4,BL,y} \times GWP_{CH4}$ Where η_{PJ} -Efficiency of the LFG capture system that will be installed in the project activity $BE_{CH4,SWDS,y}$ -Methane emission potential of a solid waste disposal site OX-Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste $F_{CH4,BL,y}$ - Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year *y* GWP_{CH4} -Global Warming Potential for methane The verification of the same is detailed below.
Efficiency of the LFG capture system that will be installed in the project activity (η_{PJ}) =50% (ex-ante parameter)	As per para 14 of AMS.III.G v10, it is used for ex-ante estimation only. Default value was used. Hence accepted by the verification team.
Methane emission potential of a solid waste disposal site ($BE_{CH4,SWDS,y}$) (calculated parameter)	As per para 14 of AMS.III.G/10/ v10, $BE_{CH4,SWDS,y}$ is calculated using the methodological tool "Emissions from solid waste disposal sites"/13/ v8.0 (hereinafter referred to as emission from solid waste tool). Since the VCS project activity mitigates methane emissions from the existing SWDS by capturing, flaring or combustion, and the methane is generated from waste disposed in the past (from 2001), including prior to the start of the CDM project activity (July 2012), Application A of the emission from solid waste tool applies to the project activity. As per para 17 or equation 1 of the emission from solid waste tool, $BE_{CH4,SWDS,y}$ as per yearly model is calculated as below. $BE_{CH4,SWDS,y} = \varphi_y \times (1\text{-}f_y) \times GWP_{CH4} \times (1\text{-}OX) \times 16/12 \times F \times DOC_{f,y} \times MCF_y \times \Sigma\Sigma(W_{j,x} \times DOC_j \times e^{-kj \times (y-x)} \times (1\text{-}e^{-kj}))$ Where φ_y-Model correction factor to account for model uncertainties for year *y* *y*-Year of the crediting period for which methane emissions are calculated

	f_y-Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year *y* GWP_{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 in volume fraction $DOC_{f,y}$-Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y* MCF_y-Methane correction factor for year y $W_{j,x}$-Amount of solid waste type *j* disposed or prevented from disposal in the SWDS in the year *x* j-Type of waste in 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* DOC_j-Fraction of degradable organic carbon in the waste type j k-Decay rate for the waste type j

Model correction factor to account for model uncertainties for year *y* (φ_y) =0.75 (ex-ante parameter) Mean annual temperature= 14.7 ℃ (tropical) Mean annual precipitation =878 mm (dry) https://www.weather-atlas.com/en/ecuador/cuenca-climate#rainfall	The model correction factor (φ_y) depends on the uncertainty of the parameters used in the FOD model. As per para 19 of the emission from solid waste tool, if baseline emissions are being calculated, then PP may choose between the either of two options described in para 20 and 21 of the emission from solid waste tool. PP has chosen option 1 (default). As per section 6.4 (table 1) of the emission from solid waste tool, default value for application A is 0.75 under dry climate conditions.
y= 2017	PP has calculated methane emissions from the crediting period which is 2017.
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) =0 (ex-ante parameter)	As per para 14 of AMS.III.G v10, f_y in the emission from solid waste 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 (1) of the applied methodology. Hence section 7.2 (table 10) of the emission from solid waste tool is superseded by the applied methodology.
Global Warming Potential of methane (GWP_{CH4}) =25 tCO2e/tCH4 (ex-ante parameter) http://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf#page=23 https://www.ipcc.ch/publications_and_data/ar4/wg1/en/errataserrata-errata.html	PP has considered GWP of methane post 2012 as 25 which is accepted for the second commitment period which is in accordance with decision 4/CMP 7 as prescribed by the "Standard for application of the global warming potentials to CDM PA and PoA for the second commitment period of the Kyoto protocol[/14/]" Version 1.0 (EB 69 Annex 3). Decision 4/CMP 7 refers to table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the IPCC and time horizon of 100 years.
Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste) (OX) =0.1 (ex-ante parameter)	It reflects the amount of methane from SWDS that is oxidized in the soil or other material covering the waste. As per para 14 of the applied methodology, this value is taken as 0.1. Hence it is accepted by the verification team.
Fraction of methane in the SWDS gas (F) =0.5 (ex-ante parameter)	It is taken section 6.4 (table 3) of the emission from solid waste tool[/13/] which is sourced from IPCC report.
Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y* ($DOC_{f,y}$) =0.5 (ex-ante parameter)	As per para 29 of the emission from solid waste tool[/13/], for application A, default value to be considered. As per section 6.4 (table 4) of the emission from solid waste tool[/13/], default value is 0.5.
Methane correction factor for year y (MCF_y) =1.0 Volume = 2.03 Million m^3 Surface area = 14.1 hectare (ex-ante parameter)	As per para 32 of the emission from solid waste tool[/13/], for application A, default value to be considered. As per section 6.4 (table 5) of the emission from solid waste tool, MCF =1 if SWDS does not have a water table above the bottom of the SWDS and application A and is controlled placement of waste and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) levelling of

<table>
<tr>
<td></td>
<td>the waste. Since the all the conditions satisfy, MCF = 1. During the onsite visit, the verification team has checked the SWDS was moist and has less porosity. The volume to surface area to be more than 1.5 m (14.4 m) (as per landfill design[8]) which confirms that SWDS is being exposed to anaerobic conditions.</td>
</tr>
<tr>
<td>Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x ($W_{j,x}$)</td>
<td>As the PP had the specific information on historic information on amounts, composition and origin of the waste in landfill from 2001 to till date, such data is used as a more reliable source. From the Ing. Paúl Crespo, head of the final disposal department, EMAC-EP data[15], PP has considered waste material (degradable waste) consists of garden, yard and park waste and food, food waste, beverages and tobacco only.
It is calculated as follows
$W_{j,x}$ = Total solid waste disposed in the SWDS in the year x x Composition of type of waste disposed in the landfill</td>
</tr>
<tr>
<td>Total solid waste disposed in the SWDS in the year x

<table>
<tr><th>Year X</th><th>Total solid waste disposed in tonnes</th></tr>
<tr><td>x_1=2001</td><td>96,990</td></tr>
<tr><td>x_2=2002</td><td>99,071</td></tr>
<tr><td>x_3=2003</td><td>101,197</td></tr>
<tr><td>x_4=2004</td><td>103,369</td></tr>
<tr><td>x_5=2005</td><td>105,588</td></tr>
<tr><td>x_1=2006</td><td>107,854</td></tr>
<tr><td>x_7=2007</td><td>110,169</td></tr>
<tr><td>x_8=2008</td><td>118,371</td></tr>
<tr><td>x_9=2009</td><td>115,034</td></tr>
<tr><td>x_{10}=2010</td><td>122,599</td></tr>
<tr><td>x_{11}=2011</td><td>130,519</td></tr>
<tr><td>x_{12}=2012</td><td>126,334</td></tr>
<tr><td>x_{13}=2013</td><td>127,720</td></tr>
<tr><td>x_{14}=2014</td><td>137,605</td></tr>
<tr><td>x_{15}=2015</td><td>143,432</td></tr>
<tr><td>x_{16}=2016</td><td>138,254</td></tr>
<tr><td>x_y=2017</td><td>149,461</td></tr>
</table>

Where
x =Active start of the landfill
y =Start year of the crediting period</td>
<td>As per para 38 (b) of the applied emission from solid waste tool[13], year x begins with the year the landfill started to receiving waste which in this case is 2001. As per para 38 (c) of the applied methodology, sampling to determine the fractions of different waste types is not necessary as the waste composition can be obtained from previous studies. From the historical data, Total solid waste disposed in the SWDS in the year x is calculated. The Pichacay Landfill (SWDS) was active from 2001 onwards. The Government permit for the landfill issued was classified it as a General Large Site. Since EMAC-EP data[15] is authentic, the verification team has accepted the value. PP has considered biodegradable waste material consists of garden, yard and park waste and food, food waste, beverages and tobacco only.</td>
</tr>
<tr>
<td>Composition of type of waste type j disposed in the landfill

<table>
<tr><th>Waste type j</th><th>Composition by weight</th></tr>
<tr><td>Wood and wood products</td><td>0.34%</td></tr>
</table></td>
<td>As per para 14 of AMS.III.G v10, sampling to determine the fractions of different waste types is not necessary as the waste composition can be obtained from previous studies. Alternatively, for existing SWDS, if the pre-existing amount and composition of the wastes in the landfill are unknown, they can be estimated by using parameters related to the serviced population or</td>
</tr>
</table>

Pulp, paper and cardboard (other than sludge)	6.30%
Food, food waste, beverages and tobacco (other than sludge)	64.39%
Textiles	1.92%
Garden, yard and park waste	0%
Glass, plastic, metal and other inert waste	27.06%
Total	100%

industrial activity, or by comparison with other landfills with similar conditions at regional or national level
As per para 26 of the emission from solid waste tool[/13/], $W_{j,x}$ based on information from the SWDS owner and administration and from interviews with senior employees. The EMAC information[/15/] gives the amounts, composition and origin of the waste received. From the historical data, PP has considered de-gradable waste material consists of 1) Paper, Pulp and cardboard waste and 2) food, food waste, 3) wood and 4) textiles only. Hence the approach is accepted by the verification team. The balance amount consists of inert material which has non-biodegradable, hence not included in the further analysis.

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

year	Paper	Wood	Food	Textiles
x_1=2001	5990	214	52189	1222
x_2=2002	6119	219	53309	1248
x_3=2003	6250	224	54453	1275
x_4=2004	6384	228	55622	1302
x_5=2005	6521	233	56816	1330
x_1=2006	6661	238	58035	1359
x_7=2007	8003	451	59903	2514
x_8=2008	8729	491	63764	2742
x_9=2009	8514	479	62361	2675
x_{10}=2010	8959	504	65423	2815
x_{11}=2011	9541	537	69961	2998
x_{12}=2012	5789	268	74032	1854
x_{13}=2013	5841	270	74952	1871
x_{14}=2014	6427	297	81126	2058
x_{15}=2015	7555	408	90246	2302
x_{16}=2016	7280	393	86490	2219
x_y=2017	7952	429	93814	2423

(ex-ante parameter)

It is calculated as follows
$W_{j,x}$ = Total solid waste disposed in the SWDS in the year x x Composition of type of waste disposed in the landfill

Fraction of degradable organic carbon in the waste type j (DOC_j)

Waste type j	DOC_j (%wet waste)
Pulp, paper cardboard (other than sludge)	40%
Wood, wood products and straw	43%
Food, food waste, sewage sludge, beverages and tobacco	15%
Textiles	24%

As per section 6.4 (table 6) of the emission from solid waste tool, and as the waste type is of MSW, then default value considered by the PP is accepted by the verification team. From the historical data, PP has considered de-gradable waste material consists of Wood, Food, Textile and Paper only. Hence the approach is accepted by the verification team.

<table>
<tr><td>(ex-ante parameter)</td><td></td></tr>
<tr><td>Decay rate for the waste type j (k_j)
<table><tr><td>Waste type$_j$</td><td>k_j</td></tr><tr><td>Pulp, paper cardboard (other than sludge)</td><td>0.04</td></tr><tr><td>Wood, wood products and straw</td><td>0.02</td></tr><tr><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.06</td></tr><tr><td>Textiles</td><td>0.04</td></tr></table>
(ex-ante parameter)

Mean annual temperature (MAT) = 14.7 ℃ (Boreal and temperate)

Mean annual precipitation (MAP) =878 mm

Potential evapotranspiration (PET) =1189 mm

MAP/PET <1 (dry)</td><td>As per section 6.4 (table 7) of the emission from solid waste tool/13/, PP has justified that mean annual temperature is less than 20℃ (Boreal and temperate) and mean annual precipitation is 878 mm and (dry), decay rate of the waste type considered in accepted by the verification team.</td></tr>
<tr><td>Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$)
<table><tr><td>Year (y)</td><td>$BE_{CH4,SWDS,y}$</td></tr><tr><td>2017 (27th July onwards)</td><td>20,876 tCO2e per year</td></tr><tr><td>2018</td><td>51,043 tCO2e per year</td></tr><tr><td>2019</td><td>53,909 tCO2e per year</td></tr><tr><td>2020</td><td>56,771 tCO2e per year</td></tr><tr><td>2021</td><td>59,629 tCO2e per year</td></tr><tr><td>2022</td><td>62,485 tCO2e per year</td></tr><tr><td>2023</td><td>65,339 tCO2e per year</td></tr><tr><td>2024</td><td>68,190 tCO2e per year</td></tr><tr><td>2025</td><td>71,039 tCO2e per year</td></tr><tr><td>2026</td><td>73,886 tCO2e per year</td></tr><tr><td>2027 (till 26th July)</td><td>43,516 tCO2e per year</td></tr></table></td><td>As per para 38 of AMS.III.G v10, $BE_{CH4,SWDS,y}$ is calculated as per emission from solid waste tool/13/. As per para 17 or equation 1 of the emission from solid waste tool, $BE_{CH4,SWDS,y}$ as per yearly model is calculated as below.

$BE_{CH4,SWDS,y} = \varphi_y \times (1-f_y) \times GWP_{CH4} \times (1-OX) \times 16/12 \times F \times DOC_{f,y} \times MCF_y \times \Sigma\Sigma(W_{j,x} \times DOC_j \times e^{-k_j \times (y-x)} \times (1-e^{-k_j}))$</td></tr>
<tr><td>Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste (OX) =10%

(ex-ante parameter)</td><td>As per para 14 of the applied methodology, default value is selected by the PP.</td></tr>
<tr><td>Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year y ($F_{CH4,BL,y}$)=0 tCH4
(ex-ante parameter)</td><td>Since there is no national or local safety requirments or legal requirements exist in Ecuador that require capture and destruction of landfill gas, hence $F_{CH4,BL,y}$ =0 tCH4.</td></tr>
</table>

Global Warming Potential of methane (GWP_{CH4}) =25 tCO2e/tCH4 (ex-ante parameter) http://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf#page=23 https://www.ipcc.ch/publications_and_data/ar4/wg1/en/errataserrata-errata.html	PP has considered GWP of methane post 2012 as 25 which is accepted for the second commitment period which is in accordance with decision 4/CMP 7 as prescribed by the "Standard for application of the global warming potentials to CDM PA and PoA for the second commitment period of the Kyoto protocol"[/14/] Version 1.0 (EB 69 Annex 3). Decision 4/CMP 7 refers to table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the IPCC and time horizon of 100 years.
Energy Conversion Efficiency of the project equipment (EE_y) =36% (monitored parameter no 2 as per the joint PD&MR[/2/])	During monitoring: It is sourced from the manufacturer details. Hence accepted. All assumptions and data used by the project participants is listed in the Joint PD&MR[/2/], including their references and sources. All documentation used by the project participants as the basis for assumptions and source of data is correctly quoted and interpreted in the Joint PD&MR[/2/]. The parameter would be monitored on implementation. The verification team concluded that the estimates provided in the Joint PD&MR[/2/] is correct.

<table>
<tr><td>Baseline emissions in year y (BE_y)

Year	BE_y
2017 (27th July onwards)	10,438 tCO2e
2018	25,522 tCO2e
2019	26,954 tCO2e
2020	28,385 tCO2e
2021	29,815 tCO2e
2022	31,243 tCO2e
2023	32,669 tCO2e
2024	34,095 tCO2e
2025	35,520 tCO2e
2026	36,943 tCO2e
2027 (till 26th July)	21,758 tCO2e
</td><td>$BE_y = \eta_{PJ} \times BE_{CH4,SWDS,y} - (1\text{-}OX) \times F_{CH4,BL,y} \times GWP_{CH4}$</td></tr>
<tr><td>Project emissions (PE_y)</td><td>As per para 15 of AMS.III.G v10, Project emissions consist of CO2 emissions from fossil fuel or electricity used by the project activity facilities, Emissions from flaring or combustion of the gas stream, Emissions from the landfill gas upgrading process.
As per equation 2 of the applied methodology,
$PE_y = PE_{Power,y} + PE_{flare,y} + PE_{process,y}$
Where
$PE_{Power,y}$ -Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y
$PE_{flare,y}$ -Emissions from flaring or combustion of the landfill gas stream in the year y
$PE_{process,y}$ - Emissions from the landfill gas upgrading process in the year y</td></tr>
<tr><td>Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y ($PE_{Power,y}$)</td><td>As per para 16 of AMS.III.G v10, For project emissions from fossil fuel consumption, the “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion”/13/ v3.0 shall be used. However, there is no fossil fuel consumption for electricity generation for captive use. Hence this project emission due to fossil fuel is zero.

Project emissions from electricity consumption are determined as per the procedures described in the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” /13/ v3.0 (hereinafter referred to as electricity consumption tool), “AMS-I.D.: Grid connected renewable electricity generation”.

As per equation 1 of the electricity consumption tool, baseline emissions from consumption of electricity are calculated as follows.
$PE_{Power,y} = PE_{EC,y} = \Sigma EC_{PJ,k,y} \times EF_{EL,j,y} \times (1+TDL_{j,y})$
Where</td></tr>
</table>

<table>
<tr><td></td><td>$EC_{PJ,j,y}$ –Net amount of electricity consumed by the project activity in year y
$EF_{EL,j,y}$-Emission factor for electricity generation for source *j* in year *y*
$TDL_{j,y}$ -Average technical transmission and distribution losses for providing electricity to source j in year *y*
j-Sources of electricity consumption in the project
The verification of the same is detailed below.</td></tr>
<tr><td>Net amount of electricity consumed by the project activity in year y ($EC_{PJ,j,y}$)

(monitored parameter no 3 as per the joint PD&MR[/2/])

<table><tr><th>Year</th><th>$EC_{PJ,j,y}$</th></tr><tr><td>2017 (27th July onwards)</td><td>67 MWh</td></tr><tr><td>2018</td><td>143 MWh</td></tr><tr><td>2019</td><td>257 MWh</td></tr><tr><td>2020</td><td>342 MWh</td></tr><tr><td>2021</td><td>342 MWh</td></tr><tr><td>2022</td><td>684 MWh</td></tr><tr><td>2023</td><td>684 MWh</td></tr><tr><td>2024</td><td>684 MWh</td></tr><tr><td>2025</td><td>684 MWh</td></tr><tr><td>2026</td><td>684 MWh</td></tr><tr><td>2027 (till 26th July)</td><td>388 MWh</td></tr></table></td><td>Ex-ante estimation:

It is based on actual electricity purchase for the year 2017 and 2018, installed nominal capacities of gas engines (1 MW each), actual capacities (0.85 MW due to derating), operational hours (7600 hours per year).

During monitoring:

It will be based on monthly electricity invoices[/12/].

QA/QC procedure:

Since the electricity meter is not in PP's control, the calibration was not expected to be conducted. Hence accepted.

All assumptions and data used by the project participants is listed in the Joint PD&MR[/2/], including their references and sources. All documentation used by the project participants as the basis for assumptions and source of data is correctly quoted and interpreted in the Joint PD&MR[/2/]. The parameter would be monitored on implementation. The verification team concluded that the estimates provided in the Joint PD&MR[/2/] is correct.</td></tr>
<tr><td>Emission factor for electricity generation for source *k* in year *y* ($EF_{EL,k,y}$)

(Ex-ante parameter)</td><td>As per the electricity consumption tool, the determination of the emission factor for electricity generation depends on which scenario (A, B or C) applies to the source of electricity consumption. Since the source of electricity is generated from the grid, scenario A applies. For scenario A, there are two options to calculate the emission factor. PP has chosen option A1. As per option A1, Emission factor for electricity generation for source k is calculated based on combined margin emission factor of the applicable electricity system, using "Tool to calculate the emission factor for an electricity system" version 7.0 (hereinafter referred to as emission factor tool[/13/]). The validation of the same detailed below.</td></tr>
<tr><td>Step 1 of Tool to calculate the emission factor for an</td><td>The validation of the combined margin is</td></tr>
</table>

electricity system Relevant electricity system: Interconnected National System of Ecuador Source: CENACE report	calculated using the emission factor tool. This is demonstrated as follows. By default, PP has considered Interconnected National System of Ecuador as the relevant electricity system as per the CENACE report[/16/]. For the present calculation, the generation units that are not connected to the interconnected system are not considered, such as the units of the Galapagos Island region, Puna Island, Eastern region isolated systems, and Petroecuador electrical system. Based on this, the validation team has accepted the electricity system as correct as it is line with the emission factor tool)
Step 2: Choose whether to include off-grid power plants in the project electricity system: option 1	PP has opted for option 1 that includes only grid power plants to calculate the operating margin and build margin. The validation team has accepted as reasonable.
Step 3: Select a method to determine the operating margin: Simple adjusted OM method (option b) Data vintage for calculating operating margin: ex-ante option	As the emission factor tool, the simple adjusted OM method (Option b) is used as low-cost/must-run resources constitute more 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. PP has demonstrated that low cost/must run resources is more than 50% of total grid generation in the average of recent 5 years. The validation team has considered must run plants including coal, hydro, geothermal, wind, biomass, nuclear and solar generation which is in line with emission factor tool. By reviewing information from official sources of CENACE report[/16/], the validation team has found that there is no biomass or nuclear or Solar power plant operating in Ecuador hence removed from the list of low cost/must run resources and the remaining resources are steam power plant based on natural gas/residual oil, Diesel power plant, open cycle power plant and combined power plant, wind and hydro power plant. The validation team has also assessed CENACE report[/16/] endorsing that only hydro, constitute low cost/must run resources in Ecuador, the validation has concluded that only hydro power plants forms the low cost/must run power plants in Ecuador. Based on the net generation for all the power plants during most recent five years in Ecuador including low cost /must run power plants, % low cost /must run resources is 62.7% (more than 50%), opting for simple adjusted OM to calculate operating margin is correct and valid.

	PP has opted for ex-ante option for the calculation of operating margin. Since ex-ante option is chosen, PP has mentioned in the PDD that emission factor need not be monitored during the crediting period. PP also used 3-year generation-weighted average, based on the most recent data for grid power plants. The validation team has accepted as it is in line with the emission factor tool[/13/]. The data vintage 2017 is not available at the time of submission of VCS PD/MR to the DOE for validation[/2/]. The validated team has reviewed the PDD and found that data vintage is also well documented in the revised PDD.
Step 4: Calculate the operating margin emission factor according to the selected method: Option b Yearly Ex ante Operating margin= 0.6628, 0.6760, 0.6431 tCO2e/MWh for the year 2014, 2015 and 2016 respectively λ_{2014} =0.0002 λ_{2015} =0.0013 λ_{2014} =0.0106 Ex ante Operating margin =0.6605 tCO2e/MWh	As per the emission tool, the simple adjusted OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation of all generating power plants serving the grid system, not including low-cost/must-run power plants. PP has opted for equation 10 of the emission factor tool to calculate the operating margin under simple adjusted OM method. The validation team has reviewed the CENACE report[/13/] in which CO2 emission factor for each power plant is not available which is necessary to calculate operating margin under option a. Moreover, based on the fact that only renewable energy resources are demonstrated as low cost/must run resources and off grid power plants are not in the calculation as demonstrated in step 2 above, the validation team accepted the calculation approach. PP has used option b which is based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel types and total fuel consumption of the project electricity system. The validation team has accepted it as it is line with emission factor tool. PP has considered net generation, total fuel consumption of all fuel types for the recent years taken from Information verified by CENACE, which the validation team has accepted as valid. The information needed to calculate the operating margin emission factor is available from official sources such as CENACE. The data used correspond to the last available information necessary to calculate the update of the national emission factor by official sources The operating margin is the calculated 3-year generation-weighted average which is in line with the emission tool.
Step 5: Calculate the build margin (BM) emission	PP has opted for ex-ante option to calculate the

factor Data vintage: Ex-ante option- Most recent year 2017 available at the time of PD submission $AEG_{SET\ 5\ units}$ = 337973.34 MWh AEGSET-≥20% =4,604,055.96 MWh SET_{sample} = $SET_{SET>20\%}$ $AG_{SET\ sample}$ = 4,604,055.96 MWh Build margin =0.0092 tCO2/MWh Source: Calculated	build margin which is accepted by the validation team. This option does not require monitoring the emission factor during the crediting period which is in line with the emission tool[/13/]. . The validation team has reviewed the PDD and found that data vintage is also well documented in the revised PDD. PP has sourced information on all the power plants including the five most recent power plants and their commissioning dates and annual generation from CENACE report[/16/]. It is observed none of the projects have registered for CDM in the UNFCCC website. The validation team has found that the $AEG_{SET5units}$, and $AEG_{SET-\geq 20\%}$ are calculated correctly as per emission factor tool. Since the annual generation of sample set of power plants that comprise 20% is more than that of recent 5 units, SET_{sample} is taken as that of $SET_{SET\ >20\%}$ which is accepted by the validation team. Moreover, none of the power plants in the sample set (SET_{sample}) started to supply electricity to the grid more than 10 years prior to the date of VCS PD submission for validation, the validation team has accepted that SET_{sample} be used to calculate the build margin. The CO2 emission factor of each power unit and build margin is calculated as per the emission factor tool, hence accepted by the validation team.
Step 6: Calculate the combined margin emissions factor ($EF_{grid,y}$) Weighted average CM (option a) Combined margin = 0.3349 tCO2/MWh wOM = 50% wBM = 50% Source: Calculated	PP has opted for weighted average combined margin method (option a) which the verification team has accepted as it is the preferred option as per the emission factor tool. Default weightage of operating margin and build margin also falls in line with the applied methodology.

<table>
<tr>
<td>Average technical transmission and distribution losses for providing electricity to source j in year y ($TDL_{j,y}$) = 5.76%

(monitored parameter no 4 as per the joint PD&MR/2/)</td>
<td>It is sourced from CENTROSUR, the electricity distribution company that owns and manages the electric grid. As it is the annual average value based on the most recent data available within the host country, it is accepted by the verification team.

All assumptions and data used by the project participants is listed in the Joint PD&MR/2/, including their references and sources. All documentation used by the project participants as the basis for assumptions and source of data is correctly quoted and interpreted in the Joint PD&MR/2/. The parameter would be monitored on implementation. The verification team concluded that the estimates provided in the Joint PD&MR/2/ is correct.</td>
</tr>
<tr>
<td>Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y ($PE_{Power,y}$)

(calculated parameter)

<table>
<tr><td>Year</td><td>$PE_{Power,y}$</td></tr>
<tr><td>2017 (27th July onwards)</td><td>24 tCO2e</td></tr>
<tr><td>2018</td><td>51 tCO2e</td></tr>
<tr><td>2019</td><td>91 tCO2e</td></tr>
<tr><td>2020</td><td>121 tCO2e</td></tr>
<tr><td>2021</td><td>121 tCO2e</td></tr>
<tr><td>2022</td><td>242 tCO2e</td></tr>
<tr><td>2023</td><td>242 tCO2e</td></tr>
<tr><td>2024</td><td>242 tCO2e</td></tr>
<tr><td>2025</td><td>242 tCO2e</td></tr>
<tr><td>2026</td><td>242 tCO2e</td></tr>
<tr><td>2027 (till 26th July)</td><td>137 tCO2e</td></tr>
</table>
</td>
<td>As per equation 1 of the electricity consumption tool, baseline emissions from consumption of electricity are calculated as follows.

$PE_{Power,y} = PE_{EC,y} = \sum EC_{PJ,k,y} \times EF_{EL,j,y} \times (1+TDL_{j,y})$</td>
</tr>
<tr>
<td>Emissions from flaring or combustion of the landfill gas stream in the year y ($PE_{flare,y}$)

(calculated parameter)</td>
<td>As per para 17 of AMS.III.G v10, If flaring (single or multiple) is used to destroy all or part of the recovered landfill gas, project emissions from flaring in year *y* shall be determined for each flare following the procedure described in the methodological tool “Project emissions from flaring” v3.0 (hereinafter referred to as flaring tool/13/). As per step 3 (equation 15) of the flaring tool, $PE_{flare,y}$ is calculated as below

$PE_{flare,y} = GWP_{CH4} \times \sum F_{CH4,RG,m} \times (1-\eta_{flare,m})$
Where
GWP_{CH4}- Global warming potential of methane valid for the commitment period
$F_{CH4,RG,m}$ - Mass flow of methane in the residual gas in the minute m
$\eta_{flare,m}$ - Flare efficiency in minute m

The verification details are below</td>
</tr>
</table>

<table>
<tr>
<td>Global warming potential of methane valid for the commitment period (GWP_{CH4}) =25 tCO2e/tCH4

(ex-ante parameter)</td>
<td>It is already verified as above.</td>
</tr>
<tr>
<td>Mass flow of methane in the residual gas in the minute m ($F_{CH4,RG,m}$)
(calculated parameter)
<table>
<tr><th>Year</th><th>$F_{CH4,RG,m}$</th></tr>
<tr><td>2017 (27th July onwards)</td><td>418 tCH4</td></tr>
<tr><td>2018</td><td>1021 tCH4</td></tr>
<tr><td>2019</td><td>1078 tCH4</td></tr>
<tr><td>2020</td><td>1135 tCH4</td></tr>
<tr><td>2021</td><td>1193 tCH4</td></tr>
<tr><td>2022</td><td>1250 tCH4</td></tr>
<tr><td>2023</td><td>1307 tCH4</td></tr>
<tr><td>2024</td><td>1364 tCH4</td></tr>
<tr><td>2025</td><td>1421 tCH4</td></tr>
<tr><td>2026</td><td>1478 tCH4</td></tr>
<tr><td>2027 (till 26th July)</td><td>870 tCH4</td></tr>
</table>

<table>
<tr><th>Option</th><th>Flow of gaseous stream</th><th>Volumetric fraction</th></tr>
<tr><td>A</td><td>Volume flow- dry basis</td><td>dry or wet basis</td></tr>
</table>
</td>
<td>As per step 1 of the flaring tool, Mass flow of methane in the residual gaseous stream in the minute m is determined using “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 3.0 (mass flow calculation tool/13/) with the following conditions satisfied.
a) The gaseous stream tool shall be applied to the residual gas; b) The flow of the gaseous stream shall be measured continuously c) CH4 is the greenhouse gas i for which the mass flow should be determined d) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the mass flow calculation tool); and e) The time interval t for which mass flow should be calculated is every minute m.

For the project activity, following applies.

a)The source of the residual gas is from the landfill (biogenic source

b) As per the PDD, flow of the gaseous stream is measured continuously

c) CH4 is the greenhouse gas for which the mass flow is determined

d) As per the mass flow calculation tool, the determination of the molecular mass of the gaseous stream requires measuring the volumetric fraction of all gases (k) in the gaseous stream. However as a simplification, the volumetric fraction of only the gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. If this mass flow calculation tool is used to calculate mass flow of CH4 the simplification can be acceptable. As the CH4 is the greenhouse gas for which mass flow is being determined, this simplification approach is accepted

As all the conditions are satisfied, per step 1 of the flaring tool, Mass flow of methane in the residual gaseous stream in the minute m can be determined using “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 3.0/13/.(mass flow calculation tool)

Para 14 (Table 2) of the mass flow calculation</td>
</tr>
</table>

<table>
<tr><td></td><td>tool shows the different ways to make the measurements for mass flow of a greenhouse gas i in a gaseous stream and the corresponding calculation option for $F_{i,t}$. PP has chosen option A..

Here $F_{CH4,RG,m}$ is calculated from $_{BECH4,y}$. Hence accepted.</td></tr>
<tr><td>Flare efficiency in minute m ($\eta_{flare,m}$) =0%

(ex-ante parameter)

Type of flare= enclosed flare

(Option A)</td><td>As per step 2 of the flaring tool[/13/], the flare efficiency depends on the efficiency of combustion in the flare and the time that the flare is operating. As the flame enclosure is more than 2 times the diameter of the enclosure, type of flare is enclosed flare which is line with the definition prescribed by the flaring tool for enclosed flaring system.
As per step 1 of the flaring tool, for determining the efficiency of combustion of enclosed flares there is the option to apply a default value (option A) or determine the efficiency based on monitored data (option B). PP has used option A. Under option A, the flare efficiency for the minute *m* is 90% when the following two conditions are met to demonstrate that the flare is operating:
(1) The temperature of the flare ($T_{EG.m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute *m*; and

(2) The flame is detected in minute *m* ($Flame_m$).
Otherwise $\eta_{flare,m}$ is 0%. Since due to non monitoring of LFG fed into flare, $\eta_{flare,m}$ =0%</td></tr>
<tr><td>Flame is detected in minute *m* ($Flame_m$) or operating hours of flare ($OT_{flare,y}$)

<table><tr><td>Year</td><td>$OT_{flare,y}$</td></tr><tr><td>2017 (27th July onwards)</td><td>476 hours</td></tr><tr><td>2018</td><td>1597 hours</td></tr><tr><td>2019</td><td>1160 hours</td></tr><tr><td>2020</td><td>1160 hours</td></tr><tr><td>2021</td><td>1160 hours</td></tr><tr><td>2022</td><td>1160 hours</td></tr><tr><td>2023</td><td>1160 hours</td></tr><tr><td>2024</td><td>1160 hours</td></tr><tr><td>2025</td><td>1160 hours</td></tr><tr><td>2026</td><td>1160 hours</td></tr><tr><td>2027 (till 26th July)</td><td>1160 hours</td></tr></table></td><td>PP has assumed from actual data during 2017 and 2018. Hence accepted.</td></tr>
<tr><td>Emissions from flaring or combustion of the landfill gas stream in the year y ($PE_{flare,y}$)

(calculated parameter)

<table><tr><td>Year</td><td>$PE_{flare,y}$</td></tr><tr><td>2017 (27th July onwards)</td><td>567 tCO2e</td></tr></table></td><td>As per step 3 (equation 15) of the flaring tool[/13/], $PE_{flare,y}$ is calculated as below
$PE_{flare,y} = GWP_{CH4} \times \sum F_{CH4,RG,m} \times (1-\eta_{flare,m})$
Where
GWP_{CH4}- Global warming potential of methane valid for the commitment period
$F_{CH4,RG,m}$ - Mass flow of methane in the residual</td></tr>
</table>

<table>
<tr>
<td>
<table>
<tr><td>2018</td><td>4653 tCO2e</td></tr>
<tr><td>2019</td><td>3569 tCO2e</td></tr>
<tr><td>2020</td><td>3759 tCO2e</td></tr>
<tr><td>2021</td><td>3948 tCO2e</td></tr>
<tr><td>2022</td><td>4137 tCO2e</td></tr>
<tr><td>2023</td><td>4326 tCO2e</td></tr>
<tr><td>2024</td><td>4515 tCO2e</td></tr>
<tr><td>2025</td><td>4704 tCO2e</td></tr>
<tr><td>2026</td><td>4892 tCO2e</td></tr>
<tr><td>2027 (till 26th July)</td><td>2881 tCO2e</td></tr>
</table>
</td>
<td>gas in the minute m
$\eta_{flare,m}$ - Flare efficiency in minute m</td>
</tr>
<tr>
<td>Emissions from the landfill gas upgrading process in the year y ($PE_{process,y}$) = 0 tCO2e per year

(calculated parameter)</td>
<td>As per para 15 of AMS.III.G v10, Emissions from the landfill gas upgrading process in the year *y*, determined by following the relevant procedures described in annex 1 of AMS-III.H v19.0. Since the if the project activity does not involve bottling of biogas, $PE_{process,y}$ =0 tCO2e per year</td>
</tr>
<tr>
<td>Project emissions (PE_y)

(calculated parameter)

<table>
<tr><td>Year</td><td>PE_y</td></tr>
<tr><td>2017 (27th July onwards)</td><td>591 tCO2e</td></tr>
<tr><td>2018</td><td>4704 tCO2e</td></tr>
<tr><td>2019</td><td>3660 tCO2e</td></tr>
<tr><td>2020</td><td>3880 tCO2e</td></tr>
<tr><td>2021</td><td>4069 tCO2e</td></tr>
<tr><td>2022</td><td>4380 tCO2e</td></tr>
<tr><td>2023</td><td>4569 tCO2e</td></tr>
<tr><td>2024</td><td>4757 tCO2e</td></tr>
<tr><td>2025</td><td>4946 tCO2e</td></tr>
<tr><td>2026</td><td>5134 tCO2e</td></tr>
<tr><td>2027 (till 26th July)</td><td>3019 tCO2e</td></tr>
</table>
</td>
<td>As per para 15 of AMS.III.G v10, Project emissions consist of CO2 emissions from fossil fuel or electricity used by the project activity facilities, Emissions from flaring or combustion of the gas stream, Emissions from the landfill gas upgrading process.
As per equation 2 of the applied methodology,
$PE_y = PE_{Power,y} + PE_{flare,y} + PE_{process,y}$</td>
</tr>
<tr>
<td>Leakage emissions (LE_y) = 0 tCO2e</td>
<td>As per para 18 of AMS.III.G v10, If the methane recovery technology is equipment transferred from another activity, leakage effects are to be considered. This is not the case here, LE_y =0 tCO2e.</td>
</tr>
</table>

<table>
<tr><td>Emission reduction achieved by the project activity (ER_y)
(calculated parameter)

<table>
<tr><td>Year</td><td>ER_y</td></tr>
<tr><td>2017 (27th July onwards)</td><td>9847 tCO2e</td></tr>
<tr><td>2018</td><td>20818 tCO2e</td></tr>
<tr><td>2019</td><td>23294 tCO2e</td></tr>
<tr><td>2020</td><td>24505 tCO2e</td></tr>
<tr><td>2021</td><td>25745 tCO2e</td></tr>
<tr><td>2022</td><td>26863 tCO2e</td></tr>
<tr><td>2023</td><td>28101 tCO2e</td></tr>
<tr><td>2024</td><td>29338 tCO2e</td></tr>
<tr><td>2025</td><td>30574 tCO2e</td></tr>
<tr><td>2026</td><td>31809 tCO2e</td></tr>
<tr><td>2027 (till 26th July)</td><td>18740 tCO2e</td></tr>
</table></td><td>As per para 19 of AMS.III.G v10, the emission reduction achieved by the project activity can be estimated ex ante in the project design document (PDD) by the following.

$ER_y = BE_y - PE_y - LE_y$</td></tr>
<tr><td>Emission reduction achieved by electricity component ($ER_{electricity,y}$)</td><td>As per para 43 of AMS.I.D v18.0,
$ER_y = BE_y - PE_y - LE_y$

Where BE_y -Baseline emissions in year *y*
PE_y -Project emissions in year *y*
LE_y-Leakage emissions in year y
The verification details of BE_y, PE_y and LE_y is detailed below.</td></tr>
<tr><td>Baseline emissions in year y (BE_y)</td><td>As per para 22 of AMS.I.D, baseline emissions include only CO2 emissions from electricity generation in power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows.

$BE_y = EG_{PJ,y} \times EF_{grid,y}$
Where
$EG_{PJ,y}$ -Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y*

$EF_{grid,y}$ -Combined margin CO2 emission factor for grid connected power generation in year *y*

The verification of the same is detailed below.</td></tr>
<tr><td>Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* ($EG_{PJ,y}$)</td><td>As per para 25 and 26 of AMS.I.D, if the project activity is the installation of a greenfield power plant, then $EG_{PJ,y} = EG_{facility,y}$

Where
$EG_{facility,y}$ -Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y*
The verification of the same is detailed below.</td></tr>
</table>

<table>
<tr>
<td>Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* ($EG_{facility,y}$)

(monitored parameter no 1 as per the joint PD&MR[/2/])

<table>
<tr><td>Year</td><td>$EG_{facility,y}$</td></tr>
<tr><td>2017 (27th July onwards)</td><td>2776 MWh</td></tr>
<tr><td>2018</td><td>5165 MWh</td></tr>
<tr><td>2019</td><td>9690 MWh</td></tr>
<tr><td>2020</td><td>12920 MWh</td></tr>
<tr><td>2021</td><td>12920 MWh</td></tr>
<tr><td>2022</td><td>25840 MWh</td></tr>
<tr><td>2023</td><td>25840 MWh</td></tr>
<tr><td>2024</td><td>25840 MWh</td></tr>
<tr><td>2025</td><td>25840 MWh</td></tr>
<tr><td>2026</td><td>25840 MWh</td></tr>
<tr><td>2027 (till 26th July)</td><td>14654 MWh</td></tr>
</table>
</td>
<td>Ex-ante estimation:
$EG_{facility,y}$ = actual capacity x no of operating hours

Where actual capacity = 0.85 MW for 4 gas engines
No of operating hours= 7600 hours for 365 days

First gas engine was commissioined in 27th July 2017, second one was expected to be commissioned during July 2019, and other two in Jan 2022.

During the monitoring:
As per PD, it is continuously moniotored by electricity meters at 22 kV.

QA/QC procedure:
It is calibrated every 2 years.

All assumptions and data used by the project participants is listed in the Joint PD&MR[/2/], including their references and sources. All documentation used by the project participants as the basis for assumptions and source of data is correctly quoted and interpreted in the Joint PD&MR[/2/]. The parameter would be monitored on implementation. The verification team concluded that the estimates provided in the Joint PD&MR[/2/] is correct.</td>
</tr>
<tr>
<td>Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* ($EG_{PJ,y}$)

<table>
<tr><td>Year</td><td>$EG_{PJ,y}$</td></tr>
<tr><td>2017 (27th July onwards)</td><td>2776 MWh</td></tr>
<tr><td>2018</td><td>5165 MWh</td></tr>
<tr><td>2019</td><td>9690 MWh</td></tr>
<tr><td>2020</td><td>12920 MWh</td></tr>
<tr><td>2021</td><td>12920 MWh</td></tr>
<tr><td>2022</td><td>25840 MWh</td></tr>
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<tr><td>2024</td><td>25840 MWh</td></tr>
<tr><td>2025</td><td>25840 MWh</td></tr>
<tr><td>2026</td><td>25840 MWh</td></tr>
<tr><td>2027 (till 26th July)</td><td>14654 MWh</td></tr>
</table>
</td>
<td>As per para 25 and 26 of AMS.I.D, if the project activity is the installation of a greenfield power plant, then $EG_{PJ,y} = EG_{facility,y}$</td>
</tr>
<tr>
<td>Combined margin CO_2 emission factor for grid connected power generation in year *y* ($EF_{grid,y}$) =0.3349 tCO_2e/MWh

(ex-ante parameter)</td>
<td>As per para 23 of AMS.I.D, the emission factor shall be calculated in a transparent and conservative manner as follows:
(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the “Tool to calculate the emission factor for an electricity system”; or</td>
</tr>
</table>

<table>
<tr><td></td><td>(b) The weighted average emissions (in t CO_2/MWh) of the current generation mix. The data of the year in which project generation occurs must be used

PP has used option a.

As per CENACE document[/16/], emission factor is estimated to be 0.3349 tCO_2/MWh. The verification team has reviewed the document and accepted the same.</td></tr>
<tr><td>Baseline emissions in year y (BE_y)

<table>
<tr><td>Year</td><td>BE_y</td></tr>
<tr><td>2017 (27th July onwards)</td><td>930 tCO2e</td></tr>
<tr><td>2018</td><td>1730 tCO2e</td></tr>
<tr><td>2019</td><td>3245 tCO2e</td></tr>
<tr><td>2020</td><td>4327 tCO2e</td></tr>
<tr><td>2021</td><td>4327 tCO2e</td></tr>
<tr><td>2022</td><td>8654 tCO2e</td></tr>
<tr><td>2023</td><td>8654 tCO2e</td></tr>
<tr><td>2024</td><td>8654 tCO2e</td></tr>
<tr><td>2025</td><td>8654 tCO2e</td></tr>
<tr><td>2026</td><td>8654 tCO2e</td></tr>
<tr><td>2027 (till 26th July)</td><td>4908 tCO2e</td></tr>
</table></td><td>As per para 22 of AMS.I.D, baseline emissions include only CO_2 emissions from electricity generation in power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows.

$BE_y = EG_{PJ,y} \times EF_{grid,y}$
.</td></tr>
<tr><td>Project emissions (PE_y) =0 tCO2e per year</td><td>As per para 39 of AMS.I.D, For most renewable energy project activities, PE_y = 0 tCO2e</td></tr>
<tr><td>Leakage emissions (LE_y) =0 tCO2e per year</td><td>As per para 42 of AMS.I.D, General guidance on leakage in biomass project activities shall be followed to quantify leakages pertaining to the use of biomass residues. Since there is no biomass residue involved in this project, leakage is zero.</td></tr>
<tr><td>Emission reduction achieved by electricity component ($ER_{electricity,y}$)
<table>
<tr><td>Year</td><td>$ER_{electricity,y}$</td></tr>
<tr><td>2017 (27th July onwards)</td><td>930 tCO2e</td></tr>
<tr><td>2018</td><td>1730 tCO2e</td></tr>
<tr><td>2019</td><td>3245 tCO2e</td></tr>
<tr><td>2020</td><td>4327 tCO2e</td></tr>
<tr><td>2021</td><td>4327 tCO2e</td></tr>
<tr><td>2022</td><td>8654 tCO2e</td></tr>
<tr><td>2023</td><td>8654 tCO2e</td></tr>
<tr><td>2024</td><td>8654 tCO2e</td></tr>
<tr><td>2025</td><td>8654 tCO2e</td></tr>
<tr><td>2026</td><td>8654 tCO2e</td></tr>
<tr><td>2027 (till 26th July)</td><td>4908 tCO2e</td></tr>
</table></td><td>As per para 43 of AMS.I.D v18.0,
$ER_{electricity,y} = BE_y - PE_y - LE_y$</td></tr>
</table>

Emission reduction achieved by the project activity ($ER_{project,y}$) Year / $ER_{project,y}$: 2017 (27th July onwards): 10777 tCO2e 2018: 22558 tCO2e 2019: 26539 tCO2e 2020: 28832 tCO2e 2021: 30072 tCO2e 2022: 35517 tCO2e 2023: 36755 tCO2e 2024: 37992 tCO2e 2025: 39227 tCO2e 2026: 40463 tCO2e 2027 (till 26th July): 23647 tCO2e Average: 33237 tCO2e per year	Emission reduction achieved by the project activity consists of emission reduction due to methane component ($ER_{methane,y}$) and emission reduction due to electricity component ($ER_{electricity,y}$). $ER_{project,y} = ER_{methane,y} + ER_{electricity,y}$ The validation team hence concluded PP has estimated the emission reductions in line with the latest approved version of the applied methodologies.

Year	$ER_{project,y}$
2017 (27th July onwards)	10777 tCO2e
2018	22558 tCO2e
2019	26539 tCO2e
2020	28832 tCO2e
2021	30072 tCO2e
2022	35517 tCO2e
2023	36755 tCO2e
2024	37992 tCO2e
2025	39227 tCO2e
2026	40463 tCO2e
2027 (till 26th July)	23647 tCO2e
Average	33237 tCO2e per year

3.3.7 Methodology Deviations

There is no methodology deviation.

3.3.8 Monitoring Plan

All assumptions and data used by the project participants is listed in the Joint PD&MR[/2/], including their references and sources. All documentation used by the project participants as the basis for assumptions and source of data is correctly quoted and interpreted in the Joint PD&MR[/2/]. The parameter would be monitored on implementation. The verification team concluded that the estimates provided in the Joint PD&MR[/2/] is correct. Refer section 3.3.6 of this report for more details.

3.4 Non-Permanence Risk Analysis

For a non AFOLU project, this section is not applicable.

4 SAFEGUARDS

4.1 No Net Harm

The verification team has reviewed the EIA[/6/], Environmental management Plan[/6/] etc and accepted the there is no net harm from the project. The EIA was approved by CONELEC, by Official Letter No. CONELEC-CNRSE-2014-0067-OF of 9 February 2014[/6/]. Hence accepted.

4.2 Environmental Impact

The verification team has reviewed the EIA[/6/], Environmental management Plan[/6/] etc and accepted the there is no net harm from the project. The EIA was approved by CONELEC, by Official Letter No. CONELEC-CNRSE-2014-0067-OF of 9 February 2014[/6/]. Hence accepted.

4.3 Local Stakeholder Consultation

A formal consultation process with the local stakeholders was carried out on 25th to 27th November 2013 at the project site. The identified stakeholders included villagers, officers from the Municipal Corporation, farmers around the project area, and representatives of project developers, relevant citizens, such as the governor, fire chief, major, community development representatives, parish priest etc. All the identified stakeholders were communicated by written invitation before the meeting on 21st November 2013. There was no negative comments. The verification team has reviewd rhe local stakeholder consultation report[/17/] as well. The verification team has interviewed the local stakeholders during the onsite visit and received the positive opinion.

The meeting discussed the environmental benefits of the project activity and the stakeholders were provided with an interactive presentation on the project activity, its local and global benefits to the environment, the process, and how the project would lead to sustainable development. The Queries / comments were summarized and adequately addressed / accounted for as evident from the minutes of the stakeholder meeting and the description provided in the PD. The verification team was able to confirm that PP had conducted the local stakeholder consultation process by reviewing the local stakeholder document[/17/] for details.

4.4 Public Comments

This project was open for public comment from 10th April to 10th May 2019. There was no comments during the commenting period[/2/].

5 VERIFICATION FINDINGS

5.1 Accuracy of GHG Emission Reduction and Removal Calculations

Particulars	Verification opinion
Emission reduction achieved by the project activity ($ER_{project,y}$)	Emission reduction achieved by the project activity consists of emission reduction due to methane component ($ER_{methane,y}$) and emission reduction due to electricity component ($ER_{electricity,y}$). $ER_{project,y} = ER_{methane,y} + ER_{electricity,y}$ The verification of the same is detailed below.
Emission reduction achieved by methane component ($ER_{methane,y}$)	As per para 19 of AMS.III.G v10, the emission reduction achieved by the project activity can be estimated ex ante in the project design document (PDD) by the following. $ER_y = BE_y - PE_y - LE_y$ Where Where BE_y -Baseline emissions in year *y* PE_y -Project emissions in year *y* LE_y-Leakage emissions in year y The verification details of BE_y, PE_y and LE_y is detailed below.
Baseline emissions in year y (BE_y)	As per para 20 of AMS.III.G v10, BE_y is calculated as follows. $BE_y = (1-OX) \times (F_{CH4,PJ,y} - F_{CH4,BL,y}) \times GWP_{CH4}$ Where OX-Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste $F_{CH4,PJ,y}$ -Methane captured and destroyed/gainfully used by the project activity in the year *y* $F_{CH4,BL,y}$ - Methane emissions that would be

<table>
<tr><td></td><td>captured and destroyed to comply with national or local safety requirement or legal regulations in the year y

The verification of the same is detailed below.</td></tr>
<tr><td>Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste) (OX) =10%

(ex-ante parameter)</td><td>It reflects the amount of methane from SWDS that is oxidized in the soil or other material covering the waste. As per para 14 of the applied methodology, this value is taken as 10%. Hence it is accepted by the verification team.</td></tr>
<tr><td>Methane captured and destroyed/gainfully used by the project activity in the year y ($F_{CH4,PJ,y}$)

(calculated parameter)</td><td>As per para 21 of AMS.III.G v10.0, for project activities that utilize the recovered methane for power generation, may be calculated as follows, based on the amount of monitored electricity generation, without monitoring methane flow and concentration.
$F_{CH4,PJ,y} = (EG_y \times 3600 \times D_{CH4}) / (NCV_{CH4} \times EE_y)$

Where
EG_y –Electricity generation
D_{CH4} -Density of methane at the temperature and pressure of the landfill gas in year y
GWP_{CH4} - Global Warming Potential of methane
NCV_{CH4} –Net calorific value of methane
EE_y -Energy Conversion Efficiency of the project equipment</td></tr>
<tr><td>Electricity generation or Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (EG_y)

<table>
<tr><th>Year</th><th>EG_y</th></tr>
<tr><td>2017 (27th July onwards)</td><td>2776 MWh</td></tr>
<tr><td>2018</td><td>5165 MWh</td></tr>
</table>

(monitored parameter no 1 as per joint PD/MR[/2/])

<table>
<tr><th>Particulars</th><th>Value</th></tr>
<tr><td>Name of the meter</td><td>Export electricity meter</td></tr>
<tr><td>Serial number of energy meter</td><td>MJ-1310A536-04</td></tr>
<tr><td>1. Date of installation of this meter/
2. Date of replacement of the meter (Measurement dates by this meter)</td><td>1. Since commissioning
The meter is retained atleast upto time of onsite visit by the verification team</td></tr>
<tr><td>Maximum permissible error of the meter</td><td>±0.2%</td></tr>
<tr><td>Calibration Validity as per PDD</td><td>2 years</td></tr>
<tr><td>Date of first calibration</td><td>5th October 2017</td></tr>
<tr><td>Calibration Agency/Calibration agency reference no</td><td>Inspeccion y Oficializacion del Sistema de Medicion Commercial</td></tr>
</table>
</td><td>As per PD, it is continuously moniotored by electricity meters at 22 kV.

QA/QC procedure:

The main meter is calibrated every 2 years. There is no error that exceeds maximum permissible error. Hence accepted. As per the PD, energy meter would be calibrated every 2 years as per government regulations. The verification team has checked the calibration certificates[/18/] against meter number, serial number, date of calibration, validity and actual error and found that meter is calibrated by the certified agency and the actual error is less than the maximum permissible error.

The verification team has accepted the measurement methods, aggregation approach and data used for emission calculations and quality control procedures.

The verification team confirmed that the monitoring of the parameter related to emission reductions is implemented in accordance with the joint PD/MR[/2/].</td></tr>
</table>

Validity upto: 4th October 2019 Actual error: 0% Calibration delay period if any: Nil Applied error: NA	
Density of methane at the temperature and pressure of the landfill gas in year y (D_{CH4}) =0.7168 kg/m^3 (ex-ante parameter)	It is sourced from ACM0001 v18.0
Net calorific value of methane (NCV_{CH4}) =35.9 MJ/NM^3 (ex-ante parameter)	It is sourced from AMS.III.G v10.0. Hence accepted.
Energy Conversion Efficiency of the project equipment (EE_y) =36% (monitored parameter no 2 as per joint PD/MR[/2/])	It is sourced from the manufacturer details. Hence accepted. The verification team confirmed that the monitoring of the parameter related to emission reductions is implemented in accordance with the joint PD/MR[/2/].
Methane captured and destroyed/gainfully used by the project activity in the year *y* ($F_{CH4,PJ,y}$) Year: $F_{CH4,PJ,y}$ 2017 (27th July onwards): 554 tCH4 2018: 1031 tCH4	As per para 21 of AMS.III.G v10.0, for project activities that utilize the recovered methane for power generation, may be calculated as follows, based on the amount of monitored electricity generation, without monitoring methane flow and concentration. $F_{CH4,PJ,y} = (EG_y \times 3600 \times D_{CH4} \times GWP_{CH4}) / (NCV_{CH4} \times EE_y)$

Global Warming Potential of methane (GWP_{CH4}) =25 tCO2e/tCH4 (ex-ante parameter) http://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf#page=23 https://www.ipcc.ch/publications_and_data/ar4/wg1/en/errataserrata-errata.html	It is fixed ex-ante parameter hence accepted.
Baseline emissions in year y (BE_y) Year — BE_y 2017 (27th July onwards) — 12471 tCO2e 2018 — 23203 tCO2e	As per para 20 of AMS.III.G v10, BE_y is calculated as follows. $BE_y = (1-OX) \times (F_{CH4,PJ,y} - F_{CH4,BL,y}) \times GWP_{CH4}$
Project emissions (PE_y)	As per para 15 of AMS.III.G v10, Project emissions consist of CO2 emissions from fossil fuel or electricity used by the project activity facilities, Emissions from flaring or combustion of the gas stream, Emissions from the landfill gas upgrading process. As per equation 2 of the applied methodology, $PE_y = PE_{Power,y} + PE_{flare,y} + PE_{process,y}$ Where $PE_{Power,y}$ -Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y $PE_{flare,y}$ -Emissions from flaring or combustion of the landfill gas stream in the year y $PE_{process,y}$ - Emissions from the landfill gas upgrading process in the year y
Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y ($PE_{Power,y}$)	As per para 16 of AMS.III.G v10, For project emissions from fossil fuel consumption, the “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion”/13/ shall be used. However, there is no fossil fuel consumption for electricity generation for captive use. Hence this project emission due to fossil fuel is zero. Project emissions from electricity consumption are determined as per the procedures described in the electricity consumption tool/13/), “AMS-I.D.: Grid connected renewable electricity generation”. As per equation 1 of the electricity consumption tool, baseline emissions from consumption of electricity are calculated as follows. $PE_{Power,y} = PE_{EC,y} = \Sigma EC_{PJ,k,y} \times EF_{EL,j,y} \times (1+TDL_{j,y})$ Where $EC_{PJ,j,y}$ –Net amount of electricity consumed by the project activity in year y $EF_{EL,j,y}$-Emission factor for electricity generation for source *j* in year *y* $TDL_{j,y}$ -Average technical transmission and

	distribution losses for providing electricity to source j in year *y* j-Sources of electricity consumption in the project The verification of the same is detailed below.
Net amount of electricity consumed by the project activity in year y ($EC_{PJ,j,y}$) Year | $EC_{PJ,j,y}$ 2017 (27th July onwards) | 67 MWh 2018 | 143 MWh (monitored parameter no 3 as per joint PD/MR[/2/]	Ex-ante estimation: It is based on actual electricity purchase for the year 2017 and 2018. The verification team has reviewed the monthly bills and accepted. Since the meter is not in PP's control, calibration is not conducted. The verification team has accepted. The verification team confirmed that the monitoring of the parameter related to emission reductions is implemented in accordance with the joint PD/MR[/2/].
Emission factor for electricity generation for source *k* in year *y* ($EF_{EL,k,y}$) =0.3349 tCO2e/MWh (ex-ante parameter)	This is fixed ex-ante parameter. Hence accepted by the verification team.
Average technical transmission and distribution losses for providing electricity to source j in year y ($TDL_{j,y}$) =5.76% (monitored parameter no 4 as per joint PD/MR[/2/])	It is sourced from CENTROSUR, the electricity distribution company that owns and manages the electric grid. As it is the annual average value based on the most recent data available within the host country, it is accepted by the verification team. The verification team confirmed that the monitoring of the parameter related to emission reductions is implemented in accordance with the joint PD/MR[/2/].
Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y ($PE_{Power,y}$) Year | $PE_{Power,y}$ 2017 (27th July onwards) | 24 tCO2e 2018 | 51 tCO2e	As per equation 1 of the electricity consumption tool, baseline emissions from consumption of electricity are calculated as follows. $PE_{Power,y} = PE_{EC,y} = \sum EC_{PJ,k,y} \times EF_{EL,j,y} \times (1+TDL_{j,y})$
Emissions from flaring or combustion of the landfill gas stream in the year y ($PE_{flare,y}$)	As per para 17 of AMS.III.G v10, If flaring (single or multiple) is used to destroy all or part of the recovered landfill gas, project emissions from flaring in year *y* shall be determined for each flare following the procedure described in the methodological flaring tool[/13/]. As per step 3 (equation 15) of the flaring tool, $PE_{flare,y}$ is calculated as below $PE_{flare,y} = GWP_{CH4} \times \sum F_{CH4,RG,m} \times (1-\eta_{flare,m})$ Where GWP_{CH4}- Global warming potential of methane valid for the commitment period $F_{CH4,RG,m}$ - Mass flow of methane in the residual gas in the minute m $\eta_{flare,m}$ - Flare efficiency in minute m

<table>
<tr><td></td><td>The verification details are below</td></tr>
<tr><td>Global warming potential of methane valid for the commitment period (GWP_{CH4}) =25 tCO2e/tCH4

(ex-ante parameter)</td><td>It is already verified as above.</td></tr>
<tr><td>Mass flow of methane in the residual gas in the minute m ($F_{CH4,RG,m}$)

<table>
<tr><td>Year</td><td>$F_{CH4,RG,m}$</td></tr>
<tr><td>2017 (27th July onwards)</td><td>498 tCH4</td></tr>
<tr><td>2018</td><td>928 tCH4</td></tr>
</table>

<table>
<tr><td>Option</td><td>Flow of gaseous stream</td><td>Volumetric fraction</td></tr>
<tr><td>A</td><td>Volume flow- dry basis</td><td>dry or wet basis</td></tr>
</table>
</td><td>As per step 1 of the flaring tool, Mass flow of methane in the residual gaseous stream in the minute m is determined using mass flow calculation tool[/13/]) with the following conditions satisfied.
a) The gaseous stream tool shall be applied to the residual gas; b) The flow of the gaseous stream shall be measured continuously c) CH4 is the greenhouse gas *i* for which the mass flow should be determined d) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the mass flow calculation tool); and e) The time interval *t* for which mass flow should be calculated is every minute *m*.

For the project activity, following applies.

a)The source of the residual gas is from the landfill (biogenic source

b) As per the PDD, flow of the gaseous stream is measured continuously

c) CH4 is the greenhouse gas for which the mass flow is determined

d) As per the mass flow calculation tool, the determination of the molecular mass of the gaseous stream requires measuring the volumetric fraction of all gases (k) in the gaseous stream. However as a simplification, the volumetric fraction of only the gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. If this mass flow calculation tool is used to calculate mass flow of CH4 the simplification can be acceptable. As the CH4 is the greenhouse gas for which mass flow is being determined, this simplification approach is accepted

As all the conditions are satisfied, per step 1 of the flaring tool, Mass flow of methane in the residual gaseous stream in the minute m can be determined using mass flow calculation tool[/13/])

Para 14 (Table 2) of the mass flow calculation tool shows the different ways to make the measurements for mass flow of a greenhouse</td></tr>
</table>

<table>
<tr><td></td><td>gas i in a gaseous stream and the corresponding calculation option for $F_{i,t}$. PP has chosen option A.</td></tr>
<tr><td>Flare efficiency in minute m ($\eta_{flare,m}$) =0%

(ex-ante parameter)

Type of flare= enclosed flare

(Option A)</td><td>As per step 2 of the flaring tool, the flare efficiency depends on the efficiency of combustion in the flare and the time that the flare is operating. As the flame enclosure is more than 2 times the diameter of the enclosure, type of flare is enclosed flare which is line with the definition prescribed by the flaring tool for enclosed flaring system.
As per step 1 of the flaring tool, for determining the efficiency of combustion of enclosed flares there is the option to apply a default value (option A) or determine the efficiency based on monitored data (option B). PP has used option A. Under option A, the flare efficiency for the minute *m* is 90% when the following two conditions are met to demonstrate that the flare is operating:
(1) The temperature of the flare ($T_{EG.m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute *m*; and

(2) The flame is detected in minute *m* ($Flame_m$).
Otherwise $\eta_{flare,m}$ is 0%. The verification team has reviewd the technical specification of the flare[/19/]. Since due to non monitoring of LFG fed into flare, $\eta_{flare,m}$ =0%</td></tr>
<tr><td>Flame is detected in minute *m* ($Flame_m$) or operating hours of flare ($OT_{flare,y}$)

<table><tr><td>Year</td><td>$OT_{flare,y}$</td></tr><tr><td>2017 (27th July onwards)</td><td>476 hours per year</td></tr><tr><td>2018</td><td>1597 hours per year</td></tr></table></td><td>It is based on actual value based on hour meters during 2017 and 2018. Hence accepted.</td></tr>
<tr><td>Emissions from flaring or combustion of the landfill gas stream in the year y ($PE_{flare,y}$)

<table><tr><td>Year</td><td>$PE_{flare,y}$</td></tr><tr><td>2017 (27th July onwards)</td><td>0 tCO2e</td></tr><tr><td>2018</td><td>0 tCO2e</td></tr></table></td><td>As per step 3 (equation 15) of the flaring tool, $PE_{flare,y}$ is calculated as below
$PE_{flare,y} = GWP_{CH4} \times \sum F_{CH4,RG,m} \times (1-\eta_{flare,m})$
Where
GWP_{CH4}- Global warming potential of methane valid for the commitment period
$F_{CH4,RG,m}$ - Mass flow of methane in the residual gas in the minute m
$\eta_{flare,m}$ - Flare efficiency in minute m

However, the verification team observed that flaring system is installed and is operational only when gas engine is shut off. The emission reduction achieved by the flare is not counted in this project, since no measurement equipment is installed, the baseline and project emissions of the use of the flare also is taken into account. Hence accepted by the verification team.</td></tr>
<tr><td>Emissions from the landfill gas upgrading process in</td><td>As per para 15 of AMS.III.G v10, Emissions</td></tr>
</table>

<table>
<tr><td>the year y ($PE_{process,y}$) = 0 tCO2e per year</td><td>from the landfill gas upgrading process in the year y, determined by following the relevant procedures described in annex 1 of AMS-III.H v19.0. Since the if the project activity does not involve bottling of biogas, $PE_{process,y}$ =0 tCO2e per year</td></tr>
<tr><td>Project emissions (PE_y)

Year | PE_y
2017 (27th July onwards) | 24 tCO2e
2018 | 51 tCO2e</td><td>As per para 15 of AMS.III.G v10, Project emissions consist of CO2 emissions from fossil fuel or electricity used by the project activity facilities, Emissions from flaring or combustion of the gas stream, Emissions from the landfill gas upgrading process.
As per equation 2 of the applied methodology,
$PE_y = PE_{Power,y} + PE_{flare,y} + PE_{process,y}$</td></tr>
<tr><td>Leakage emissions (LE_y) = 0 tCO2e</td><td>As per para 18 of AMS.III.G v10, If the methane recovery technology is equipment transferred from another activity, leakage effects are to be considered. This is not the case here, LE_y =0 tCO2e.</td></tr>
<tr><td>Emission reduction achieved by methane component ($ER_{methane,y}$)
Year | ER_y
2017 (27th July onwards) | 12448 tCO2e
2018 | 23152 tCO2e</td><td>As per para 19 of AMS.III.G v10, the emission reduction achieved by the project activity can be estimated ex ante in the project design document (PDD) by the following.

$ER_y = BE_y - PE_y - LE_y$</td></tr>
<tr><td>Emission reduction achieved by electricity component ($ER_{electricity,y}$)</td><td>As per para 43 of AMS.I.D v18.0,
$ER_y = BE_y - PE_y - LE_y$

Where BE_y -Baseline emissions in year y
PE_y -Project emissions in year y
LE_y-Leakage emissions in year y
The verification details of BE_y, PE_y and LE_y is detailed below.</td></tr>
<tr><td>Baseline emissions in year y (BE_y)</td><td>As per para 22 of AMS.I.D, baseline emissions include only CO2 emissions from electricity generation in power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows.

$BE_y = EG_{PJ,y} \times EF_{grid,y}$
Where
$EG_{PJ,y}$ -Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y

$EF_{grid,y}$ -Combined margin CO2 emission factor for grid connected power generation in year y</td></tr>
</table>

<table>
<tr><td></td><td>The verification of the same is detailed below.</td></tr>
<tr><td>Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y ($EG_{PJ,y}$)</td><td>As per para 25 and 26 of AMS.I.D, if the project activity is the installation of a greenfield power plant, then $EG_{PJ,y} = EG_{facility,y}$

Where
$EG_{facility,y}$ -Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
The verification of the same is detailed below.</td></tr>
<tr><td>Quantity of net electricity generation supplied by the project plant/unit to the grid in year y ($EG_{facility,y}$)

(monitored parameter no 1 as per joint PD/MR[/2/])

<table><tr><td>Year</td><td>$EG_{facility,y}$</td></tr><tr><td>2017 (27th July onwards)</td><td>2776 MWh</td></tr><tr><td>2018</td><td>5165 MWh</td></tr></table></td><td>During the monitoring:
As per PD, it is continuously moniotored by electricity meters at 22 kV. The verification team has reviewed the monthly invoices[/12/] and accepted the same.

QA/QC procedure:
It is calibrated every 2 years. The verification team has reviewed the calibration certificates[/18/] and accepted the same.

The verification team confirmed that the monitoring of the parameter related to emission reductions is implemented in accordance with the joint PD/MR[/2/].</td></tr>
<tr><td>Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y ($EG_{PJ,y}$)

<table><tr><td>Year</td><td>$EG_{PJ,y}$</td></tr><tr><td>2017 (27th July onwards)</td><td>2776 MWh</td></tr><tr><td>2018</td><td>5165 MWh</td></tr></table></td><td>As per para 25 and 26 of AMS.I.D, if the project activity is the installation of a greenfield power plant, then $EG_{PJ,y} = EG_{facility,y}$</td></tr>
<tr><td>Combined margin CO2 emission factor for grid connected power generation in year y ($EF_{grid,y}$) =0.3349 tCO2e/MWh

(ex-ante parameter)</td><td>It is fixed ex-ante parameter. Hence accepted.</td></tr>
<tr><td>Baseline emissions in year y (BE_y)

<table><tr><td>Year</td><td>BE_y</td></tr><tr><td>2017 (27th July onwards)</td><td>930 tCO2e</td></tr><tr><td>2018</td><td>1730 tCO2e</td></tr></table></td><td>As per para 22 of AMS.I.D, baseline emissions include only CO2 emissions from electricity generation in power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows.

$BE_y = EG_{PJ,y} \times EF_{grid,y}$</td></tr>
<tr><td>Project emissions (PE_y) =0 tCO2e per year</td><td>As per para 39 of AMS.I.D, For most renewable energy project activities, PE_y = 0 tCO2e</td></tr>
<tr><td>Leakage emissions (LE_y) =0 tCO2e per year</td><td>As per para 42 of AMS.I.D, General guidance on leakage in biomass project activities shall be followed to quantify leakages pertaining to the use of biomass residues. Since there is no</td></tr>
</table>

<table>
<tr><td></td><td>biomass residue involved in this project, leakage is zero.</td></tr>
<tr><td>Emission reduction achieved by electricity component ($ER_{electricity,y}$)
<table>
<tr><td>Year</td><td>$ER_{electricity,y}$</td></tr>
<tr><td>2017 (27th July onwards)</td><td>930 tCO2e</td></tr>
<tr><td>2018</td><td>1730 tCO2e</td></tr>
</table>
</td><td>As per para 43 of AMS.I.D v18.0,
$ER_{electricity,y} = BE_y - PE_y - LE_y$</td></tr>
<tr><td>Emission reduction achieved by the project activity ($ER_{project,y}$)
<table>
<tr><td>Year</td><td>$ER_{project,y}$</td></tr>
<tr><td>2017 (27th July onwards)</td><td>13377 tCO2e</td></tr>
<tr><td>2018</td><td>24882 tCO2e</td></tr>
<tr><td>Total</td><td>38259 tCO2e</td></tr>
</table>
</td><td>Emission reduction achieved by the project activity consists of emission reduction due to methane component ($ER_{methane,y}$) and emission reduction due to electricity component ($ER_{electricity,y}$).
$ER_{project,y} = ER_{methane,y} + ER_{electricity,y}$

The verification team was is able to confirm that the monitoring plan contained in the joint PD/MR[/2/] is in accordance with the approved methodologies. The monitoring has been carried out in accordance with the monitoring plan contained in the joint PD/MR[/2/]. All parameters stated in the monitoring plan and the applied methodology has been fulfilled in the current monitoring period. All parameters used for emission reductions calculation have been verified and found satisfactory. The discussion regarding each parameter has been elaborated as above. The monitoring plan as mentioned in the joint PD/MR[/2/] is in accordance with the applied methodology. The monitoring approach for each parameter described in the joint PD/MR[/2/] was found consistent in terms of unit, measurement procedures and monitoring frequency.</td></tr>
</table>

5.2 Quality of Evidence to Determine GHG Emission Reductions and Removals

The verification team was is able to confirm that the monitoring plan contained in the joint PD/MR[/2/] is in accordance with the approved methodologies. The monitoring has been carried out in accordance with the monitoring plan contained in the joint PD/MR[/2/]. All parameters stated in the monitoring plan and the applied methodology has been fulfilled in the current monitoring period. All parameters used for emission reductions calculation have been verified and found satisfactory. The discussion regarding each parameter has been elaborated as above. The monitoring plan as mentioned in the joint PD/MR[/2/] is in accordance with the applied methodology. The monitoring approach for each parameter described in the joint PD/MR[/2/] was found consistent in terms of unit, measurement procedures and monitoring frequency. Refer section 5.1 of this report for details.

6 VALIDATION AND VERIFICATION CONCLUSION

EPIC performed a validation and verification of the proposed VCS project “Pichacay Landfill Gas Renewable Energy Project”. The validation was carried out to independently assess whether the project confirms to the qualification criteria and requirements of the Voluntary Carbon Standard (VCS), including the baseline and monitoring methodology applied. The VCS program provides the standard and framework for independent validation based on ISO 14064-2:2006 and ISO14064-3:2006 standards.

The validation was performed using a risk based approach, the review of the project description and the subsequent follow-up interviews provided EPIC with sufficient evidence to determine the fulfillment of the stated criteria.

The GHG emission calculations are documented in a complete and transparent manner. The formulae and methodologies for accounting GHG emissions are appropriate and emission factors are deemed to be of sufficient accuracy. The emission reductions forecast has been checked and it is deemed likely that the stated amount is achievable on the basis that the underlying assumptions do not change.

The monitoring plan is in line with the approved monitoring methodologies of AMS.III.G v10.0 and AMS.I.D v18.0. The plan adequately addresses all necessary information for monitoring and reporting of emissions reductions due to the project activity. Responsibilities and authorities for project management, monitoring and reporting, and the data quality control and quality assurance procedures have been described in the final PD/MR.

In summary, it is EPIC opinion that the VCS project in the the PD&MR version 3.2 dated 7th July 2019, meets all relevant VCS requirements, is eligible as small scale project type and correctly applies the baseline and monitoring methodology specified in AMS.III.G v10.0 and AMS.I.D v18.0. As such, EPIC recommends the registration of the project as a VCS project activity.

The verification was carried out in accordance with the requirements of the Validation and Verification standard for project activities Version 2.0 and VCS Standard 3.7. As a result of the verification, the verification team confirms that for the reporting period:

- all operations of the project were implemented as described in the registered PD, (project ID PL1883) ,
- the monitoring plan is in accordance with the approved monitoring methodology applied by the project activity.
- the monitoring has been carried out in accordance with the PD&MR version 3.2 dated 7th July 2019.
- the monitoring aspects (i.e. additional monitoring parameters, monitoring frequency and calibration frequency) were in place and functional, with the installed equipment essential for generating emission reduction operating appropriately and the calibration of all the equipment had been carried out accordingly and appropriate adjustments had been made when there were delays in the calibration, and
- the GHG emission reductions achieved were calculated correctly on the basis of approved monitoring methodology.

We have verified that the information included in the final PD &MR was correct and that the emission reductions achieved had been determined correctly. In our opinion, the GHG emission reductions for the monitoring period stated in the latest revised monitoring report for the project are fairly stated

The verifier confirms that the GHG emission reductions were calculated without material misstatements for the whole monitoring period. Our opinion is based on the project's GHG emissions and resulting GHG emission reductions reported, and, to the valid and registered project baseline and monitoring documents. We confirm that Verified GHG emission reductions and removals for the period from 27th July 2017 to 31st December 2018 is 38,259 tCO2e.

Verification period: From [27-July-2017] to [31-December-2018]

Verified GHG emission reductions and removals in the above verification period:

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
27th July 2017 to 31st December 2017	13401	24	0	13377
1st January 2018 to 31st December 2018	24933	51	0	24882
Total	38334	75	0	38259

Prepared by :	Approved by:
R. Vijayaraghavan (Vijayaraghavan. R) Verification Team Leader	(K. Sudheendra) Head-Operations

REFERENCES

No	Author	Title	Provider
1	UNFCCC/ VCS	Validation and Verification Standard for project activities, v2.0 https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20181221092105818/Reg_stan06v02.pdf Project Standard for project activities, v2.0 https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20181221092046526/Reg_stan04v02.pdf Project Cycle Procedure for project activities, v2.0 https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20181221092024737/PC_proc03v02.pdf VCS Standard v3.7 https://verra.org/wp-content/uploads/2018/03/VCS_Standard_v3.7.pdf Registration & Issuance Process v3.8 https://verra.org/wp-content/uploads/2018/03/Registration_and_Issuance_Process_v3.8.pdf	Publicly available
2	VCS	Listed PD/MR v1.0 (initial PD/MR-Pipeline) https://www.vcsprojectdatabase.org/#/pipeline_details/PL1883 Joint PD/MR template version 3.1 https://verra.org/wp-content/uploads/2018/03/VCS-Joint-Project-Description-Monitoring-Report-Template-v3.1.doc	Publicly available
3	EMAC	Commissioning certificates Gas engines, Flares, Blowers	PP
4	EMAC	Final PD/MR (request for registration/issuance) v 3.2 dated 7th July 2019	PP
5	Ministry of Environment	Licence for landfill operation, Environmental licence	PP
6	EMAC	Environment Impact Assessment and its approval Environmental management Plan	PP
7	ARCONEL	Contract referred as Título Habilitante between EBE and CONELEC	PP
8	EMAC	Public deed of constitution	PP
9	PP	CDM PDD published in 2012 for Global stakeholder consultation https://cdm.unfccc.int/Projects/Validation/DB/B91W1L5HMMP6UYA7K1QT9HE7TWITB6/view.html	Publicly available
10	UNFCCC	AMS.III.G -Landfill methane recovery -v10.0 https://cdm.unfccc.int/methodologies/DB/0KHNES8D09H134V3TZDQ47C3LQL3H2 AMS.I.D - Grid connected renewable electricity generation -v18.0 https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK	Publicly available
11	UNFCCC	AMS-III.H.: Methane recovery in wastewater treatment" (version 19.0) https://cdm.unfccc.int/methodologies/DB/K7FDTJ4FL3432I1UKRNKLDCUFAMBX7	Publicly available
12	EMAC	Monthly electricity invoices	PP

13	UNFCCC	Emissions from solid waste disposal sites v8.0 https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v8.0.pdf Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation v3.0 https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf Tool to calculate project or leakage CO2 emissions from fossil fuel combustion v3.0 https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf Tool Project emissions from flaring v3.0 https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v3.0.pdf Tool to determine the baseline efficiency of thermal or electric energy generation systems v2.0 https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v2.0.pdf Positive lists of technologies v1.0 https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v2.0.pdf Tool to calculate the emission factor for an electricity system v7.0 https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 3.0 https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf	Publicly available
14	IPCC/UNFCCC	Standard for application of the global warming potentials to CDM PA and PoA for the second commitment period of the Kyoto protocol" Version 1.0 (EB 69 Annex 30) http://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf#page=23 https://www.ipcc.ch/publications_and_data/ar4/wg1/en/errataserrata-errata.html	Publicly available
15	EMAC-EP	EMAC-EP data on waste	PP
16	CENACE	CENACE document for emission factor	PP
17	EMAC	Local stakeholder consultation report	PP
18	EMAC	Calibration certificates	PP
19	Manufacturer	Technical specifications of gas engines, flaring, blower, electricity meters, biogas flow meter, methane analyser, transformers.	PP
20	EMAC	Lifetime of the gas engines	PP

APPENDIX: <RESOLUTION OF CARS AND CLS>

Correction Action Request (CAR) or Clarification Request (CR) or Forward Action Request (FAR)	Response from project participant	Verification team conclusion
CL 1 Please provide evidence for lifetime of the project (land fill and Biogas engines)	<u>Landfill piping</u> We answered the question on the lifetime of the landfill piping already at an earlier stage. For evidence lifetime landfill piping See: "9 TECHNICAL MANUAL – GEORG FISCHER". This report works with an operational lifetime of 50 years. See page 20. <u>Biogas engines:</u> Cristina Segura, Regional Director Engine Business for our brand engine, in relation to the lifetime of the genset wrote the following: "If the engine is properly maintained according to the established maintenance guidelines and the biogas fulfil the technical specifications, the engine can operate normally until overhaul. This cycle can be completed up to three times (3 cycles, two overhauls). Before the third Overhaul, customers usually acquire a new engine." PLEASE CHECK ENCLOSED DOCUMENT NO. 2. CRISTINA S - ESTIMACIÓN DE VIDA ÚTIL DE GRUPO SFGM 560 According to the Maintenance Manual an overhaul occurs every 25.000 operation hours. Please check document no 1 MAINTENANCE SHEET - SFGM ENGINES If we consider a maximum operation time of 7.500 hours/year, this will mean 3,33 years. So that, in a normal operation time, the genset can last near to 10 years.	The verification team has reviewed the documents and accepted that the crediting period will match upto the life time only. CL1 is closed.
CAR 1 The simplified version of additionality demonstration is valid for three years from 2014 as per methodology. Pls clarify how additionality is valid.	During EB meeting 101 "Tool 32, methodological tool: positive list of technologies, version 01.0", which are deemed to be automatically additional was approved. (see 18a	PP has revised the PD with using AMS. III.G v10.0 which refers to positive list of additionality. The simplified procedure of additionality as

Correction Action Request (CAR) or Clarification Request (CR) or Forward Action Request (FAR)	**Response from project participant**	**Verification team conclusion**
	18a am-tool-32-v1 Positive list of technologies) LFG projects below 10 MW are part of this list. The main meeting report paragraph 31 (see 18b eb101_meeting_report) states the following: *31. The Board approved the new methodological tool "TOOL32: Positive lists of technologies", as contained in annex 6 to this report and requested the MP to propose, at a future meeting, revisions to the following methodologies to allow for the application of the new tool:* *(a) "ACM0001: Flaring or use of landfill gas";* *(b) "ACM0014: Treatment of wastewater";* *(c) "AMS-III.G: Landfill methane recovery";* *(d) "AMS-III.H: Methane recovery in wastewater treatment"* This clearly shows that it is the intention of the CDM Executive board to regard landfill gas projects under AMS-III.G additional automatically. The EB ordered the MP (Methodology Panel of CDM) to process these changes. Given the fact that AMS III-G allowed automatic additionality already in a previous period, and that automatic additionally will be implemented in AMS-III-G soon via reference to TOOL32, we request to apply automatic additionality for the Pichacay Landfill Gas Renewable Energy Project	per version 10 of the methodology has vlaidty upto Novemeber 2021. Hence accepted by the verification team. CAR 1 is closed.
CAR 2 The project was envisaged for 4 MW. But the ex-ante validation calculation is based on 2 MW only. Please do the corrective action.	We changed the ex ante emission calculation for validation and the project description accordingly. Please find them attached.	The verification team has reviewed the revised PD/MR and excel sheets and accepted the same. CAR 2 is closed.

Correction Action Request (CAR) or Clarification Request (CR) or Forward Action Request (FAR)	Response from project participant	Verification team conclusion
CAR 3 During the local stakeholder meeting by the verification team, the following concerns were raised by the local stakeholders. 1. Air quality 2. Stray dog bites 3. Mosquitoes bites	The dog´s problem is the one with high priority. According to Ecuadorian local regulations, the eradication control of dogs is not allowed, so that, a short-term solution will be not feasible. Nonetheless, the Mayor of the town at the meeting held on June 6 2019 showed his concern about this problem and point to several plans to be developed: • Relocation of landfill dogs to a proper and dedicated animal care area. • Massive sterilization in affected areas. A particular initiative will be led by EMAC and supported by EBE and Junta Parroquial de Santa Ana. A technical-social proposal will be delivered to the Municipality regarding for make an "exception to the rule" and declare the landfill area as a "special zone" were dog control can be executed. The biogas project improves air quality as biogas is removed from the landfill. The problem of mosquito bites requires further study since it takes place only in a specific community. Please be informed that these problems are related to the landfill, owned by EMAC, and not the biogas project owned by EBE (the joint venture of the Dutch BGP and EMAC). EMAC, looking for a good relation with the close by communities will have a meeting with the stakeholders involved in the project to develop jointly procedures and actions to solve the problems. EBE as the owner of the biogas project will stimulate EMAC to communicate regularly with the local stakeholders to mitigate the problems as far as possible, and	During interview with localstakeholders at the site during onsite visit, some of the stakeholders were clearly not happy about air quality, dog bites and mosquito bites. During the site itself, PP representative has commited to do some mitigation measures. The verification team has reviewed the mitigation measure mentioned here. The verification team would like to point out is it is PP's and PP represtative' responsibility to take mitigation measures to avoid the grievances of local stakeholders. The project should improve the communication channel between local stakeholders and PP. Based on this, CAR is converted into a FAR.

Correction Action Request (CAR) or Clarification Request (CR) or Forward Action Request (FAR)	**Response from project participant**	**Verification team conclusion**
	will make the follow-up of the procedures and agreements. Next to these problems, the local stakeholder meeting showed that local stakeholders are very satisfied with the 5% of EMAC turnover; fund invested in particular community projects.	
CL2 Please provide the following documents 1. Calibration certificates of biogas flow meter (flaring and engines) 2. Calibration certificates of export main meter and import main meter 3. Calibration certificate of methane analyser set	1. Please check 15b Biogas Analysis Calibration Certificate. 2. Export main meter: the calibration was carried out on May 10 2017, and is valid for 2 years. See “15a electricity export meter_calibration certificate” Import main meter: owned by electricity company, we have no access to the calibration certificate. The meter was calibrated once the electrical distribution company bought it. This company owns the device so they keep the calibration document. 3. The methane analyser set is a portable device from GEOTECH model BIOGAS 5000. We got if fully new but without factory calibration certificate. We calibrated it two weeks ago, so now a certificate is available. Please note that only the export main meter and import main meter are relevant for the emission reduction calculation.	The verification team has reviewed the calibration certificate of biogas analyser and accepted. For export electricity meter: The verification team has reviewed the calibration certificate of electricity meter and accepted. For import meter: Since it is not in PP’s control, the verification team has accepted. Methane concentration: Since methane concentration is not a monitoring parameter, the verification team has accepted.
CAR 4 Please provide technical specifications of landfill, flaring system, blowers, gas engines, transformers, gas flow meters (flaring and gas engines), electricity meters (export and import),	The technical specifications of equipment was provided already in our reply to *“List of documents required for project numbered PL1883”.* Below, we have repeated our reply and added files where needed. General information on landfill biogas project is included in the project description of the environmental impact assessment. See “4 Project description (chapter 8 of EIA)” Specification of horizontal or vertical pipes: see files in subdirectory “11e Hor vert lines”	The verification team has reviewed the documents and accepted

Correction Action Request (CAR) or Clarification Request (CR) or Forward Action Request (FAR)	**Response from project participant**	**Verification team conclusion**
	blowers, flaring equipment (including diameter and height: see "11c CONTINENTAL BLOWER MANUAL.pdf" and "11d H20378 Wiring Diagram Flare.pdf" Gas engines and generator set: see "11b Info on engine genset including efficiency.pdf" Transformers, substation (primary and secondary voltage): See 11p, 11q, and 11r Transformer of incoming power: see 3. TRANSFORMER CHARACTERISTICS Electricity generation meter: See "11a: Info on meter EGfacility.pdf" Electricity consumption: meter is owned by local energy distribution company. As stated in the project description paragraph 4.2 under $EC_{project,y}$. this is Electricity meter class CL200, type A3R model ELSTER ZE3300000L0. We don't have access to the full technical description. Gas flow meter: see "11t Biogas Analysis device"	
FAR 1 (A CAR was converted into a FAR) During the local stakeholder meeting by the verification team, the following concerns were raised by the local stakeholders. 1. Air quality 2. Stray dog bites 3. Mosquitoes bites	The dog´s problem is the one with high priority. According to Ecuadorian local regulations, the eradication control of dogs is not allowed, so that, a short-term solution will be not feasible. Nonetheless, the Mayor of the town at the meeting held on June 6 2019 showed his concern about this problem and point to several plans to be developed: • Relocation of landfill dogs to a proper and dedicated animal care area. • Massive sterilization in affected areas. A particular initiative will be led by EMAC and supported by EBE and Junta Parroquial de Santa Ana. A technical-social proposal will be	The verification team for the next verification period shall verify the same.

Correction Action Request (CAR) or Clarification Request (CR) or Forward Action Request (FAR)	Response from project participant	Verification team conclusion
	delivered to the Municipality regarding for make an “exception to the rule” and declare the landfill area as a “special zone” were dog control can be executed. The biogas project improves air quality as biogas is removed from the landfill. The problem of mosquito bites requires further study since it takes place only in a specific community. Please be informed that these problems are related to the landfill, owned by EMAC, and not the biogas project owned by EBE (the joint venture of the Dutch BGP and EMAC). EMAC, looking for a good relation with the close by communities will have a meeting with the stakeholders involved in the project to develop jointly procedures and actions to solve the problems. EBE as the owner of the biogas project will stimulate EMAC to communicate regularly with the local stakeholders to mitigate the problems as far as possible, and will make the follow-up of the procedures and agreements. Next to these problems, the local stakeholder meeting showed that local stakeholders are very satisfied with the 5% of EMAC turnover; fund invested in particular community projects.	