MONITORING REPORT

Document Prepared by Martijn Vis, BTG Biomass Technology Group B.V.

Contact Information

Project Title	Pichacay Landfill Gas Renewable Energy Project
Version	4.0
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

At the Pichacay landfill the municipal wastes from the city of Cuenca are disposed. In the landfill, methane is produced, which before project implementation, was released into the atmosphere. The project involves the implementation of a landfill gas (LFG) extraction network with horizontal and vertical pipes, a biogas pumping station, 4 engine-gensets of 0.85 MWe each, a flare and a transformer to 22 kV. The project recovers landfill methane and delivers electricity to the grid.

The landfill - without landfill gas recovery - is in operation since 2001; the environmental impact assessment and other needed permissions for landfill gas extraction and renewable electricity generation were obtained in 2014. The project was constructed and commissioned between 2014 - 2017 and started commercial operation with one engine-genset on 27 July 2017. The second engine-genset was initially expected to start operation around July 2019 but has been delayed. It is expected that it will start operation in Summer 2021. For the first 2 engines the project has all licences to be operational until 2029. The company wishes to extend operation after this date.

Installation of Engine 3 is planned in the last trimester of 2022 or the first semester of 2023; the installation of Engine 4 has not been planned yet/ Engine 2 - 4 are not part of the monitoring period 1 Jan 2019 – 31 Dec 2020. Since engine 3 & 4 are still in an early stage of development no permits have been obtained yet.

Prior to the implementation of the project organic waste at the landfill was left to decay, and methane was emitted to the atmosphere. The project collects methane that would otherwise be emitted to the atmosphere. By generation of renewable electricity, grid connected electricity generation capacity is replaced, reducing emissions of fossil-based electricity generation.

The project is located in Santa Ana, city of Cuenca, province of Azuay, in Ecuador.

In the monitoring period of 1 January 2019 – 31 Dec 2020 a total emission reduction of **42,990 tCO_2e** has been achieved.

1.2 Sectoral Scope and Project Type

Sectoral scope: 13 & 1, Waste handling and disposal & Energy (renewable/non-renewable)

Project Type -III Other project and Type-I Renewable Energy Project

The project activity is not a grouped project.

1.3 Project Proponent

Organization name	EMAC-BGP ENERGY COMPAÑÍA DE ECONOMÍA MIXTA CEM
Contact person	Mr. David González Hidalgo
Title	General manager
Address	Edif. San Vicente de Paúl, 6to Piso Av. Solano y 12 de Abril Cuenca Ecuador
Telephone	+593 7-284-1806
Email	david.gonzalez@ebe.com.ec

1.4 Other Entities Involved in the Project

Organization name	EMAC EP
Role in the Project	Main Partner of project proponent
Contact person	Wilfrido Bermeo
Title	Technical Director
Address	Avda. Solano y Avda. 12 de Abril Edif. San Vicente de Paul
Telephone	+5937 284 0045
Email	wbermeo@emac.gob.ec

Organization name	BGP Engineers B.V.
Role in the Project	Main partner of project proponent, project developer
Contact person	Jilles Nijboer
Title	General Director
Address	Europark 12, NL-4904 SX Oosterhout Netherlands
Telephone	+31 162 820 399
Email	j.nijboer@ees-energyneers.com

Organization name	BTG Biomass Technology Group B.V.
Role in the Project	Consultant
Contact person	Martijn Vis
Title	Senior consultant
Address	Josink Esweg 34, 7545 PN, Enschede, The Netherlands
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1.5 Project Start Date

The start date of the project is 27 July 2017.

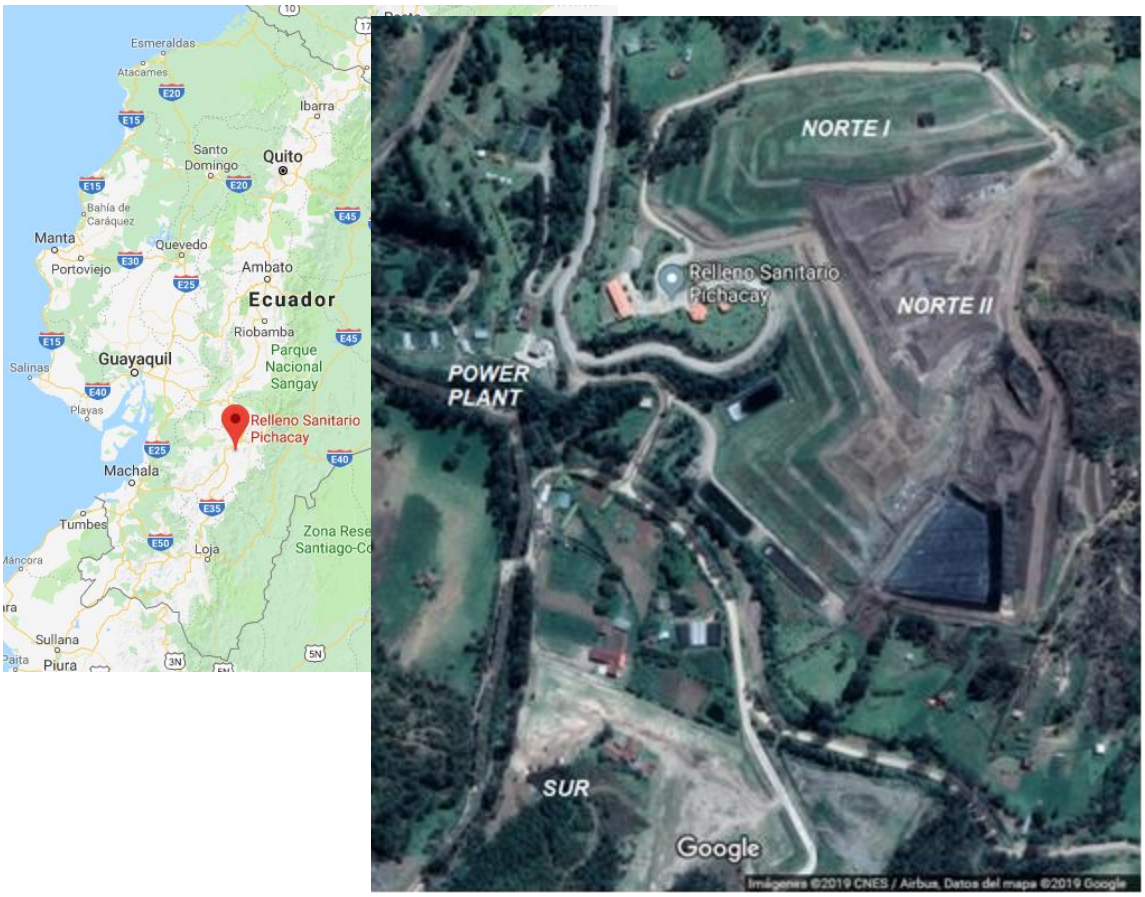
1.6 Project Crediting Period

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).

1.7 Project Location

The project is located at Santa Ana, Cuenca, Azuay, Ecuador.

Coordinates: Lat = -2.9660411, Long = -78.9314400



1.8 Title and Reference of Methodology

The following approved baseline & monitoring methodology is applied:

Title: AMS-III.G Small-scale Methodology: Landfill methane recovery. Version 10.0, Sectoral Scope: 01 and 13, valid from 14 June 2019 onwards.

Tools and methodologies referenced in this methodology, used in this project:

- Tool04 Methodological tool: Emissions from solid waste disposal sites, Version 08.0.
- Tool05 Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation, version 03.0
- AMS-III.H: Methane recovery in wastewater treatment, version 19.0
- Tool06: Methodological tool: project emissions from flaring, version 02.0.0

Title: AMS-I.D Small-scale Methodology: Grid connected renewable electricity generation. Version 18.0, sectoral Scope: 01, valid from 18 Nov 2014 onwards.

Tools and methodologies referred to in this methodology, used in this project:

- Tool07 Methodological tool: Tool to calculate the emission factor for an electricity system, version 05.0.

Other tools referred to:

- Tool 32, Methodological tool: Positive of technologies, version 01.0. (CDM-EB101).

1.9 Participation under other GHG Programs

The project activity has not been registered under any other GHG programs.

1.10 Other Forms of Credit

The project is not part of emission trading programs or subject to other binding limits. The project has not sought or received another form of GHG-related environmental credits.

In 2012 the PDD of the CDM project "Biogas project at the Municipal landfill of Pichacay, Cuenca" was submitted for public comments, between 01 May 12 – 30 May 12. However, the project never passed the validation stage and has not been registered as CDM project. The project was not rejected.

1.11 Sustainable Development

Numeral 66. Article 27 of the Constitution of the Republic of Ecuador, recognizes and guarantees individuals the right to live in a healthy, ecologically balanced, free from contamination and in harmony with nature. The project strongly contributes to a sustainable development both within the local area and at national level.

Locally the project will have its strongest impacts in social and environmental benefits. The release of landfill gas could directly influence the health of the affected inhabitants negatively and additionally leads to the risk of explosions in the surroundings. Furthermore, emissions of other harmful gases, such as H2S and odorous compounds are going to be reduced. This project improves the living conditions of the direct affected neighborhoods. Furthermore, the project has a small but positive impact on employment in the local area as staff is employed to maintain the operation of the project.

Focusing on national level, the project contributes to the generation of renewable energy from non-conventional resources, which is welcomed by CONELEC, as stated in the "Titulo habiliante".

Moreover, the project contributes to the reduction the emission of greenhouse gases. Finally, the project promotes the sustainable development of Ecuador by increasing the employment opportunities in the area due to direct or indirect effects of the project realization.

2 SAFEGUARDS

2.1 No Net Harm

Landfill gas can be combusted in the engines with low emissions. Combustion of landfill gas reduces the risk of fire and improve safety at the landfill. The quality of life of the local community increases because of odor reduction and improved air quality. Potential negative impacts are noise and dust emissions.

The Environmental management Plan describes measures to avoid, reduce or mitigate potential negative environmental and socio-economic impacts. It contains programs on mitigation, safety, prevention, social participation and community relations, environmental training and monitoring. These programs are developed for the building and operation and maintenance phase of the project. For example, measures are taken for noise and dust control, such as no unnecessary horning, keeping dusty areas wet, etc. Monitoring campaigns on noise, air quality, etc. are foreseen.

The program on social participation foresees in the appointment of an environmental facilitator to the Ministry of Environment, who will be asked to (1) validate the various stakeholders who may be affected by the operation and (2) check the areas of direct and indirect influence described in the Environmental Impact Study and the Environmental Management Plan.

2.2 Local Stakeholder Consultation

Since it concerns a retroactive project, we refer to the local stakeholder consultation conducted during the performance of the Environmental Impact Assessment. This is called the socialisation process, which is documented in a separate report *"Informe de facilitatación, proceso de consulta y participación social del borrador del studio de impacto Ambiental definitive y plan de manejo ambiental del proyecto "generation electrica de biogas (2MW) en el relleno sanitaria Pichacay y linea de transmission asociada"* facilitated by Soc. Jaime Arevalo Ayala.

The procedures or methods used for engaging local stakeholders (e.g., dates of announcements or meetings, periods during which input was sought).

The socialisation process to the population living in the area directly and indirectly impacted by the project, was announced in the following ways:

- on the radio "Spendid Radio City Cuenca during 25th, 26th and 27th November 2013 at 06h00, 12h00 and 18h00.

- In the newspaper El Tiempo of the city of Cuenca in the issue of 21 November 2013.
- Posters in the infocentre located in the Tenure Policy Parroquia Santa Ana in El Chorro longhouse in the longhouse Playa de los Angeles and Mosquera.
- Personal invitation to 47 relevant citizens, such as the governor, fire chief, major, community development representatives, parish priest etc.

The following stakeholder consultation activities were performed:

- Establishment of an information centre at the Tenure Policy parish in Santa Ana, from 21 Nov 2013 – 5 Dec 2013. The info centre was open from 08h00 – 12h00, and 14h00 – 17h00.
- Briefings Saturday 23 November at the community houses of Mosquera (22 persons), Playa de los Angeles (26 persons) and El Chorro (34 persons).
- Public presentation of the draft Environmental Impact Assessment and Environmental Management Plan on Nov 28, 2013, at the Longhouse community of El chorro (more than 44 persons).

The procedures or methods used for documenting the outcomes of the local stakeholder communication.

The outcomes of the local stakeholder consultation is documented in the report "*Informe de facilitatación, proceso de consulta y participación social del borrador del studio de impacto Ambiental definitive y plan de manejo ambiental del proyecto "generation electrica de biogas (2MW) en el relleno sanitaria Pichacay y linea de transmission asociada*", and is input to the Environmental Management Plan. This report is needed to complete the environmental impact assessment. It systematically registers the questions and comments of the local stakeholders and the responses/explanations given by the project owner or his consultant. One chapter is dedicated to identification and solutions formulation of socio-environmental conflicts.

The mechanism for on-going communication with local stakeholders.

The Environmental Management Plan contains a "Social participation and Community Relations Programme" for the building (PRCC 1) and the operation and maintenance (PRCO1 and PRCO2) phase of the project.

PRCC 1 takes care that the people of the parish of Santa Ana, particularly communities Playa de los Angeles and El Chorro, have been informed about the characteristics of the plant, its construction, and possible impacts incurred.

PRCO 1 on community relations has the objective that the project must operate with less social impact by referring to the security of the people that are in the vicinity of the plant. The inhabitants of the area of directly and indirectly influenced by the project should have access to information concerning the environmental management of facilities.

PRCO 2 takes care that the inhabitants directly or indirectly influenced by the project should be granted benefits by the operation of the plant. This is related to the Social Responsibility Agreement for Co-management of the new Landfill (15 December 2011). In this agreement it is established, among others, that Parish Santana and its communities will be beneficiaries of an Environmental Services Fund, which represents 5% of the amounts collected for the concept of the public cleaning fee and garbage collection. It also means that the communities can manage their development in topics such as economic reactivation, health and sanitation, infrastructure; environmental management, among others. Moreover, it covers prevention of environmental pollution, protection of health and safety.

How due account of all and any input received during ongoing communication has been taken? Include details on any updates to the project design or justify why updates are not appropriate.

In the above-described stakeholder consultation activities no signs of conflict or opposition to the project were noticed. The plan to let the population benefit from the activities (see next paragraph) and the avoidance of odours was welcomed. One stakeholder recommended to avoid noise and pollution during construction and operation of the project, issues that are addressed in the Environmental Management Plan. By no CNR-2013-0584-0 Office of December 19, 2013, the corresponding process of social participation related to the EIA was approved. The positive responses from the stakeholder process did not raise the need to update the project design.

2.3 AFOLU-Specific Safeguards

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

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

In general, the project was operational as expected, except for (1) a maintenance period of the first engine that took longer than expected, and (2) a delay in the installation of the second engine. Finally, the second engine has not been installed during the monitoring period (1 Jan 2019 – 31 Dec 2020).

Ad 1. Long maintenance period first engine

The first 12,500 operation hours maintenance of the first engine was planned to be performed at the end of January 2019. According to the plan, the maintenance would last 21 days. After 5 days of work, the technicians took out the cylinder heads and realized that many internal parts required an immediate replacement. The total diagnosis, in order to know which parts must be replaced and which repaired, took 21 days. The repairment process, due to the specificity of the works, took around a month to be completed. In parallel, considering that many replacement parts were not in stock, an acquisition process of spare parts was carried out. The spare parts and repaired items were fully available on first week of May 2019. The rebuild of the engine, testing and back to operation took three weeks. So, the engine got back in normal commercial operation in the last week of May 2019.

Ad 2. Installation of second engine delayed

In the joint project description and monitoring report, it was announced that the second engine was expected to become operational around July 2019. Some initial delays were caused by the election of a new Mayor, and with it the replacement of most of EMAC authorities. EMAC is one of the joint venture partners of EBE, the project proponent. Among others, Cécar Arévalo, technical director of EMAC, was replaced by Wilfrido Bermeo. After that, a new plan was structured with an estimated installation date of the second engine of December 2019. The new engine arrived in Ecuador in October 2019 in the middle of a widespread social protest, so it couldn´t be taken out of customs for two weeks. After that, several bureaucratic requirements caused a delay of 45 days letting the engine finally released from customs the second week of December 2020. The engine was transported to the Pichacay Landfill gas and renewable energy project on December 16th, 2019. Eight kilometers from reaching its destination, the truck that held the engine suffered a rollover causing several damages to the unit.

With an un-functional genset, all installation works (electrical – mechanical) were postponed. After two months of tests, the damages of the unit were defined having the technical backup to proceed with the damaged engine reparation. The Covid-19 caused further delays affecting transportation, factories and distribution companies (couriers). Only in June 2020, after the first wave of the disease, the installation works and spare parts acquisition were retaken. The engine

was ready to begin the start-up works in mid-September. The start-up, due to the Covid-19 crisis, could not be performed by the factory technicians personally, but remotely. This and other particularities impeded a normal commissioning execution been necessary three months to finish the pre-operative works. The engine is expected to be commercially operational by April 2021. Therefore, during the monitoring period (1 Jan 2019 – 31 Dec 2020) the second engine was not operational.

3.2 Deviations

3.2.1 Methodology Deviations

No methodology deviations have been applied.

3.2.2 Project Description Deviations

As already described in section 3.1 the installation of the second engine was initially planned in July 2019 and delayed until at least April 2021. This delay does not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario.

3.3 Grouped Projects

The project is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	η_{PJ}
Data unit	%
Description	Efficiency of the LFG capture system that will be installed in the project activity. It is used for ex ante estimation only. A default value of 50 percent is used.
Source of data	-
Value applied	50%
Justification of choice of data or description of measurement methods and procedures applied	A default value may be used.
Purpose of Data	Ex ante calculation of baseline emissions
Comments	

Data / Parameter	$\varphi_{default}$
Data unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	-
Value applied	0.75
Justification of choice of data or description of measurement methods and procedures applied	Option 1 of Tool04 is chosen, therefore a default value for $\varphi_{default}$ is used. For baseline emissions: refer to the table below to identify the appropriate factor based on the application of the tool (A or B) and the climate where the SWDS is located. **Default values for the model correction factor** Humid/wet conditions: Application A 0.75; Application B 0.85 Dry conditions: Application A 0.75; Application B 0.80 As application A is applicable, 0.75 is the value to be applied.

Purpose of Data	Ex ante calculation of baseline emissions
Comments	

Data / Parameter	f_y
Data unit	-
Description	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.
Source of data	-
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	As this is already accounted for in $F_{CH4,BL,y}$, "f" in the tool is assigned a value of 0
Purpose of Data	Ex ante calculation of baseline emissions
Comments	

Data / Parameter	GWP_{CH4}
Data unit	t CO_2e/t CH_4
Description	Global Warming Potential of methane
Source of data	IPCC
Value applied	25
Justification of choice of data or description of measurement methods and procedures applied	Global warming potential of methane valid for the relevant commitment period.
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	OX
Data unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied	0.1
Justification of choice of data or description of measurement methods and procedures applied	Default value
Purpose of Data	Calculation of baseline emissions
Comments	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO_2. The oxidation factor represents the proportion of methane that is oxidized to CO_2 This should be distinguished from the methane correction factor (MCF) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer of SWDS

Data / Parameter	F
Data unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	Default value
Purpose of Data	*Ex ante calculation of baseline emissions*
Comments	Upon biodegradation, organic material is converted to a mixture of methane and carbon dioxide.

Data / Parameter	$DOC_{f,default}$
Data unit	Weight fraction
Description	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	In case of ex ante estimation of emissions (Application A) following Tool 04 paragraph 4) a default value of DOC_f can be used. $DOC_{f,y} = DOC_{f,\ default} = 0.5$
Purpose of Data	*Ex ante calculation of baseline emissions*
Comments	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. This default value can only be used for Application A or Application B if the tool is applied to MSW.

Data / Parameter	$MCF_{default}$
Data unit	-
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied	1.0
Justification of choice of data or description of measurement methods and procedures applied	In case that the SWDS does not have a water table above the bottom of the SWDS and in case of application A, then select the applicable value from the following: (a) 1.0 for anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e.waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) levelling of the waste; (b) 0.5 for semi-aerobic managed solid waste disposal sites. These must have controlled placement of waste and will include all of the following structures for introducing air to the waste layers: (i) permeable cover material; (ii) leachate drainage system; (iii) regulating pondage; and (iv) gas ventilation system; (c) 0.8 for unmanaged solid waste disposal sites – deep. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters;

	(d) 0.4 for unmanaged-shallow solid waste disposal sites or stockpiles that are considered SWDS. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of less than five meters. This includes stockpiles of solid waste that are considered SWDS (according to the definition given for a SWDS) Application A is applicable. The landfill of Pichacay is an anaerobic managed solid waste disposal site, as described under (a).
Purpose of Data	*Ex ante calculation of baseline emissions*
Comments	

Data / Parameter	$W_{j,x}$
Data unit	T
Description	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x
Source of data	Several sources: EMAC-EP (2016) Caracterización de los residues sólidos generatos en el Cantón Cuenca, año 2015, informe preparado para la empresa pública municipal de aseo de Cuenca, enero de 2016; estimations from Ing Paul Crespo, head of the final disposal department of EMAC-EP, Hendrik Velthuis BGP Engineering B.V.
Value applied	See Table 5 of the *Joint Project description & monitoring report PICHACAY LANDFILL GAS RENEWABLE ENERGY PROJECT, version 3.2 of 7 July 2019*
Justification of choice of data or description of measurement methods and procedures applied	The characterisation of solid waste in Cuenca has been done for three decades. EMAC-EP (2016) is the most recent update and includes historical data on waste composition. More info is provided in section 3.4 of the *Joint Project description & monitoring report PICHACAY LANDFILL GAS RENEWABLE ENERGY PROJECT, version 3.2 of 7 July 2019*.
Purpose of Data	Ex ante calculation of baseline emissions
Comments	The time period in which waste is disposed at the SWDS is from 2001 on. Therefore, x=1 corresponds with the year 2001.

Data / Parameter	DOC_j
Data unit	Weight fraction
Description	Fraction of degradable organic carbon in the waste type j (weight fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value applied	For MSW, the following values for the different waste types j should be applied: **Default values for DOC_j** **Waste type *j*** | ***DOC_j (% wet waste)*** Wood and wood products | 43 Pulp, paper and cardboard (other than sludge) | 40 Food, food waste, beverages and tobacco (other than sludge) | 15 Textiles | 24 Garden, yard and park waste | 20 Glass, plastic, metal, other inert waste | 0
Justification of choice of data or description of measurement methods and procedures applied	The default values are applied.
Purpose of Data	*Ex ante calculation of baseline emissions*
Comments	The procedure for the ignition loss test is described in BS EN 15169:2007 Characterization of waste. Determination of loss on ignition in waste, sludge and sediments. The percentages listed in table above are based on wet waste basis which are concentrations in the waste as it is delivered to the SWDS. The IPCC Guidelines also specify DOC values on a dry waste basis, which are the concentrations after complete removal of all moist from the waste, which is not believed practical for this situation

<table>
<tr><td>Data / Parameter</td><td>k_j</td></tr>
<tr><td>Data unit</td><td>1/yr</td></tr>
<tr><td>Description</td><td>Decay rate for the waste type j</td></tr>
<tr><td>Source of data</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)</td></tr>
<tr><td>Value applied</td><td>
<table>
<tr><td></td><td>Waste type j</td><td>Value for boreal and temperature (MAT≤20 °C). Dry (MAP/PET<1)</td></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.04</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.02</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.05</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.06</td></tr>
</table>
</td></tr>
<tr><td>Justification of choice of data or description of measurement methods and procedures applied</td><td>MAT = 14.7 ° C. Therefore, the values belonging to a boreal and temperature (MAT≤20 °C) should be applied
Source: Sistema de Clasificación Bioclimática Mundial (temperatures) and: Cuenca Climate Guide, meaning that Cuenca has a boreal and temperate climate.
MAP = 878 mm/year (source: https://www.weather-atlas.com/en/ecuador/cuenca-climate#rainfall)
PET = 1189 mm/year (source: data from weather station Cuenca-Ricauerte obtained from FAO Climwat, processed in FAO Eto calculator. ETo represents the evapotranspiration rate from a reference surface, not short of water. The ETo calculator assesses ETo from meteorological data by means of the FAO</td></tr>
</table>

	Penman-Monteith equation. See http://www.fao.org/land-water/databases-and-software/eto-calculator/en/ and MAP/PET < 1, so values for dry climate are taken
Purpose of Data	Ex ante calculation of baseline emissions
Comments	MAT = Mean Annual Temperature MAP = Mean Annual Precipitation PET = Potential evapotranspiration.

Data / Parameter	$F_{CH4,BL,y}$
Data unit	t CH_4
Description	Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year y (t CH4).
Source of data	-
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	In Ecuador there is no law that requires to destroy methane. Before the project no existing LFG capture and destruction system was in place. Hence $F_{CH4,BL,y}$ as per table 3 of ACM0001 "Flaring or use of landfill gas" Case 1 is applicable. In this situation $F_{CH4,BL,y}$=0.
Purpose of Data	Ex ante calculation of baseline emissions
Comments	The relevant procedures in "ACM0001: Flaring or use of landfill gas" may be followed, as well as taking into account the compliance with the relevant local laws and regulation if such laws and regulations exist

Data / Parameter	$EF_{grid,y}$
Data unit	t CO_2e/MWh
Description	CO_2 emission factor of the grid electricity in year y
Source of data	CENACE (2017), 2017 report, CO_2 emission factor of the National Interconnected System, determined by the Technical Commission for Determination of Greenhouse Gas Emission Factors. See the Joint Project Description and Monitoring Report of the Pichacay Landfill Gas Renewable Energy Project, version 3.2 of 7 July 2019.
Value applied	0.3349
Justification of choice of data or description of measurement methods and procedures applied	Combined margin CO_2 emission factor for grid connected power generation in year y was calculated using the latest version of the "Tool to calculate the emission factor for an electricity system". For the determination of OM and BM it was chosen to determine these factors ex ante for the whole duration of the first crediting period.
Purpose of Data	Calculation of baseline emissions Calculation of project emissions
Comments	The calculation of $EF_{grid,y}$ using the "Tool to calculate the emission factor for an electricity system" is described in further detail in the Joint Project Description and Monitoring Report of the Pichacay Landfill Gas Renewable Energy Project, version 3.2 of 7 July 2019.

Data / Parameter	$TDL_{j,y}$
Data unit	Fraction
Description	Average technical transmission and distribution losses for providing electricity to source j in year y.
Source of data	CENTROSUR, the electricity distribution company that owns and manages the electric grid
Value applied	5.76%
Justification of choice of data or description of measurement methods and procedures applied	Scenario A of TOOL 05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" applies. The annual average value based on the most recent data available within the host country was chosen. (See TOOL05, version 03.0, Data / Parameter table 3)
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	$EG_{PJ,facility,2017-2018}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in 2017-2018
Source of data	Electricity meters (ION 7650)
Value applied	2017: 2,776 2018: 5,165
Justification of choice of data or description of measurement methods and procedures applied	Since this is a retroactive project it is possible to apply measured data for the ex ante determination of the emission reduction from grid displacement electricity.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$EG_{PJ,facility,2019 - 2027,estimated}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Estimation from project owner
Value applied	2019: 9,690 2020: 12,920 2021: 12,920 2022: 25,840 2023: 25,840 2024: 25,840 2025: 25,840 2026: 25,840 1 Jan – 26 July 2027: 14,654
Justification of choice of data or description of measurement methods and procedures applied	The project consists of 4 engines that convert landfill gas into electricity. Engine 1 started commercial operation on 27 July 2017; engine 2 is expected to start commercial operation on the 7th of July 2021; engine 3 is expected to start in the last trimester or the first semester of 2023.; the installation of Engine 4 has not been planned yet; and are not part of the monitoring period 1 Jan 2019 – 31 Dec 2020. Each engine has a capacity of 1 MW and is expected to generate 0.85 MWh/h

	during 7,600 hours per year, i.e. 6,460 MWh/engine/year, and 25,840 MWh/year for all 4 engines together. For 2027, a fraction of 207/365 is applied, based on the number of calendar days from 1 Jan – 26 July.
Purpose of Data	Ex ante calculation of baseline emissions
Comments	-

Data / Parameter	NCV_{CH4}
Data unit	MJ/Nm^3
Description	NCV of methane
Source of data	-
Value applied	35.9
Justification of choice of data or description of measurement methods and procedures applied	Default value
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	D_{CH4}
Data unit	t CH_4/Nm^3 CH_4
Description	Density of methane at the temperature and pressure of the landfill gas in year y
Source of data	ACM0001 version 11
Value applied	0.0007168
Justification of choice of data or description of measurement methods and procedures applied	Because the NCV of methane is reported at normal conditions, the density of methane is also determined at normal conditions. In ACM0001 (version 18.1) reference conditions are defined as 0°C (273.15 K) and 1 atm (101.325 kN/m2, 101.325 kPa). According to ACM0001 (version 11.0) at standard temperature and pressure (0 degree Celsius and 1.013 bar) the density of methane is 0.0007168 tCH_4/m^3CH_4)
Purpose of Data	Calculation of baseline emissions
Comments	AMS-III.G, TOOL04, nor ACM0001 (version 18) provide info on the density of methane under normal conditions. Therefore, a value found in ACM0001 (version 11) was applied.

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{PJ,facility}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Electricity meters (Schneider electric ION 7650 serial numbers MJ-1401A358-04 (main meter) and MJ-1310A536-04 (backup meter).
Description of measurement methods and procedures to be applied	The electricity generated and delivered to the grid is measured continuously and recorded hourly by two ION-7650 meters. The meters are connected to an automatic software – SIMEC, provided by CENACE (technical and economical administrator of the Ecuadorian Electrical System). On a daily basis, SIMEC generates a report automatically, called TPL, with the hourly energy (active, reactive) produced and delivered to the grid. The daily report is double-checked by the Technical Manager of the power plant as well as by CENACE technical specialists. Once the file is approved, it is stored on an online platform – SIMEM. The platform allows viewing and downloading of the stored files, named CON_MED_EXE_20YY-MM-DD.xls. At EBE, the Project Manager groups the data of the respective monitoring period into one excel sheet. All daily reports remain available and can be double checked by the project advisor and verification body.
Frequency of monitoring/recording	Continuous monitoring, hourly measurement and at least monthly recording
Value monitored	2019: 3,768.77 MWh 2020: 5,161.76 MWh See the file "GHG calculation Pichacay VCS project 2019&2020.xls" for the complete calculation. Daily files CON_MED_EXE_20YY-MM-DD.xls are also available.
Monitoring equipment	Two Schneider Electric ION7650 electricity meters, serial numbers MJ-1401A358-04 (main meter) and MJ-1310A536-04 (backup meter), ANSI C12.16 approved revenue meters; meets ANSI C12.20 class 0.2 accuracy standard. Its accuracy is 0.2% as found in the technical documentation. See "Technical data sheet ION7650.pdf"
QA/QC procedures to be applied	The two ION7650 meters are digital and therefore needs no servicing. It is tested for accuracy at the factory and remains

	accurate for the life of the meter. In contrast, electro-mechanical meters need mechanical adjustment before installation and periodic calibration thereafter. Calibration testing is unnecessary for digital meters (See "PowerLogic ION 7550 ION7650 Verifying Accuracy Technical Note 032009.pdf" Digital meters require 'accuracy' testing, or verification, once after installation to ensure the meter meets required accuracy specifications. Errors observed in the field could be attributed to incorrect connections or instrument transformer ratio settings. This initial testing after installation has taken place on the 5th of October 2017. See "Electricity export meter_calibration certificate 2017.pdf". Although not necessary from a technical viewpoint, the National Center for Energy Control – CENACE (the institution that controls and regulate the Ecuadorian Electrical Power System) has a legal obligation to perform calibration testing every two years. EBE does not have access to the biannual calibration reports, but can show the invitation letter and the invoice to prove that this calibration has taken place. If, for some unexpected reasons the ION meter would fail for this biannual check, Cenace would stop paying for the exported electricity.
Purpose of the data	Calculation of baseline emissions
Calculation method	Reading hourly electricity production and aggregate them for the monitoring period.
Comments	From a technical point of view no bi-annual calibration is needed. However, calibration has taken place in September 2019. See the *"Letter nro CENACE-GDT-2019 -0136 of 5 September 2019, on Calibración de los sitemas de midición commercial de la Central Térmica Biogas Pichacay"* and Cenace invoice no. 001-002-000002059 of 2 Nov 2020. Both provided as separate documents. EBE has no access to the calibration report. Since Cenace did not stop the payments for renewable electricity generated by the project, the calibration can be deemed to meet its accuracy requirements.

Data / Parameter	EE_y
Data unit	%
Description	Energy Conversion Efficiency of the project equipment, i.e. Guascor Power Genset type SFGM560.
Source of data	Specification provided by the equipment manufacturer. See specifications provided in offer "Budget reference: "OFV004932-170314-CS-SFGM560-Landfill-BGP Engineers"
Description of measurement methods and procedures to be applied	The specification provided by the equipment manufacturer is used as the equipment is designed specifically to utilise biogas as fuel. This is the case. If the specification provides a range of efficiency values, the highest value of the range shall be used for the calculation. The efficiency of nominal load is taken, which is the highest value.
Frequency of monitoring/recording	Once for each engine.
Value monitored	Engine 1: 36.0% (Engine 2 is expected to start commercial operation on 7 July 2021; Engine 3 in the last trimester or the first semester of 2023.; the installation of Engine 4 has not been planned yet; and are not part of the monitoring period 1 Jan 2019 – 31 Dec 2020)
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	$EC_{project,y}$
Data unit	MWh
Description	The quantity of electricity used for the operation of the installed facilities in the year y
Source of data	Monthly electricity bills of the of the local energy distribution company Empresa Elèctrica Regional Centro Sur C.A.
Description of measurement methods and procedures to be applied	They send a monthly bill with detailed specification of the electricity consumed, based on three periods (A: 07h00-18h00; B: 18h00-22h00; C: 22h00-07h00). The monthly electricity bills are kept and stored on paper and as a scanned pdf file. Due to new regulations, since 25 October 2019 the electricity bill is split in two bills: • Energy consumed from the grid in low voltage (220 – 110 V: auxiliary services). • Energy consumed by the genset in mid voltage (22,000 V: substation and 480 V equipment).
Frequency of monitoring/recording	Continuous monitoring, hourly measurement and at least monthly recording
Value monitored	2019: 153.68 MWh 2020: 184.47 MWh See separate excel file for monthly values.
Monitoring equipment	Electricity meter class CL200, type A3R model ELSTER ZE3300000L0, serial number 17548507 owned and maintained by the local energy distribution company. The electricity bills show the electricity consumed by the project. The electricity meter is situated in a box outside and locked with a padlock, only accessible by the electricity distribution company. The meter meets ANSI C12.20 accuracy for accuracy class 0.2%. See the technical manual (“A3MeterTM42-2190BUSVersion.pdf”).
QA/QC procedures to be applied	The meter is an electronic meter, factory calibrated, and does not require user calibration (See “A3MeterTM42-2190BUSVersion.pdf”). Moreover, EBE has no access to this meter.

Purpose of the data	Calculation of project emissions
Calculation method	-
Comments	

Data / Parameter	$TDL_{j,y}$
Data unit	Fraction
Description	Average technical transmission and distribution losses for providing electricity to source j in year y.
Source of data	CENTROSUR, see https://www.centrosur.gob.ec/principales-indicadores/ (under Péridas de Energía)
Description of measurement methods and procedures to be applied	Obtained from CENTROSUR, the electricity distribution company that owns and manages the electric grid
Frequency of monitoring/recording	Annually
Value monitored	6.49% (latest available value of 2019)
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Calculation of project emissions
Calculation method	-
Comments	-

4.3 Monitoring Plan

The organizational structure, responsibilities and competencies of the personnel that carried out the monitoring activities.

Project owner EBE operates the LFG plant that is part of the project and will measure the required monitoring data related to the project and is qualified to do so.

- The *general manager* of EBE legally represents the project owner. He/she is involved in high level decision making.
- The *supervising Engineer* of the plant in charge of the electrical, electronical and mechanical of the LFG extraction and energy generation plant will be responsible for on-site monitoring data collection. He is qualified to work with the monitoring equipment and preferably speaks English.
- Three *operators* working under the directly supervision of the supervising engineer support the supervising engineer to collect relevant monitoring data.

During the reported monitoring period David González Hidalgo was both the general manager and the supervising engineer of EBE.

BGP Engineers B.V. is responsible for interpretation of the monitoring data, and leakage effects, preparation of the monitoring reports and quality assurance. BGP will provide instructions and training to operators of EBE and operates as the *Project Manager* regarding monitoring in the frame of this VCS project.

Optionally, a *project advisor* is hired to support the project manager with monitoring and quality assurance. For the current monitoring period BTG is appointed as project advisor.

Jilles Nijboer of BGP was the Project Manager during the reported monitoring report and has appointed Martijn Vis of BTG as project advisor to support with monitoring and quality assurance.

The methods used for generating/measuring, recording, storing, aggregating, collating and reporting the data on monitored parameters.

With regards to monitoring AMS-III.G, AMS-I.D provides the following requirements:

1. Flow meters, sampling devices and gas analysers shall be subject to regular maintenance, testing and calibration to ensure accuracy. (AMS-III.G paragraph 27)
2. The quantities and types of biomass and the biomass to fossil fuel ratio (in case of co-fired system) to be used during the crediting period should be explained and documented transparently in the CDM-PDD. For the selection of the baseline scenario, an ex ante estimation of these quantities should be provided (AMS-I.D paragraph 44)
3. The applicable requirements specified in the "General guidelines for SSC CDM methodologies" (e.g. calibration requirements, sampling requirements) are also an integral part of the monitoring guidelines specified below and therefore shall be applied by the project participants (AMS-III.G paragraph 28 & AMS-I.D paragraph 45)

Conform the data and parameters monitored, the monitoring plan foresees in the metering of electricity generated by the engine-gensets ($EG_{PJ,facility}$), the electricity consumed ($EC_{project,y}$) and the efficiency of the engine-genset (EE_y).

The procedures used for handling any internal auditing performed and any non-conformities identified.

The procedures below are related to the activities of the project manager.

The project manager stores and keeps the contracts, fills in data sheets and additional documentation in an orderly way.

The project manager keeps all paper and electronic documents at a safe place during the VCS project period, and longer, if required according to VCS-regulations.

The monitoring data collected from the project owners is processed in the following way:

1. Data is checked on completeness. If the data is not complete, the project manager contacts the supervising engineer by visit, phone, email or fax to ask for additional information.
2. Data is checked on calculation errors. If calculation errors occur, the supervising engineer is contacted by visit, phone, email or fax and asked for clarification, and if necessary additional explanation is given. This type of errors is noted and taken into account in the evaluation of the Monitoring Protocol.
3. If uncertainty exists on the monitoring data, a conservative approach will be applied in the interpretation of this data.
4. Data is entered into the central database, an excel sheet that contains all necessary calculation rules and procedures.
5. Consistency checks are carried out. If significant inconsistencies are observed, the project owner is asked for clarification. The technician of the project owner and project manager will jointly formulate a plausible explanation for the inconsistencies. If this approach does not work, the trouble shooting procedures will be followed.
6. The calculated emission reductions and other relevant information are reported in the monitoring report and offered to the verification body.

The project manager carries out corrective actions as stated in validation and/or verification reports, and/or otherwise as requested by the verification body. If appropriate, the project manager takes care that the project owner implements the corrective actions. The results of corrective actions will be described in the monitoring report of the subsequent period, or will be immediately send to the verification body, depending on its urgency.

The project manager prepares the concept monitoring report and internally checks the report on completeness and quality of data. The concept monitoring report is sent to the project advisor. The project advisor checks the concept monitoring report and the calculations and returns open questions to the project manager. After both project manager and project advisor are fully

satisfied with the content of the final monitoring report, the verification body is requested to verify the monitoring report.

If problems occur related to the monitoring of the project performance, for instance data collection, measurement equipment, the data registration form, etc., the project manager will execute the following actions if problems are directly related to the monitoring of projects:

1. The project manager will try to explain and indicate solutions for problems by visit, phone, email or fax.
2. In case of problems that cannot be easily solved, the project manager will contact the project advisor. They will jointly formulate an approach to solve the problem.
3. All disputes that might arise from problems related to monitoring of the project performance will be settled as described in contracts that between project owner, project manager and project advisor.

The implementation of sampling approaches, including target precision levels, sample sizes, sample site locations, stratification, frequency of measurement and QA/QC procedures. Where applicable, demonstrate whether the required confidence level or precision has been met.

Not applicable. For the parameters monitored, no sampling approached need to be applied. These parameters can be just measured and recorded.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The baseline emissions are calculated as follows:

$$BE_y = BE_{CH4,y,} + BE_{electricity,y}$$

Where:

Parameter	Unit	Description
BE_y	tCO_2e	Baseline emission for in year y
$BE_{CH4,y}$	tCO_2e	Baseline emission from LFG avoidance that otherwise would be emitted to the atmosphere in absence of the Project in year y (tCO_2e) which is estimated as per AMS-III.G
$BE_{electricity,y}$	tCO_2e	Baseline emission from electricity displacement that otherwise would be provided by grid in year y (tCO_2e) which is estimated as per AMS-I.D

Baseline emission from landfill methane recovery ($BE_{CH4,y}$):

As per AMS-III.G paragraph 22. the actual emission reduction achieved by the project during the crediting period will be calculated using the amount of methane recovered and destroyed/gainfully used by the project activity calculated as:

$$ER_{y,calculated} = (1 - OX) \times F_{CH4,PJ,y} \times GWP_{CH4} - PE_y - LE_y$$

Thus, the calculated baseline emissions from landfill methane recovery are

$$BE_{CH4,PJ,y} = (1 - OX) \times F_{CH4,PJ,y} \times GWP_{CH4}$$

Where:

Parameter	Unit	Description
$BE_{CH4,PJ,y}$	tCO_2e	Baseline emissions achieved by the project in year y.

OX	-	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste) (dimensionless). A default value of 0.1 may be used.
$F_{CH4,PJ,y}$	tCH_4	Methane captured and destroyed/gainfully used by the project activity in the year y
GWP_{CH4}	-	Global Warming Potential for methane (value of 25)

At the project site a flare has been installed that is operational in case the engine is not operational. The emission reduction achieved by the flare is not counted in this project, since no measurement equipment is installed that meets the requirements of TOOL06 and TOOL08. Therefore, during *monitoring*, the baseline and project emissions of the use of the flare also will not be taken into account. ($ER_{flare} = BE_{flare} - PE_{flare} = 0$).

As per paragraph 23 of AMS-III.G, for project activities that utilize the recovered methane for power generation, $F_{CH4,PJ,y}$ can be calculated as follows, based on the amount of monitored electricity generation, without monitoring methane flow and concentration:

$$F_{CH4,PJ,y} = \frac{EG_y \times 3{,}600}{NCV_{CH4} \times EE_y} \times D_{CH4}$$

Where:

Parameter	Unit	Description
EG_y	MWh	Electricity generation in year y
3,600	-	Conversion factor (1 MWh = 3,600 MJ)
EE_y	%	Energy Conversion Efficiency of the project equipment
NCV_{CH4}	MJ/Nm^3	NCV of methane
D_{CH4}	$t\ CH_4/Nm^3\ CH_4$	Density of methane

Remark: In AMS-III.G paragraph 23 the $F_{CH4,PJ,y}$ includes GWP_{CH4}. Since GWP_{CH4} is already included in $BE_{y,calculated}$, it has been left out. The resulting baseline emissions of landfill methane recovery are summarised in Table 1.

Table 1: baseline emissions of landfill methane recovery

Year	$EG_{PJ,facility}$	$F_{CH4,PJ}$	$BE_{CH4,y}$

1 Jan - 31 Dec 2019	3,769	752	16,931
1 Jan - 31 Dec 2020	5,162	1,031	23,189
Total	**8,931**		**40,120**

Baseline emissions from electricity displacement ($BE_{electricity,y}$)

The baseline emissions from electricity displacement are calculated as follows:

$$BE_{electricity,y} = EG_{PJ,y} \times EF_{grid,y}$$

Where:

Parameter	Unit	Description
$BE_{electricity,y}$	t CO_2e	Baseline emissions from grid electricity displacement in year y
$EG_{PJ,y}$	MWh	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
$EF_{grid,y}$	tCO_2e/MWh	Combined margin CO_2 emission factor for grid connected power generation in year y was calculated using the latest version of the "Tool to calculate the emission factor for an electricity system".

As per paragraph of AMS-I.D, if the project activity is the installation of a greenfield power plant, therefore:

$$EG_{PJ,y} = EG_{PJ,facility,y}$$

Where:

$EG_{PJ,facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh)

$EF_{grid,y}$ has been determined ex ante and is fixed during the first crediting period. See Annex A.

The resulting baseline emissions of landfill methane recovery are summarized in *Table 2*. The detailed calculations are presented in GHG calculation "GHG calculation Pichacay VCS project 2019&2020.xls" as separate annex to this monitoring report.

Table 2: Monitored baseline emissions from grid connected renewable electricity production

Year	$EG_{PJ,facility}$	$EF_{grid,y}$	$BE_{electricity,y}$
1 Jan - 31 Dec 2019	3,769	0.3349	1,262
1 Jan - 31 Dec 2020	5,162	0.3349	1,729
Total	**8,931**		**2,991**

5.2 Project Emissions

Project emissions includes two parts, which are calculated as per AMS-III.G and AMS-I.D separately.

$$PE_y = PE_{CH4,y,} + PE_{electricity,y}$$

Where:

Parameter	Unit	Description
PE_y	tCO_2e	Project emissions in year y
$PE_{CH4,y}$	tCO_2e	Project emissions of landfill methane recovery estimated as per AMS-III.G
$PE_{electricity,y}$	tCO_2e	Project emissions from LFG electricity generation estimated as per AMS-I.D

Project emissions landfill methane recovery

As determined in the "VCS-Joint-Project-Description-Monitoring-Report 7 July 2019 v2.pdf" the project emissions from landfill methane recovery in this project can be described as follows:

$$PE_{CH4,y} = PE_{power,y} + PE_{flare,y}$$

Where:

Parameter	Unit	Description
PE_y	t CO_2e	Project emissions in year y

$PE_{power,y}$	t CO_2e	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y
$PE_{flare,y}$	t CO_2e	Emissions from flaring or combustion of the landfill gas stream in the year y

At the project site a flare has been installed that is operational in case the engine is not operational. The emission reduction achieved by the flare is not counted in this project, since no measurement equipment is installed that meets the requirements of TOOL06 and TOOL08. Therefore, during *monitoring*, the baseline and project emissions of the use of the flare also will not be taken into account. ($ER_{flare} = BE_{flare} - PE_{flare} = 0$). Consequently, the project emissions of the flare have not been taken into account. This is a conservative approach since in reality the flare has destroyed methane part of the year.

Therefore, $PE_{CH4,y} = PE_{power,y}$

Project emissions from electricity consumption for the operation of the installed facilities are determined in the following way:

$$PE_{power,y} = EC_{project,y} \times EF_{grid,y} \times (1 + TDL_{j,y})$$

Where:

Parameter	Unit	Description
$PE_{power,y}$	tCO_2e	Emissions from the use of electricity for the operation of the installed facilities in the year y (t CO_2e)
$EC_{project,y}$	MWh	The quantity of electricity used for the operation of the installed facilities in the year y
$EF_{grid,y}$	tCO_2e/MWh	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
$TDL_{j,y}$	fraction	Average technical transmission and distribution losses for providing electricity to source j in year y

$EF_{grid,y}$ has been determined ex ante and is fixed during the first crediting period. See Annex A. The most recent available (2019) value of TDLj,y is 6.49%.

The resulting baseline emissions of landfill methane recovery are summarised in *Table 3*. The detailed calculations are presented as separate annex ("GHG calculation Pichacay VCS project 2019&2020.xls) to this monitoring report.

Table 3: Monitored project emissions from the operation of the installed facilities

Year	$EC_{project,y}$	$EF_{grid,y}$	$PE_{power,y}$
2019	153.68	0.3349	55
2020	184.47	0.3349	66
Total	**338.15**		**121**

Project emissions renewable electricity production

As determined in "VCS-Joint-Project-Description-Monitoring-Report 7 July 2019 v2.pdf" the project emissions from renewable electricity production are zero.

5.3 Leakage

As determined in "VCS-Joint-Project-Description-Monitoring-Report 7 July 2019 v2.pdf" leakage emissions from landfill methane recovery and replacement of grid connected electricity can be set at zero.

5.4 Net GHG Emission Reductions and Removals

The net GHG emission reductions and removals are summarized in the table below:

(1) 1 Jan – 31 Dec 2019 and

(2) 1 Jan – 31 Dec 2020.

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)
2019	18,193	55	0	18,138
2020	24,918	66	0	24,852
Total	**43,111**	**121**	**0**	**42,990**