Validation report form for renewal of crediting period for CDM project activities

(Version 03.0)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title and UNFCCC reference number of the project activity	Brazil NovaGerar Landfill Gas to Energy Project reference number 0008
Number and duration of the next crediting period	3rd crediting period, 01/07/2018 to 30/06/2025
Version number of the validation report for RCP	2.0Aa
Completion date of the validation report for RCP	29/07/2020
Version number of PDD to which this report applies	6
Project participants	Brazil: Haztec Technologia e Planejamento Ambiental S.A.
Host Party	Brazil
Applied methodologies and standardized baselines	ACM0001 “Flaring or use of landfill gas” version 19 of 14/06/2019
Mandatory sectoral scopes linked to the applied methodologies	13 - Waste handling and disposal
Conditional sectoral scopes linked to the applied methodologies	1 - Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions or GHG removals by sinks in the next crediting period	257,753 tCO_{2e}
Name and UNFCCC reference number of the DOE	RINA Services S.p.A. (RINA), UNFCCC reference number of the DOE E-0037
Name, position and signature of the approver of the validation report for RCP	**Laura Severino** Head of Certification Innovation & Sustainability Unit [signature]

SECTION A. Executive summary

>> Purpose and general description

The project activity has the objective to capture and to flare/combustion the landfill gas produced in the landfill called Nova Iguaçu (former name of “Andrianópolis”) located in the city of Nova Iguaçu (in the state of Rio de Janeiro), Brazil. The landfill started its operation in February 2003, and is currently disposing about 4,000 tons of municipal solid waste (MSW) per day.

The project activity results in greenhouse gas (GHG) emission reduction from the landfill through the ways below:

- Burning LFG in flares and/or group generators;
- The amount of electricity generated in the project activity will be exported to the Brazilian national grid, avoiding the dispatch of an equal amount of energy produced by fossil-fuelled thermal plants to that grid. The initiative avoids CO_2 emissions and contributes to the regional and national sustainable development.

The project activity was validated by DNV (validation report nº 2003-0221 dated 03/09/2004) and it was registered on 18/11/2004 under the CDM registration reference N° 0008. The second crediting period was validated by AENOR (validation report number 2011/018/CDM/11, dated 22/11/2011) and PRC validated by TUV Nord (validation report nº 10479-2012/456, dated 02/04/2013)

Scope of validation

The objective of the Validation is to have an independent evaluation of the update PDD’s compliance with relevant UNFCCC requirements and host Party criteria to confirm that the original project baseline is still valid or has been updated taking into account of new data where applicable. In particular, the project’s baseline, monitoring plan and the project’s compliance with relevant UNFCCC requirements and host Party criteria are validated in order to confirm the correctness of the application of the approved baseline methodologies for the determination of the continued validity of the baseline/or its update, and estimation of the emission reductions for the applicable crediting period. The validation scope is to review the updated PDD against the UNFCCC criteria for CDM refer to Article 12 of the Kyoto Protocol, and the subsequent decisions by the CDM Executive Board.

Validation process

This report summarizes the findings from the validation of the updated PDD of the project, performed on the basis of UNFCCC criteria for CDM, as well as criteria given by the CDM Validation and Verification Standard, CDM Project Cycle Procedure and CDM Project Standard and included an assessment of: (a) The impact of new relevant national and/or sectoral policies and circumstances on the baseline taking into account relevant guidance from the Board with regard to renewal of the crediting period at the time of requesting renewal of crediting period; (b) The correctness of the application of an approved baseline methodology for the determination of the continued validity of the baseline or its update, and the estimation of emission reductions from the applicable crediting period. This validation opinion is also to be seen in conjunction with the validation report at the time of requesting registration for the first crediting period. The Validation Opinion is not meant to provide any consultancy towards the project participants. However, stated requests for clarifications and/or corrective actions may have provided input for improvement of the project design.

Conclusion

RINA Services S.p.A. (RINA), commissioned by Haztec Technologia e Planejamento Ambiental S.A., has performed the validation for renewal of the crediting period for the registered project activity Brazil NovaGerar Landfill Gas to Energy Project in Brazil. In conclusion, it is RINA’s opinion that the project meets all the relevant requirements for the renewal of the crediting period.

The following points were raised in the request for review for request for period renewal received on 03/07/2020. The responses are provided bellow.
Request 1, Request 2, Request 3 and Request 4 are exactly the same.

1) Refer to paragraph: Para 291, CDM project cycle procedure for project activities, version 02.0.
The DOE verifies the energy plant Operational license dated 30/04/2019 to confirm the increase in the installed capacity from 4.245 MW in the registered PDD to 16.93 MW. The change in the installed capacity has become effective ten months after the expiry of the second crediting period on 30/06/2018. Para 291 of the PCP specifies that "If a post-registration change becomes effective during the crediting period prior to or after its renewal, a request for approval of such post-registration change shall not be combined with a

request for renewal of crediting period". The DOE shall substantiate how it confirms that the combined request complies with the requirement of para 291 of the PCP for project activities version 02.0.

RINA response: In order to answer the request for Brazil NovaGerar Landfill Gas to Energy Project, it is interesting to first discuss the historical of another similar project from the same project participant and validated by the same DOE.
On 12/03/2020, another CDM project from the same PP (Haztec Technologia e Planejamento Ambiental S.A.) being CTR Candeias Landfill Gas Project (UNFCCC Ref. Number 3958) received the same comment as an incomplete.
During a call on 18/03/2020 with a member of the CDM Secretariat, further information was provided in order to clarify the incomplete received for CTR Candeias Landfill Gas Project. After this call, RINA and PP clearly understand the rules and the documents were revised in order to remove all information related to the post-registration changes. Following the same procedure adopted for Candeias, the DOE shall submit the request for renewal of crediting period (RCP) without change, in accordance with paragraph 291, if the post-registration change becomes effective during the crediting period prior to or after its renewal, a request for approval of such post-registration change shall not be combined with a request for renewal of crediting period. Once the Board approves the RCP, the PP/DOE shall submit the post registration changes accordingly.
Thus, all documents for Brazil NovaGerar Landfill Gas to Energy Project were revised in order to remove all information related to the post-registration changes. This report was updated just to provide information regarding the renewal of the crediting period.

2) Refer to paragraph: Para 243 (a), CDM project standard for project activities, version 02.0
The PP has argued that the proposed increase in the installed capacity from 4.245 MW in the registered PDD to 16.93 MW is not within the control of the PP, the PP mentions that the company Nova Iguaçu Energia e GasRenovavel LTDA which is responsible for exploration, electricity generation and commercialization made investments related to power generation operations. It is however noted that the revised calculations to demonstrate that the project activity remains financially unattractive without CDM include inputs such as CAPEX on engines and operating costs related to operating the power plants in deriving net cash flows. The PP/DOE shall further justify how they have considered it appropriate to account for revenues and expenses not attributable by the project participant in demonstrating financial unattractiveness of the project activity.

RINA response: Based on the response provided below by project participant, RINA raised a FAR in order to document that PP shall answer the question above during the submission of the PRC after the renewal of the crediting period.

PP response: The Brazil NovaGerar Landfill Gas to Energy Project is the first project activity ever registered under the Clean Development Mechanism. It is well known that the standards were different at that time and became clearer and sometimes stricter over the years. Moreover, there is a deadline to renew the crediting period of CDM Project Activities until 30/09/2020, thus the renewal of crediting period process is being submitted at this moment as priority manner.
In line with the answer provided for item 1 above, the PP understand that the post-registration change that led to the request for review (i.e. the proposed increase in the installed capacity) should not combined with a request for renewal of crediting period (PCP para 291). Therefore, the post-registration change was removed from the document package being submitted for the request for renewal of crediting period. The project's additionality parameters will be dully reassessed as part of the process of requesting approval of the post-registration change.

SECTION B. Validation team, technical reviewer and approver

B.1. Validation team member

No.	Role	T y	Last name	First name	Affiliation	Involvement in

					(e.g. name of central or other office of DOE or outsourced entity)	Desk/document review	On-site inspection	Interview(s)	Validation findings
1.	Team Leader/ validator Technical Expert	IR	Carvalho	Thaís	RINA Brazil	x	x	x	x
2.	financial expert (PRC)	EI	Rocha	Mayra	RINA Brazil				x
3.	Validator Technical Expert	EI	Leiroz	Andrea	RINA Brazil	x			x

B.2. Technical reviewer and approver of the validation report for RCP

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of DOE or outsourced entity)
1.	Technical reviewer	IR	Buragohain	Champok	RINA India
2.	Approver	IR	Severino	Laura	RINA HQ

SECTION C. Means of validation

C.1. Desk/document review

>> The updated PDD version 6 of 29/07/2020 and previous versions /02/, in particular the applicability of the methodology, the baseline determination, the emission reduction calculations provided in the form of a spreadsheet “No PRC - Novagerar 3rd CP CER Spreadsheet v3 2020 07 03 JAS.xls” version 3 of 03/07/2020 and previous versions /10/, and the documents listed in the table 3 below, were reviewed during the validation.

C.2. On-site inspection

Duration of on-site inspection: 19/09/2018				
No.	**Activity performed on-site**	**Site location**	**Date**	**Team member**
1.	- Implementation and operation of the proposed project activity; - interviewed key personnel of the plant to confirm the operational and data collection procedures; QA QC procedures - Ex-ante parameters, baseline, project and leakage emissions calculation. - Monitoring Plan	Nova Iguaçu Landfill	19/09/2018	Thaís Carvalho
2.	- RINA assessed the Project activity design and implementation (changes). - Assessment of choice and applicability of the baseline methodology, project boundary and emissions sources included in the project boundary. - Additionality. (parameters modified)	Nova Iguaçu Landfill	19/09/2018	Thaís Carvalho

C.3. Interviews

No.	Interviewee			Date	Subject	Team member
	Last name	First name	Affiliation			
1.	Sprovieri	João	BENG	19/09/2018	Consultant: PDD CERs calculation Methodology applicability Monitoring, QA/QC procedures	Thaís Carvalho
2.	Paulino	Ivan	Foxx Haztec	19/09/2018	Operational project supervisor: project and landfill data, operation, maintenance	Thaís Carvalho
3.	Merces	Emerson	Foxx Haztec	19/09/2018	Operational project assitant: project and landfill data, operation	Thaís Carvalho
4.	Laguardia	Paulo	Foxx Haztec	19/09/2018	Project manager: Environmental licenses; project equipments, project change;	Thaís Carvalho

					monitoring; QA/QC procedures	

C.4. Sampling approach

>>Not applicable

C.5. Clarification requests (CLs), corrective action requests (CARs) and forward action requests (FARs) raised

Area of validation findings	No. of CL	No. of CAR	No. of FAR
Compliance with PDD form			
Application and selection of methodologies and standardized baselines	1		
Validity of original baseline or its update	3	1	
Estimated emission reductions or net anthropogenic removals	7	3	
Validity of monitoring plan	2	2	
Crediting period			
Project participants		1	
Post-registration changes			
Others (please specify)			1
Total	13	7	1

SECTION D. Validation findings

D.1. Compliance with PDD form

Means of validation	PDD applies the applicable CDM- PDD-FORM: Project design document form version 10.1. /7/. RINA verified that for the renewal crediting period, information transferred to the later valid version of the PDD form is materially the same as that in the registered PDD.
Findings	N/A
Conclusion	RINA confirms that the PDD is based on the currently valid CDM-PDD-FORM template version 11.0 and is completed in accordance with the Attachment: Instructions for completing this form /07/.

D.2. Application and selection of methodologies and standardized baselines

<table>
<tr><td>Means of validation</td><td>
The project was originally registered based on version 11 of the ACM0001 “Consolidated baseline and monitoring methodology for landfill gas project activities” /09/; the revised PDD /2/ applies ACM0001 “Flaring or use of landfill gas” version 19 of 14/06/2019 /6/.

RINA verified that the ACM0001 is still applicable to the project activity as described below:

<table>
<tr><td>Applicability criteria</td><td>Project activity</td><td>Criteria is met?</td></tr>
<tr><td>(a) Install a new LFG capture system in a new or existing SWDS where no LFG capture system was installed prior to the implementation of the project activity; or
(b) Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that:</td><td>The methodology is applicable as the project activity consists in Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that:
(i) The captured LFG was only vented and not used prior to the implementation of the project activity; (option B (i))</td><td>OK</td></tr>
</table>
</td></tr>
</table>

	(i) The captured LFG was vented or flared and not used prior to the implementation of the project activity; and (ii) In the case of an existing active LFG capture system for which the amount of LFG cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project system: historical data on the amount of LFG capture and flared is available; (c) Flare the LFG and/or use the captured LFG in any (combination) of the following ways: (i) Generating electricity; (ii) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace; and/or (iii) Supplying the LFG to consumers through a natural gas distribution network; (iv) Supplying compressed/liquefied LFG to consumers using trucks; v) Supplying the LFG to consumers through a dedicated pipeline; (d) Do not reduce the amount of organic waste that would be recycled in the absence of the project activity.	Verified during the onsite visit that the LFG will be captured from the Nova Iguaçu landfill. In the project activity, the LFG is flared and will be used to generate electricity. PP has provided a public research from IPEA to demonstrate the recycling panorama in Rio de Janeiro region and it is possible to state that recycling percentage in the project activity area is negligible /38/, confirming that the project activity does not reduce the amount of organic waste that would be recycled in the absence of the project activity.		
	The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is: (a) Atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons; and (b) In the case that the LFG	The baseline scenario is release the LFG to atmosphere from the SWDS, and the electricity would be generated in the grid connected power plants.	Yes	

	is used in the project activity for generating electricity and/or generating heat in a boiler, air heater, glass melting furnace or kiln; (i) For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or (ii) For heat generation: that heat would be generated using fossil fuels in equipment located within the project boundary.		
	This methodology is not applicable: (a) In combination with other approved methodologies. For instance, ACM0001 cannot be used to claim emission reductions for the displacement of fossil fuels in a kiln or glass melting furnace, where the purpose of the CDM project activity is to implement energy efficiency measures at a kiln or glass melting furnace; (b) If the management of the SWDS in the project activity is deliberately changed during the crediting in order to increase methane generation compared to the situation prior to the implementation of the project activity.	The project applies only the approved methodology ACM0001. Moreover the management of the CTR Nova Iguaçu landfill will not be changed to increase the methane generation, confirmed through interview during the onsite visit.	Yes

The following tools are also described in the applied methodologies:

"Combined tool to identify the baseline scenario and demonstrate additionality", version 07.0 of 22/09/2017 /19/;
"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"; version 3 of 22/09/2017 /20/;
"Emissions from solid waste disposal sites", version 08.0 of 04/05/2017 /12/;
"Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation", Version 3.0 of 22/09/2017 /18/;
"Project emissions from flaring", version 02.0.0 dated 20/07/2012 /14/;
"Tool to determine the mass flow of a greenhouse gas in a gaseous stream", Version 03.0 of 27/11/2015 /15/;
"Determining the baseline efficiency of thermal or electric energy generation systems", Version 02.0 of 27/11/2015 /16/ (not applicable to the project activity);
"Tool to determine the remaining lifetime of equipment", version 01 of 16/10/2009 /17/ (not applicable to the project activity);
"Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period", version 03.0.1 of 02/03/2012 /08/;
"Project and leakage emissions from transportation of freight", version 01.1.0 of 23/11/2012 /21/ (not applicable to the project activity);
"Tool to calculate the emission factor for an electricity system", version 6 of 01/11/2017 /22/.

Findings	**CL 1:** PP is requested to provide the evidences that the project activity does not reduce the amount of organic waste that would be recycled in the absence of the

	project activity, in accordance with the methodology requirements, described in Box 1 of the applied methodology. To closed CL 1 PP has provided a public research from IPEA to demonstrate that a small amount of organic waste is recycled in Nova Iguaçu area.
Conclusion	RINA confirms that the selected baseline and monitoring methodologies have been previously approved by the CDM Executive Board and are applicable to the project, which complies with all the applicability conditions therein the selected versions are valid at the time of submission of the renewal of crediting period. It is also confirmed that the methodologies are correctly applied by comparing them with the actual text of the applicable versions.

D.3. Validity of original baseline or its update

Means of validation	The baseline was assessed according to the tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period, version 03.0.1" /8/. The following steps were assessed: ***Step 1: Assess the validity of the current baseline for the next crediting period*** ***Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies***. Prior to the implementation of the project activity the landfill gas is being released to atmosphere and electricity is being generated in existing and/or new grid-connected power plants, other than the project activity power plant. Thus, the baseline remains the same as defined in the 1st and 2nd crediting periods and required regulations. RINA verified that in the beginning of 2010, the Política Nacional de Resíduos Sólidos (National Solid Waste Policy), under discussion since 2000, was approved. One of the scopes of this policy is to enforce the adequate environmental final destination of the solid waste. However, the Policy does not foresee either the obligation of landfill gas destruction or the promotion of the landfill gas use such as those for the production of renewable energy and processing of organic waste /25/. Therefore, there are no new relevant national and/or sectoral policies and/or circumstances in the waste management and energy sectors applicable to the Project Activity, in comparison to the time of the submission of the project activity for validation, which would affect the compliance of the current baseline scenario. RINA has verified that the current baseline remains the same for the next crediting period. Moreover, PP has provided the environmental license number applicable to the biogas station, energy plant installation and landfill /30/. **Step 1.2: Assess the impact of circumstances** There are no new relevant national and/or sectoral policies and/or circumstances in the waste management sector applicable to the Project Activity, in comparison to the time of the submission of the project activity for validation, which could impact the validity of the current baseline for the next crediting period. Therefore, the current baseline scenario does not need to be updated for this crediting period. **Step 1.3: Assess whether the continuation of the use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which the renewal is requested** This sub-step is not applicable since the baseline scenario of the project activity is the business as usual (BAU) scenario (passive venting system). Also, in the baseline scenario, electricity is being generated in existing and/or new grid-connected power plants, other than the project activity power plant. **Step 1.4: Assessment of the validity of the data and parameters** The baseline emissions of the project activity were updated considering the last version of the methodologies, related applicable tools and IPCC values.

	Step 2: Update the current baseline and the data and parameters **Step 2.1: Update the current baseline** The baseline emissions for the third crediting period have been updated, based on the latest approved version of the methodology ACM0001. **Step 2.2: Update the data and parameters** The data and/or parameter(s) for the third crediting period were updated. The assessment is described in the sections below.
Findings	**CL 2**: In the PDD it is not clear the baseline scenario for the landfill gas (LFG) and energy (E), in the Assessment of the validity of the current baseline for the next crediting period. To close CL 2, PDD was revised to present the baseline scenarios. **CAR 1**: Updated PDD does not describe the relevant mandatory national and/or sectoral policies applicable to the project activity that came into effect after the submission of the project activity for validation (for both scenarios). To close CAR 1, PDD was correctly revised. **CL 3**: Updated PDD does not consider the Assess whether the continuation of the use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which the renewal is requested (flaring and energy baseline). To close CL 3, PDD was correctly revised. **CL 4**: Updated PDD describes that $EF_{grid,BM,y}$ will be monitored ex-post, not in line in the description in the section B.6.1. Moreover, the update of the parameters was not limited to the ones related to the emission factor, as described in the section B.4 of the updated PDD. To close CL 4, data vintage of the emission factor was correctly revised.
Conclusion	RINA verified that the baseline was assessed according to the tool “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period, version 03.0.1” /8/. The current project baseline is still valid at the renewal crediting period.

D.4. Estimated emission reductions or net anthropogenic removals

Means of validation	The approved baseline and monitoring ACM0001 “Flaring or use of landfill gas” version 19 of 14/06/2019 /6/ has been applied. The following parameters are presented in the updated PDD.

Data/parameter	Unit	Value applied	Assessment
$EF_{grid,BM,y}$ (Build margin emission factor of the Brazilian grid)	tCO_2 /MWh	0.1404	RINA verified that the value is in accordance with the data published by the Brazilian DNA. RINA verified that the requirements of the tool /22/ are met: For the third crediting period, the build margin emission factor calculated for

					the second crediting period should be used (2010) /31/.	
		OX_{top_layer} ***(***Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline)	Dimensionless	0.1	Consistent with how oxidation is accounted for in the methodological tool "Emissions from solid waste disposal sites", application A (confirmed during the onsite visit) /12/.	
		GWP_{CH4}: Global Warming Potential of CH_4.	tCO_2e/tCH_4	25	In accordance with Standard for application of the global warning potentials to clean development mechanism project activities and programmes of activities for the second commitment period of the Kyoto protocol /13/.	
		R_u: Universal ideal gas constant	$Pa.m^3/kmol.K$	0.008314472	PP applied the default value in accordance with the Methodological tool "Project emissions from flaring" /14/.	
		Waste composition	%	**Composition of waste** A) Wood and wood products: 0.00% B) Pulp, paper and cardboard (other than sludge): 16.10% C) Food, food waste, beverages: 48.68%	RINA verified that the waste composition is in accordance with the third part study provided by	

				and tobacco (other than sludge) D) Textiles: 4.90% E) Garden, yard and park waste: 0.00% F) Glass, plastic, metal, other inert waste: 30.32% **TOTAL**: **100.00%**	PP /32/.	
		$SPEC_{flare}$: Manufacturer's flare specifications for temperature, flow rate and maintenance schedule	Temperature - °C Flow rate - Nm³/h Maintenance schedule - number of days	Flare model: LLC-ZTOF® 8X40 Minimum flare temperature: 760 ºC Maximum flare temperature: 1094 ºC Minimum and maximum inlet flow rate: 713 Nm3/h 2,999 Nm3/h Maximum duration in days between maintenance events: 7 days (The maximum duration in days between maintenance events has been chosen considering preventive maintenance program which defines the frequency for checking flare equipment situation every week)	Confirmed in the manufacturer letter, with the flare specifications /26/	
		P_{ref}: Atmospheric pressure at reference conditions	Pa	101,325	PP applied the default value in accordance with the Methodological tool "Project emissions from flaring" /14/.	
		T_{ref}: Temperature at reference conditions	K	273.15	PP applied the default value in accordance with the Methodological tool "Project emissions from flaring" /14/.	
		-η_{PJ}:	Dimensi	40%.	In	

		Efficiency of the LFG capture system that will be installed in the project activity.	onless		accordance with Feasibility Study /24/.	
		φ $\varphi_{default}$: Default value for the model correction factor to account for model uncertainties.	-	0.75	Value applied considering MAT >20 ºC and MAP> 1.000 mm, considering data for Recife. /23/. In accordance with "Emissions from solid waste disposal sites" /12/. This parameter is used to determine the baseline emissions following the procedures related to Application A.	
		OX: Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)	-	0.1	Value applied in accordance with the tool "Emissions from solid waste disposal sites" /12/.	
		F: Fraction of methane in the SWDS gas (volume fraction).	-	0.5	Value applied in accordance with the tool "Emissions from solid waste disposal sites"/12/.	
		$DOC_{f,default}$: Default	Weight fraction	0.5	The proposed	

		value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS.			project activity corresponds to *Application A* described in the applicable methodological tool *"Emissions from solid waste disposal sites"* /12/. Therefore, in accordance with the requirements set out by tool, the default value was chosen.	
		$MCF_{default}$: Methane correction factor.	-	1.0	The proposed project activity corresponds to *Application A* described in the applicable methodological tool *"Emissions from solid waste disposal sites"* /12/. Therefore, in accordance with the requirements set out by tool, the default value was chosen. The Novagerar Landfill Project Activity meets the criteria of managed SWDS. Hence, the value corresponding to anaerobic managed	

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>solid waste disposal sites is chosen considering option 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;
The choice chosen by PP was confirmed during the onsite visit.</td><td></td></tr>
<tr><td></td><td></td><td>DOC_j: Fraction of degradable organic carbon in the waste type j</td><td>weight fraction</td><td>
<table>
<tr><th>DOC_j (% wet waste)</th><th>Waste type j</th></tr>
<tr><td>43%</td><td>Wood and wood products</td></tr>
<tr><td>40%</td><td>Pulp, paper and cardboard</td></tr>
<tr><td>15%</td><td>Food, food waste, beverages and tobacco</td></tr>
<tr><td>24%</td><td>Textiles</td></tr>
<tr><td>20%</td><td>Garden, yard and park waste</td></tr>
<tr><td>0%</td><td>Glass, plastic, metal, other inert waste</td></tr>
</table>
</td><td>Value applied in accordance with the tool “Emissions from solid waste disposal sites”/12/.</td><td></td></tr>
<tr><td></td><td></td><td>k_j: Decay rate for the waste type j</td><td>1/yr</td><td>
<table>
<tr><th>Waste type j</th><th>k_j</th></tr>
</table>
</td><td>Value applied considering MAT >20ºC</td><td></td></tr>
</table>

				Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.07	and MAP>1.000 mm, considering data for Rio de Janeiro /23/. In accordance with "Emissions from solid waste disposal sites" /16/ - Tropical /23/.
					Wood, wood products and straw	0.035	
				Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.17	
				Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.40	
		MM_i: Molecular mass of greenhouse gas i (i = CH4)	kg/kmol	16.04			Value applied in accordance with the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" /15/.
		MM_k: Molecular mass of greenhouse gas ki (k = N_2)	kg/kmol	28.01			Value applied in accordance with the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" /15/.

	MM_{H2O}: ***M**olecular mass of water*	kg/kmol	18.0152	Value applied in accordance with the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" /15/.

Baseline emissions:
Baseline emissions is calculated in accordance with the methodology ACM0001 "Flaring or use of landfill gas" version 19 of 14/06/2019:

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}$$

Where:

BE_y= Baseline emissions in year y (t CO_{2e}/yr)

$BE_{CH4,y}$= Baseline emissions of methane from the SWDS in year y (t CO_{2e}/yr)

$BE_{EC,y}$ = Baseline emissions associated with electricity generation in year y (t CO_2/yr).

$BE_{HG,y}$= Baseline emissions associated with heat generation in year y (t CO_2/yr). Not applicable to this project activity.

$BE_{NG,y}$ = Baseline emissions associated with natural gas use in year y (t CO_2/yr).

Not applicable to this project activity.

Baseline emissions of methane from the SWDS (*$BE_{CH4,y}$*)

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

Where:
$BE_{CH4,y}$= Baseline emissions of methane from the SWDS in year *y* (t CO_2e/yr).
OX_{top_layer}= Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless).
$F_{CH4,PJ,y}$= Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr).
$F_{CH4,BL,y}$= Amount of methane in the LFG that would be flared in the baseline in year *y* (t CH_4/yr).
GWP_{CH4}= Global warming potential of CH_4 (t CO_2e/t CH_4).

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

During the crediting period, the $\mathbf{F_{CH4,PJ,y}}$ will be determined as follows:
$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y}$
Where:
$F_{CH4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the project activity in year y (t_{CH4}/yr).
$F_{CH4,flared,y}$ = Amount of methane in the LFG which is destroyed by flaring in year *y* (tCH_4/yr).
$F_{CH4,EL,y}$ = Amount of methane in the LFG which is used for electricity generation in year *y* (tCH_4/yr).
$F_{CH4,HG,y}$ = Amount of methane in the LFG which is used for heat generation in year *y* (tCH_4/yr). Not applicable to the project activity.
$F_{CH4,NG,y}$= Amount of methane in the LFG which is sent to the natural gas distribution network and/or dedicated pipeline and/or to the trucks in year *y* (tCH_4/yr). Not applicable to the project activity.
As the project flares LFG, generate electricity, the $F_{CH4,NG,y}$= 0 and $F_{CH4,HG,y}$ = *0*.

$F_{CH4,EL,y,}$ *is* determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" and monitoring the working hours of the power plant, so that

	no emission reduction are claimed, for methane destruction during non-working hours. This is taken into account by monitoring the hours that the equipment utilizing the LFG is operating in year y ($Op_{j,h,y}$). The following requirements apply: • As per the gaseous stream tool, if the LFG is used for multiple purposes (e.g. flaring or energy generation), and all methane destruction devices are verified to be operational (e.g. by means of flame detectors records, energy generated), a single flow meter may be used to record the flow into multiple destruction devices. The destruction efficiency of the least efficient among the destruction devices shall be used as the destruction efficiency for all destruction devices monitored by this flow meter. If there are any periods for which one or more destruction devices are not operational, paragraph 5 (a) and (b) of the Appendix of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" tool shall be followed; • CH_4 is the greenhouse gases for which the mass flow should be determined; • The simplification offered for calculating the molecular mass of the gaseous stream is valid equations 3 or 17 in the tool); and • The mass flow should be calculated on an hourly basis for each hour h in year *y*; • The mass flow calculated for hour h is 0 if the equipment is not working in hour *h* ($O_{pj,h}$=not working), the hourly values are then summed to a yearly unit basis. The amount of methane destroyed by flaring ($F_{CH4,flared,y}$) will be determined as follows: $$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}}$$ Where: $F_{CH4,flared,y}$= Amount of methane in the LFG which is destroyed by flaring in year y (t CH_4/yr). $F_{CH4,sent\_flare,y}$ = Amount of methane in the LFG which is sent to the flare in year y (t CH_4/yr). $PE_{flare,y}$ = Project emissions from flaring of the residual gas stream in year y (t CO_2e/yr). GWP_{CH4} = Global warming potential of CH4 (t CO_2e/t CH_4). $F_{CH4,sent\_flare,y}$ will be determined directly using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, applying the requirements described below. The tool shall be applied to the gaseous stream flowing in the LFG delivery pipeline to each flare. For calculating $F_{CH4,sent\_flare,y,}$ it will be used the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” /15/. the following options may be applied: • Option A (Volume flow in dry basis and volumetric fraction in dry basis) when the temperature of the gaseous stream is less than 60^oC (333.15 K) at the flow measurement point. • Option B (Volume flow in wet basis and volumetric fraction in dry basis) when the temperature of the gaseous stream is higher than 60^oC (333.15 K) at the flow measurement point. **Option A** Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. The demonstration will be made as following:

	The mass flow of greenhouse gas i (Fi,t) is determined as follows: $F_{i,t}= V_{t,db} * v_{i,t,db} * \rho_{i,t}$ and $\rho_{i,t} = (P_t * MM_i) / (R_u * T_t)$ Where: $F_{i,t}$= Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h); $V_{t,db}$ = Volumetric flow of the gaseous stream in time interval t on a dry basis (m³ dry gas/h); $v_{i,t,db}$ = Volumetric fraction of greenhouse gas i in the gaseous stream in time interval t on a dry basis (m³ gas i /m³ wet gas); $\rho_{i,t}$ = Density of greenhouse gas i in the gaseous stream in time interval *t* (kg gas *i*/m³ gas *i*); P_t = Absolute pressure of the gaseous stream in time interval *t* (Pa); MM_i= Molecular mass of greenhouse gas i (kg/kmol); R_u = Universal ideal gases constant (8,314 Pa.m3/kmol.K); T_t = Temperature of the gaseous stream in time interval *t* (K). If it cannot be demonstrated that the gaseous stream is dry, then the flow measurement should be assumed to be on a wet basis and the option B should be applied instead. **Option B** The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using equations used to Option A. The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis as follows: $$V_{t,tb} = V_{t,wb}/(1 + v_{H2O,t,db})$$ Where: $V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m³ dry gas/h). $V_{t,wb}$ = Volumetric flow of the gaseous stream in time interval *t* on a wet basis (m³ wet gas/h). $v_{H2O,t,db}$ = Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m³ H_2O/m³ dry gas). The volumetric fraction of H_2O in time interval *t* on a dry basis ($v_{H2O,t,db}$) is estimated according to following equation. $$v_{H2O,t,db} = \frac{m_{H2O,t,db} * MM_{t,db}}{MM_{H2O}}$$ Where: $v_{H2O,t,db}$ = Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m³ H_2O/m³ dry gas). $m_{H2O,t,db}$ = Absolute humidity in the gaseous stream in time interval *t* on a dry basis (kg H_2O/kg dry gas). $MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas). MM_{H2O} = Molecular mass of H_2O (kg H_2O/kmol H_2O). The absolute humidity of the gaseous stream ($m_{H2O,t,db}$) will be determined using Option 2 (simplified calculation without measurement of the moisture content): *Option 2: Simplified calculation without measurement of the moisture content* This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. Concerning the project activity, the conservative situation will be to assume that the gaseous stream is saturated, then $m_{H2O,t,db}$ is assumed to equal the saturation absolute humidity ($m_{H2O,t,db,sat}$) and calculated using the following equation.

$$m_{H2O,t,db,Sat} = \frac{p_{H2O,t,Sat} * MM_{H2O}}{(P_t - p_{H2O,t,Sat}) * MM_{t,db}}$$

Where:
$m_{H2O,t,db,sat}$ = Saturation absolute humidity in time interval *t* on a dry basis (kg H_2O/kg dry gas).
$p_{H20,t,Sat}$ = Saturation pressure of H_2O at temperature Tt in time interval t (Pa).
T_t = Temperature of the gaseous stream in time interval *t* (K).
P_t = Absolute pressure of the gaseous stream in time interval *t* (Pa).
MM_{H2O} = Molecular mass of H_2O (kg H_2O/kmol H_2O).
$MM_{t,db}$ = Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas).

Parameter $MM_{t,db}$ is estimated using the following equation.

$$MM_{t,db} = \sum_{k} (v_{k,t,db} * MM_k)$$

Where:
$MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas).
$v_{k,t,db}$ = Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis (m³ gas k/m³ dry gas).
MM_k = Molecular mass of gas *k* (kg/kmol).
k = All gases, except H_2O, contained in the gaseous stream (e.g. N_2 and CH_4,). See available simplification below.
The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (*k*) in the gaseous stream. However, as a simplification, in the case of the project activity, the volumetric fraction of the methane that is a greenhouse gas and considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. The simplification is not acceptable if it is differently specified in the underlying methodology.

Project emissions from flaring
$PE_{flare,y}$ shall be determined using the methodological tool "Project emissions from flaring – version 03.0" /14/. If LFG is flared through more than one flare, then $PE_{flare,y}$ is the sum of the emissions for each flare determined separately.

The calculation of flare efficiency will be made by the following steps:
Step 1: Determination of the methane mass flow of the residual gas
The mass flow of methane in the residual gaseous stream in the minute *m* ($F_{CH4,m}$) will be determined using the procedures set out by the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" /15/.
$F_{CH4,m}$, which is measured as the mass flow during minute *m*, shall then be used to determine the mass of methane in kilograms fed to the flare in minute *m* ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis. The option chosen for the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" by the project participant is option A. However, during the project operational monitoring, If not demonstrated that the temperature of the gaseous stream (T_t) is less than 60ºC (dry basis), then the flow measurement should be assumed to be on a wet basis and the option B should be applied instead.

Step 2: Determination of flare efficiency

According to "Project emissions from flaring", the flare efficiency will be calculated as follows:

<u>Open flare</u>

In the case of open flares, the flare efficiency in the minute *m* ($\eta_{flare,m}$) is 50% when the flame is detected in the minute *m* (Flamem), otherwise $\eta_{flare,m}$ is 0%.

	Enclosed flares In the case of enclosed flares, project participants may choose between the following two options to determine the flare efficiency for minute *m* ($nf_{lare,m}$). Option A: Apply a default value for flare efficiency Option B: Measure the flare efficiency. The project participant has chosen Option B. In the present project activity the flare efficiency for minute m (ηflare,m) will be determined by Option B.2 of the methodological tool "Project emissions from flaring", where the flare efficiency is measured in each minute or, if option B.2. measurements are not available, Option A of the methodological tool "Project emissions from flaring" will be used. Both options are described below: For enclosed flares that are defined as low height flares, which is the case of the project activity, the flare efficiency in the minute m ($n_{flare,m}$) shall be adjusted, as a conservative approach, by subtracting 0.1 from the efficiency as determined in Option A. For example, the default value applied should be 80%, rather than 90%, and if for example the measured value was 99%, then the value to be used shall correspond to 89%. ***Option A: Default value*** The flare efficiency for the minute m ($n_{flare,m}$) 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 $n_{flare,m}$ is 0%. ***Option B: Measured flare efficiency*** The flare efficiency in the minute *m* is a measured value ($n_{flare,m} = n_{flare,calc,m}$) when the following three conditions are met to demonstrate that the flare is operating: (1) The temperature of the flare (TEG.m) and the flow rate of the residual gas to the flare (FRG,m) is within the manufacturer's specification for the flare (SPEC*flare*) in minute *m*; (2) The flame is detected in minute *m* (Flamem); and Otherwise $n_{flare,m}$ is 0%. In applying Option B, the project participants chose to determine $n_{flare,calc,m}$ using Option B.2 where the measurement of flare efficiency are conducted in each minute. ***Option B.2: Measurement of flare efficiency in each minute*** The flare efficiency ($\eta_{flare,calc,m}$) is determined based on monitoring the methane content in the exhaust gas, the residual gas, and the air used in the combustion process during the minute m in year y, as follows: $$\eta_{flare,calc,m} = 1 - \frac{F_{CH4,EG,m}}{F_{CH4,RG,m}}$$ Where:

$\eta_{flare,calc,m}$= Flare efficiency in the year y
$F_{CH4,EG,m}$= Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the minute m (kg)
$F_{CH4,RG,m}$= Mass flow of methane in the residual gas on a dry basis at reference conditions in the minute m (kg)

$F_{CH4, EG,t}$ is measured according to an appropriate national or international standard. $F_{CH4,RG,t}$ is calculated according to Step 1, and consists of the sum of methane flow in the minutes *m* that make up the time period *t*.

Step 2.1: Determine the methane mass flow in the exhaust gas on a dry basis

The mass flow of methane in the exhaust gas is determined based on the volumetric flow of the exhaust gas and the measured concentration of methane in the exhaust gas, as follows:

$$F_{CH4,EG,m} = V_{EG,m} \times fc_{CH4,EG,m} \times 10^{-6}$$

Where:
$F_{CH4,EG,m}$= Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the minute m (kg)
$V_{EG,m}$= Volumetric flow of the exhaust gas of the flare on a dry basis at reference conditions in minute m (m^3)
$fc_{CH4,EG,m}$= Concentration of methane in the exhaust gas of the flare on a dry basis at reference conditions in minute m (mg/m^3)

Step 2.2: Determine the volumetric flow of the exhaust gas ($V_{EG,m}$)

Determine the average volume flow of the exhaust gas in minute m based on a stoichiometric calculation of the combustion process. This depends on the chemical composition of the residual gas, the amount of air supplied to combust it and the composition of the exhaust gas. It is calculated as follows:

$$V_{EG,m} = Q_{EG,m} \times M_{RG,m}$$

Where:
$V_{EG,m}$= Volumetric flow of the exhaust gas of the flare on a dry basis at reference conditions in minute m (m^3)
$Q_{EG,m}$= Volume of the exhaust gas on a dry basis at reference conditions per kilogram of residual gas on a dry basis at reference conditions in minute m (m^3 exhaust gas/kg residual gas)
$M_{RG,m}$= Mass flow of the residual gas on a dry basis at reference conditions in the minute m (kg)

Step 2.3: Determine the mass flow of the residual gas ($M_{RG,m}$)

Project participants may select to monitor the mass flow of the residual gas in minute m directly (see monitored parameter $M_{RG,m}$) or, according to the procedure given in this step, calculate $M_{RG,m}$ based on the volumetric flow and the density of the residual gas. The density of the residual gas is determined based on the volumetric fraction of all components in the gas.

$$M_{RG,m} = \rho_{RG,ref,m} \times V_{RG,m}$$

Where:
$M_{RG,m}$= Mass flow of the residual gas on a dry basis at reference conditions in the minute m (kg)
$\rho_{RG,ref,m}$= Density of the residual gas at reference conditions in minute m (kg/m^3)

	$V_{RG,m=}$ Volumetric flow of the residual gas on a dry basis at reference conditions in the minute m (m^3) And $$\rho_{RG,ref,m} = \frac{P_{ref}}{\frac{R_u}{MM_{RG,m}} \times T_{ref}}$$ $\rho_{RG,ref,m}$= Density of the residual gas at reference conditions in minute m (kg/m^3) P_{ref}= Atmospheric pressure at reference conditions (Pa) R_u= Universal ideal gas constant ($Pa.m^3/kmol.K$) $MM_{RG,m}$= Molecular mass of the residual gas in minute m (kg/kmol) $T_{ref=}$ Temperature at reference conditions (K) Use the equation below to calculate $MM_{RG,m}$. When applying this equation, project participants may choose to either a) use the measured volumetric fraction of each component i of the residual gas, or b) as a simplification, measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2). The same equation applies, irrespective of which option is selected. $$MM_{RG,m} = \sum_i (v_{i,RG,m} \times MM_i)$$ $MM_{RG,m=}$ Molecular mass of the residual gas in minute m (kg/kmol) $MM_{i=}$ Molecular mass of residual gas component i (kg/kmol) $v_{i,RG,m=}$ Volumetric fraction of component i in the residual gas on a dry basis at reference conditions in the hour h i= Components of the residual gas. If Option (a) is selected to measure the volumetric fraction, then i = CH_4, CO, CO_2, O_2, H_2, H_2S, NH_3, N_2 or if Option (b) is selected then i = CH_4 and N_2 ***Step 2.4: Determine the volume of the exhaust gas on a dry basis at reference conditions per kilogram of residual gas ($Q_{EG,m}$)*** $Q_{ECO2,EG,m}$ shall be determined as follows: $$Q_{EG,m} = Q_{CO_2,EG,m} + Q_{O_2,EG,m} + Q_{N_2,EG,m}$$ $Q_{EG,m=}$ Volume of the exhaust gas on a dry basis per kg of residual gas on a dry basis at reference conditions in the minute m (m^3/kg residual gas) $Q_{CO2,EG,m=}$ Quantity of CO_2 volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m^3/kg residual gas) $Q_{N2,EG,m=}$ Quantity of N_2 volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m^3/kg residual gas) $Q_{O2,EG,m=}$ Quantity of O_2 volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m^3/kg residual gas) With $$Q_{O_2,EG,m} = n_{O2,EG,m} \times VM_{ref}$$ $Q_{O2,EG,m=}$ Quantity of O_2 volume in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m^3/kg residual gas) $n_{O2,EG,m=}$ Quantity of O_2 (moles) in the exhaust gas per kg of residual gas flared on a dry basis at reference conditions in minute m (kmol/kg residual gas) $VM_{ref=}$ Volume of one mole of any ideal gas at reference temperature and pressure (m^3/kmol)

$$Q_{N2,EG,m} = VM_{ref} \times \left\{ \frac{MF_{N,RG,m}}{2 \times AM_N} + \left(\frac{1 - v_{O2,air}}{v_{O_2,air}} \right) \times \left[F_{O2,RG,m} + n_{O2,EG,m} \right] \right\}$$

$Q_{N2,EG,m=}$ Quantity of N_2 (volume) in the exhaust gas per kg of residual gas on a dry basis at reference conditions in the minute m (m^3/kg residual gas)
$VM_{ref=}$ Volume of one mole of any ideal gas at reference temperature and pressure (m^3/kmol)
$MF_{N,RG,m=}$ Mass fraction of nitrogen in the residual gas in the minute m
$AM_{N=}$ Atomic mass of nitrogen (kg/kmol)
$v_{O2,ai=}$ Volumetric fraction of O_2 in air
$F_{O2,RG,m=}$ Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in minute m (kmol/kg residual gas)
$n_{O2,EG,m=}$ Quantity of O_2 (moles) in the exhaust gas per kg of residual gas flared on a dry basis at reference conditions in minute m (kmol/kg residual gas)

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

$Q_{CO2,EG,m}$	=	Quantity of O_2 (moles) in the exhaust gas per kg of residual gas flared on a dry basis at reference conditions in minute m (kmol/kg residual gas)
$v_{O2,EG,m}$	=	Volumetric fraction of O_2 in the exhaust gas on a dry basis at reference conditions in the minute m
$v_{O2,air}$	=	Volumetric fraction of O_2 in the air
$MF_{C,RG,m}$	=	Mass fraction of carbon in the residual gas in the minute m
AM_C	=	Atomic mass of carbon (kg/kmol)
$MF_{N,RG,m}$	=	Mass fraction of nitrogen in the residual gas in the minute m
AM_N	=	Atomic mass of nitrogen (kg/kmol)
$F_{O2,RG,m}$	=	Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in minute m (kmol/kg residual gas)

$$n_{O2,EG,m} = \frac{v_{O2,EG,m}}{\left(1 - \left(v_{O2,EG,m}/v_{O2,air}\right)\right)} \times \left[\frac{MF_{C,RG,m}}{AM_C} + \frac{MF_{N,RG,m}}{2 \times AM_N} + \left(\frac{1 - v_{O2,air}}{v_{O2,air}} \right) \times F_{O2,RG,m} \right]$$

$nO2,EG,m$= O2 (moles) in the exhaust gas per kg of residual gas flared on a dry basis at reference conditions in minute m (kmol/kg residual gas)
$vO2,EG,m$= Volumetric fraction of O2 in the exhaust gas on a dry basis at reference conditions in the minute m
$vO2,air$= Volumetric fraction of O2 in the air
MFC,RG,m= Mass fraction of carbon in the residual gas in the minute m
AMC= Atomic mass of carbon (kg/kmol)
MFN,RG,m= Mass fraction of nitrogen in the residual gas in the minute m
AMN= Atomic mass of nitrogen (kg/kmol)
$FO2,RG,m$= Stochiometric quantity of moles of O2 required for a complete oxidation of one kg residual gas in minute m (kmol/kg residual gas)

$$F_{O2,RG,m} = \frac{MF_{C,RG,m}}{AM_C} + \frac{MF_{H,RG,m}}{4AM_H} - \frac{MF_{O,RG,m}}{2AM_O}$$

$F_{O2,RG,m=}$ Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in minute m (kmol/kg residual gas)

	$MF_{C,RG,m=}$ Mass fraction of carbon in the residual gas in the minute m $AM_{C=}$ Atomic mass of carbon (kg/kmol) $MF_{O,RG,m=}$ Mass fraction of oxygen in the residual gas in the minute m $AM_{O=}$ Atomic mass of oxygen (kg/kmol) $MF_{H,RG,m=}$ Mass fraction of hydrogen in the residual gas in the minute m $AM_{H=}$ Atomic mass of hydrogen (kg/kmol) Determine the mass fractions of carbon, hydrogen, oxygen and nitrogen in the residual gas, using the volumetric fraction of component *i* in the residual gas and applying the equation below. In applying this equation, the project participants may choose to either a) use the measured volumetric fraction of each component *i* of the residual gas, or (b) as a simplification, measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N2). The same equation applies, irrespective of which option is selected. $$MF_{j,RG,m} = \frac{\sum_{i} v_{i,RG,m} \times AM_j \times NA_{j,i}}{MM_{RG,m}}$$ $MF_{j,RG,m=}$ Mass fraction of element j in the residual gas in the minute m $v_{i,RG,m=}$ Volumetric fraction of component i in the residual gas on a dry basis in the minute m $AM_{j=}$ Atomic mass of element j (kg/kmol) $NA_{j,i=}$ Number of atoms of element j in component i $MM_{RG,m=}$ Molecular mass of the residual gas in minute m (kg/kmol) j= elements C, O, H and N i= Component of residual gas. If Option (a) is selected to measure the volumetric fraction, then i = CH4, CO, CO2, O2, H2, H2S, NH3, N2 or if Option (b) is selected then i= CH4 and N2 ***Step 3: Calculation of project emissions from flaring*** Project emissions from flaring are calculated as the sum of emissions for each minute *m* in year *y,* based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows: $$PE_{flare\,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times \left(1-\eta_{flare\,m}\right) \times 10^{-3}$$ Where: $PE_{flare,y=}$ Project emissions from flaring of the residual gas in year *y* (tCO_{2e}). $GWP_{CH4=}$ Global warming potential of methane valid for the commitment period (tCO_{2e}/tCH_4). $F_{CH4,RG,m=}$ Mass flow of methane in the residual gas in the minute *m* (kg). $\eta_{flare,m=}$ Flare efficiency in minute m. **Ex-ante estimation of $F_{CH4,PJ,y}$, in accordance with ACM0001** $$F_{CH4,PJ,y} = \eta_{PJ} \cdot BE_{CH4,SWDS,y}/GWP_{CH4}$$ $F_{CH4,PJ,y}$= Amount of methane in the LFG which is flared and/or used in the project activity in year y (t CH_4/yr); $BE_{CH4,SWDS,y}$= Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y (t CO_2e/yr); η_{PJ}= Efficiency of the LFG capture system that will be installed in the project activity, this is considered as 40% in accordance with Feasibility Study /24/; GWP_{CH4}= Global warming potential of CH_4 (t CO_2e/t CH_4); $BE_{CH4,SWDS,y}$ is determined using the methodological tool *“Emissions from solid waste*

	disposal sites" /12/. PDD applies the "Application A" of the tool: The CDM project activity mitigates methane emissions from a specific existing SWDS. The amount of methane that would in the absence of the project activity be generated from disposal of waste at the solid waste disposal site ($BE_{CH4,SWDS,y}$) is calculated with a multi-phase model. The calculation is based on a first order decay (FOD) model. $BE_{CH4,SWDS,y}$= φyx (1-f_y)* GWP_{CH4}*(1-OX)*16/12*F*$DOC_{f,y}$*MCFy*∑∑ $W_{j,x}$* DOC_jx$e^{-k(y-x)}$*(1-e^{-kj}) $BE_{CH4,SWSD,y}$= Baseline methane emissions occurring in year y generated from waste disposal at the solid waste disposal site (SWDS) during a period ending in year y (tCO_2e/y); φ= Model correction factor to account for model uncertainties (default value of 0.75), Option 1 in the Tool has been selected, value as per Table 3 of the Tool (Application A and humid wet conditions); f= 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. As this is already accounted for in $\boldsymbol{F_{CH4,BL,y}}$, "f" in the Tool shall be assigned a value of 0; GWP_{CH4}= Global Warming Potential (GWP) of methane, valid for the relevant commitment period; OX= Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste) (default Tool value 0.1); F= Fraction of methane in the SWDS gas (volume fraction) (0.5); $DOC_{f,y}$= Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWSD for year y (weight fraction). Default value of 0.5 used as the Tool; MCF_y= Methane correction factor for year y (1.0); $W_{j,x}$= Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year *x* (t); DOC= Fraction of degradable organic carbon (by weight fraction) in the waste type *j;* k_j= Decay rate for the waste type *j (1/yr);* j= Type of residual waste or types of waste in the MSW; x= Years in the time period in which waste is disposed at the SWSD, extending from the first year in the time period (x=1) to year (x = y); y= Year for which methane emissions are calculated (considering a consecutive period of 12 months). The historic amount of waste received is in accordance with data provided during the onsite visit (annual report from the waste balance) /37/. **Determination of $F_{CH4,BL,y}$** In the baseline there are no regulatory or contractual requirements, or to address safety and odour concerns to capture and destroy LFG. Thus, the case of the project activity for determining methane captured and destroyed in the baseline is Case 3 because there is existing LFG capture system (passive system), however there is no requirement to destroy methane. In this case: $F_{CH4,BL,y} = F_{CH4,BL,sys,y}$ Where: $F_{CH4,BL,sys,y}$ = Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system (t CH_4/yr).

	The amount of methane captured with the existing system will be monitored along with the amount captured under the project activity and there is no historic data on the amount of methane that was captured in the year prior to the implementation of the project activity. Thus, the situation to determine $F_{CH4,BL,y}$ is: If there is no monitored or historic data on the amount of methane that was captured in the year prior to the implementation of the project situation, then: $F_{CH4,BL,sys,y} = 20\% \times F_{CH4,PJ,y}$; or $F_{CH4,BL,y} = 20\% \times F_{CH4,PJ,y}$ **Baseline emissions associated with electricity generation ($BE_{EC,y}$)** In accordance with the methodology, the baseline emissions associated with electricity generation in year y ($BE_{EC,y}$) shall be calculated using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" /15/ as follow: $BE_{EC,y} = \sum_{k} EC_{BL,k,y} \times EF_{EL,k,y} \times (1 + TDL_{k,y})$ $BE_{EC,y}$= Baseline emissions from electricity generation in year *y* (tCO_2/yr). $EC_{BL,k,y}$= $EG_{PJ,y}$= Net amount of electricity generated using LFG in year y (MWh/yr). $EF_{EL,k,y}$= Emission factor for electricity generation for source k in year y (tCO_2/MWh). $TDL_{k,y}$= Average technical transmission and distribution losses for providing electricity to source k in year y. The technical transmission and distribution losses (TDLj,y) value has been assumed to be 16%, according to World Bank Database – 2014 /40/. k= Sources of electricity generated identified in the selection of the most plausible baseline scenario. Project participant choose Option A.1 of the "*Tool to calculate baseline, project and/or leakage emissions from electricity consumption*" for determining $EF_{EL,k,y}$. thus according to the option chosen : *"Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest approved version of the Tool to calculate the emission factor for an electricity system ($EF_{EL,j/k/l,y} = EF_{grid,CM,y}$)".* For the project estimative energy, was provided by the electricity plant owner /39/ The Load Factor reference 92% was calculated based on data provided by the project owner, where: Load Factor (%) = Electricity generated in the plant (MWh) / Installed capacity (MW) / 8760. RINA verified that the emission factor data is provided by the Brazilian DNA /31/. **STEP 1: Identify the relevant electricity system** The Brazilian DNA published a Resolution #08, issued on 26th May, 2008, defines the Brazilian Interconnected Grid as a single system that covers all the five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest) /11/. **STEP 2: Choose whether to include off-grid power plants in the project electricity system (optional)** The Brazilian DNA is responsible for calculating the emission factors and it did not include off-grid power plants in the calculation, therefore Option I is used: Only grid power plants are included in the calculation. **STEP 3: Select a method to determine the operating margin (OM)** The $EF_{grid,OM,y}$ is given by the Brazilian DNA and calculated under the method: *c)*

	Dispatch data analysis OM. For the dispatch data analysis OM, it is necessary to use the year in which the project activity displaces grid electricity and to update the emission factor annually during monitoring. **Step 4: Calculate the operating margin emission factor according to the selected method** The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the power units that are actually dispatched at the margin during each hour h where the project is displacing electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of $EF_{grid,OM-DD,y}$. The emission factor is calculated as follows: $$EF_{grid,OM-DD,y} = \frac{\sum_h EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}}$$ Where: $EF_{grid,OM-DD,y}$ = Dispatch data analysis operating margin CO_2 emission factor in year *y* (tCO_2/MWh). $EG_{PJ,h}$ = Electricity displaced by the project activity in hour *h* m of year *y* (MWh). $EF_{EL,DD,h}$ = CO_2 emission factor for power units in the top of the dispatch order in hour *h* in year *y* (tCO_2/MWh). $EG_{PJ,y}$ = Total electricity displaced by the project activity in year *y* (MWh). h = hours in year y in which the project activity is displacing grid electricity. y = Year in which the project activity is displacing grid electricity. **Step 5. Calculate the build margin (BM) emission factor** For data vintage, Option 1 (ex-ante) was chosen for the proposed project in the third crediting period. Hence, the build margin emission factor calculated for the second crediting period should be used for the third crediting period. **Step 6: Calculate the Combined Margin emission factor** $$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM}$$ According with the Tool, values adopted for w_{OM} and w_{BM} in the second crediting period is equal w_{OM}= 0.25 and w_{BM}=0.75. **Baseline emissions associated with heat generation ($BE_{HG,y}$) and Baseline emissions associated with natural gas use ($BE_{NG,y}$)** are not applicable to the project activity. **Project emissions** In accordance with ACM0001, emissions are electricity and fossil fuel consumption: $PEy= PE_{EC,y}+ PE_{FC,y}+ PE_{DT,y+} PE_{spy}$ $PE_{EC,y}$= Emissions from consumption of electricity due to the project activity in year y (t CO_2/yr). $PE_{FC,y}$= Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year y (t CO_2/yr).

$PE_{DT,y}$= Emissions from the distribution of compressed/liquefied LFG using trucks, in year y (tCO_2/yr) – Not applicable to the project activity.

PE_{spy}= Emissions from the supply of LFG to consumers through a dedicated pipeline, in year y (tCO2/yr) – Not applicable to the project activity.

The project emissions from electricity consumption ($PE_{EC.y}$) will be calculated following the procedures set out by the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" /18/ while the project emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation ($PE_{FC.y}$) will be calculated following the procedures set out by the "Methodological tool: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" /20/.

Calculation of $PE_{EC,y}$ – project emission from consumption of electricity

The project emission from consumption of electricity will be from two sources:

- $PE_{EC1,y}$ - Grid (Brazilian interconnected electric system);
- $PE_{EC2,y}$ - Diesel generator(s) (off-grid captive power plant).

<u>$PE_{EC1,y}$ - Project emission from electricity consumption from the grid</u>

The project will consume electricity from the grid. Therefore, Option A.1 of the scenario A was chosen, considering $EF_{EL,j/k/l,y} = EF_{grid,CM,y}$.

$$PE_{EC1,y} = EC_{PJ1,y} \times EF_{grid,CM,y} \times (1 + TDL_y)$$

$PE_{EC1,y}$= Project emissions from electricity consumption from the grid by the project activity during the year y (tCO_2/year);
$EC_{PJ1,y}$= quantity of electricity consumed from the grid by the project activity during the year y (MWh);
$EF_{grid,CM}$ the emission factor for the grid in year y (tCO_2/MWh);
$TDL_{j,y}$= average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

<u>$PE_{EC2,y}$ - Project emission from electricity consumption from an off-grid captive power plant (diesel generator(s)</u>

As electricity will be consumed from diesel generators (off-grid captive power plant), a conservative approach was adopted and the option B2 of the scenario B was chosen because: "The electricity consumption source is a project or leakage electricity consumption source". Therefore, the value used will be 1.3 tCO2/MWh for project emission from diesel generator(s).

$$PE_{EC2,y} = EC_{PJ2,y} \times EF_{diesel\_generator,y} \times (1 + TDL_y)$$

Where:

$EC_{PJ2,y}$ = quantity of electricity consumed from diesel generator by the project activity during the year y (MWh);
$EF_{diesel\_generator,y}$ = the emission factor for the diesel generator in year y (tCO_2/MWh);
TDLy = average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

<u>$PE_{FC,y}$ - Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation</u>

The project will consume liquefied petroleum gas (LPG) for the ignition of the flare system. CO2 emissions from fossil fuel combustion are calculated based on the quantity of LPG combusted and the CO2 emission coefficient of the LPG, as follows:

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

Where:
$PE_{FC,j,y}$ = Are the CO_2 emissions from fossil fuel combustion in process j during the year y (tCO_2e/yr);
$FC_{i,j,y}$ = Is the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr);
$COEF_{i,y}$ = is the CO_2 emission coefficient of fuel type I in year y (tCO_2/mass or volume unit);
i = Are the fuel types combusted in process j during the year y.

Option B was chosen to determine the CO_2 emission coefficient due to availability of data.

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

Where:
$COEF_{i,y}$ = is the CO_2 emission coefficient of fuel type I in year y (tCO_2/mass or volume unit);
$NCV_{i,y}$ = Is the weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit);
$EF_{CO2,i,y}$ = Is the weighted average CO_2 emission factor of the fuel type i in year y (tCO_2/GJ);
i = Are the fuel types combusted in process j during the year y.

Leakage:
Leakage is not applicable in accordance with the methodology /03/.

Emission Reduction

Emission reductions are calculated as follows:

$ER_y = BE_y – PE_y$,

Where:
ER_y = Emission reductions in year y (tCO_2e/yr);
BE_y = Baseline emissions in year y (tCO_2e/yr);
PE_y = Project emissions in year y (tCO_2e/yr).

Year	Baseline emissions ($t\ CO_2e$)	Project emissions ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions ($t\ CO_2e$)
2018	126,046	384	0	125,662
2019	260,555	190	0	260,365
2020	267,731	0	0	267,731
2021	273,943	0	0	273,943
2022	279,414	0	0	279,414
2023	284,300	0	0	284,300
2024	222,941	0	0	222,941
2025	89,916	0	0	89,916
Total	**1,804,846**	**574**	**0**	**1,804,272**

	Total number of crediting years	**7**			
	Annual average over the crediting period	**257,835**	**82**	**0**	**257,753**
	*Since 01/07/2018 until 30/06/2025				
Findings	**CAR 2**: PDD does not describe/provide evidences of the parameter SPECflare for the enclosed flares of the project activity. To close CAR 2 the evidences were provided. **CL 5**: PP is requested to clarify the use of ex-ante parameter $\boldsymbol{NCV_{CH4}}$ described in the section B.6.2. To close CL 5, PDD was revised. **CL 6**: paragraph 34 of the updated methodology is not correctly described in the revised PDD. To close CL 6, PDD was revised. **CL 7**: During the onsite visit it was not clear the option chosen to determine the flare efficiency in the case of installation enclosed flares. To close CL 7, flare efficiency method was described in the revised PDD. **CL 8**: PP is requested to provide the evidences for the historic amount of waste received. To close CL 8, evidence was provided. **CL 9**: PDD describes that $F_{CH4,BL,y}$= $F_{CH4, sent\_flare,y}$, however, project activity does not comply with paragraph 46 of the methodology (amount of methane captured with the existing system can be monitored separately from the amount captured under the project). To close CL 9, PDD was revised in accordance with the methodology. **CL 10**: PP is requested to provide the evidences for the energy generation estimative and load factor. To close CL 10, evidences were provided. **CAR 3**: Data for the emission factor is not consistent through the revised PDD (year, value and data vintage for the Building margin). To close CAR 3, data for the emission factor was correctly revised in the last version of the PDD. **CAR 4**: Sections B.6.1, B.6.3 and B.7 are not coherent for project emissions from fossil fuel consumption. To close CAR 4, PDD was correctly revised. **CL 11**: formula for project emissions are not in accordance with the applied methodology (paragraph 65). Moreover, PP is requested to clarify the project emissions from electricity consumption estimated as zero during the crediting period. To close CL 11, revised PDD presents formula in accordance with the methodology.					
Conclusion	It is RINA's opinion: (a) All assumptions and data used by the PP are listed in the PDD; (b) All documentation used by the PP as the basis for assumption and source of data is correctly quoted and interpreted in the PDD /01/ (please, refer to the documents described in Appendix 3); (c) All values used in the PDD and CERs spreadsheet. including GWPs are considered reasonable in the context of the proposed project activity /10/; (d) The baseline methodology and methodological tools have been applied correctly to calculate project emissions, baseline emissions, leakage and emission reductions; /01/ /02/ /06/ /08/ /09/ /10/ /12/ /14/ /15/ /16/ /17/ /18/ /19/ /20/ /21/ /22/; (e) All estimates of the baseline and project emissions can be replicated using the data and parameters values provided in the PDD and CERs spreadsheet.					

D.5. Validity of monitoring plan

Means of validation	The approved baseline and monitoring ACM0001 "Flaring or use of landfill gas" version 19 of 14/06/2019 /06/ has been applied. **Parameters monitored ex-post** The assessment of the ex-post parameters are described in the table below:

Parameter	Description/Assessment
$EF_{grid,CM,y}$ (tCO2/MWh) CO_2 emission factor of the Brazilian grid electricity during the year y	Value applied: 0.2401. RINA verified that it is considered the latest data provided by the Brazilian DNA /31/. The detailed calculations of the combined margin emission factor are described in section D.4.
$EF_{grid,OM,y}$ (tCO2/MWh) Operating margin emission factor of the Brazilian grid	Value applied: 0.5390. RINA verified that it is considered the latest data provided by the Brazilian DNA /31/. The detailed calculations of the Operating margin emission factor are described in section D.4.
$TDL_{,y}$ (-).Average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.	Value applied: 16%. World Bank Database (15.775% for 2014 is the most recent data. It was adopted 16%) /40/. Monitoring frequency: Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years. TDLj/k/l,y should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation.
$EC_{PJ1,y}$ = $EG_{EC1,y}$ (MWh) Quantity of electricity consumed from the grid by the project activity during the year y	Value applied for the ex-ante calculation: 1,377MWh for the year 2018 and 679 MWh for the year 2019, when the power plant is not installed. Parameter will be continuously measured by electricity meters for the grid electricity consumption. In the section B.7.3 it is described: All the measurement instruments will be subject to regular calibration as per manufacturer's specifications.
$EC_{PJ2,y}$ = $EG_{EC2,y}$ (MWh/y) Quantity of electricity consumed from diesel generator by the project activity during the year y	Value applied for the ex-ante calculation: 0 (it is not forecast electricity consumed from diesel generator; however, it will be monitored during the crediting period. Parameter will be continuously measured by electricity meters for the diesel electricity consumption. In the section B.7.3 it is described: All the measurement instruments will be subject to regular calibration as per manufacturer's specifications.
Management of SWDS	Value applied: not applicable. Project participants

		(-).	should refer to the original design of the landfill to ensure that any practice to increase methane generation have been occurring prior to the implementation of the project activity. Any change in the management of the SWDS after the implementation of the project activity should be justified by referring to technical or regulatory specifications. Monitoring frequency: annually.
		$NCV_{diesel,y}$ (GJ per mass (GJ/ton))= Weighted average net calorific value of fossil fuel i in year y	Value applied: 46.71. (The value was based on Brazilian Database). Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
		$NCV_{LPG,y}$ (GJ per volume (GJ/m^3))= Weighted average net calorific value of fossil fuel i in year y	Value applied: 0.106. (The value was based on fuel supplier). Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
		$EF_{CO2,LPG,y}$ (tCO_2/GJ). Weighted average CO_2 emission factor of LPG in year y	Value applied: 0.0656. (IPCC 2006). Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
		$FC_{i,j,y}$ (m^3/year). Quantity of LPG combusted in flare ignition system during year y.	Ex ante value not applicable however, it will be monitored during the crediting period. Parameter will be continuously measured by volumetric meter. The metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
		$EG_{PJ,y} = EC_{BL,k,y}$ (MWh) Amount of electricity generated using LFG by the project activity in year y	Value applied: 33,960 in 2021. Parameter will be monitored continuously by electricity meter that will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company.
		$Op_{j,h}$ (-).Operation of the equipment that consumes the LFG.	Value applied: not applicable for the ex ante estimative (RINA verified that it is accordance with the applied methodology). For each equipment unit j using the LFG monitor that the plant is operating in hour h by the

			monitoring any one or more of the following three parameters: (a) Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer's specifications of the burning equipment. Document and justify the location and minimum threshold in the PDD; (b) Flame. Flame detection system is used to ensure that the equipment is in operation; (c) Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnances. This option is not applicable to brick kilns. Opj,h=0 when: (a) One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); (b) Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); (c) No products are generated in the hour h. Otherwise, Opj,h=1
		$V_{t,db}$ (m^3 /h). Volumetric flow of the gaseous stream in time interval *t* on a dry basis. ***$V_{t,wb}$*** (m^3 /h). Volumetric flow of the gaseous stream in time interval *t* on a wet basis.	Value applied: Not used for ex-ante calculation. Data is measured continuously by a flow meter and hourly aggregated. The volumetric flow rate of the residual gas which is sent to each individual flare, LFG engines in the hour h will be measured by the installed flow meters with digital recordable electronic signal, according to the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" /15/ to calculate $F_{CH4,flared,y}$, $F_{CH4,EL,y}$.: • Option (A) dry basis: when the temperature of gaseous stream is lower than 60ºC (333.15 K) at the flow measurement point; • Option (B) wet basis: when the temperature of gaseous stream is higher than 60ºC (333.15 K) at the flow measurement point. Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. The calibration frequency of this monitoring equipment should be in accordance with manufacturer's specifications.
		$V_{i,t,db}$= (m^3 gas i/m^3 dry gas). Volumetric fraction of greenhouse gas i in a time interval t on a dry basis **$V_{i,t,wb}$=** (m^3 gas i/m^3 wet gas). Volumetric fraction of greenhouse gas i in a time interval t on a wet basis	Value applied: 50% for the CH_4. Data is measured continuously by a gas analyzer. This parameter will be monitored $F_{CH4,flared,y}$, $F_{CH4,EL,y}$ in dry or wet basis. Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
		Tt (K): Temperature of the gaseous stream in time interval t.	Value applied: not applicable. Temperature will be measured continuously by Thermoresistance with digital recordable electronic signal will be

			used. The accuracy and uncertainty of the monitoring instrument will be in accordance with manufacturer specifications. Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, this parameter must be monitored continuously to assure the applicability condition. In the section B.7.3 it is described: All the measurement instruments will be subject to regular calibration as per manufacturer's specifications.	
		Pt (Pa): Pressure of the gaseous stream in time interval t	Value applied: not applicable. Instruments with recordable electronic signal (analogical or digital) are required. Examples include pressure transducers, etc. Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly. In case the pressure meter is not a capacitive or resistive pressure transducer, the calibration frequency of this monitoring equipment should be according to the manufacturer's specifications. Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency).	
		Status of biogas destruction device (-): Operational status of biogas destruction devices	Monitoring and documenting may be undertaken by recording the energy production from methane captured or the operation of the flare by means of a flame detector to demonstrate the actual destruction of methane, unless a different method is specified in the underlying methodology/tool. Emission reductions will not accrue for periods in which the destruction device is not operational.	
		$P_{H2O,t,Sat}$ (Pa): Saturation pressure of H_2O at temperature Tt in time	This parameter is solely a function of the gaseous stream temperature Tt and for a total pressure equal to 101,325 Pa in accordance with the reference inside the Tool to determine the mass flow of a greenhouse gas in a gaseous stream /15/.	
		Flame$_m$ (Flame on or Flame off). Flame detection of flare in the minute *m*.	Value applied: not applicable. Measurements by project participants using a continuous Ultra Violet flame detector. Monitoring frequency: Once per minute. Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations.	
		$Maintenance_y$ (calendar dates). Maintenance events completed in year y	Record the date that maintenance events were completed in year y. Records of maintenance logs must include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced, or needing to be replaced, source of replacement parts, serial	

	numbers and calibration certificates. In accordance with maintenance program, there is daily inspection at the flare.
$T_{EG,m}$ (ºC): Temperature in the exhaust gas of the enclosed flare in minute m	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. Data will be recorded continuously and values will be averaged hourly or at a shorter time interval.
$v_{i,RG,m}$ (-): Volumetric fraction of component i in the residual gas on a dry basis in the minute	Ex ante value not applicable. Measurement may be made on either dry or wet basis. If value is made on a wet basis, then it shall be converted to dry basis for reporting. Data will be continuously monitored, values to be averaged on a minute basis. Measurement may be made on either dry or wet basis. If value is made on a wet basis, then it shall be converted to dry basis for reporting. Analysers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas
$V_{RG,m}$ (m³) Volumetric flow of the residual gas on a dry basis at reference conditions in the minute m	Ex ante value not applicable. Measurements by project participants using a flow meter. Data will be continuously monitored, values to be averaged on a minute basis. Flow meters are to be periodically calibrated according to the manufacturer's recommendation
$M_{RG,m}$ (kg) Mass flow of the residual gas on a dry basis at reference conditions in the minute m	Ex ante value not applicable. Instruments with recordable electronic signal (analogical or digital). Data will be continuously monitored, values to be averaged on a minute basis. Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
$v_{O2,EG,m}$ (-)Volumetric fraction of O2 in the exhaust gas on a dry basis at reference conditions in the minute m	Ex ante value not applicable. Measurements by project participants using a continuous gas analyser. Data will be continuously monitored, values to be averaged on a minute basis. Analysers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard gas
$fc_{CH4,EG,m}$ (mg/m3) Concentration of methane in the exhaust gas of the flare on a dry basis at reference conditions in the minute m	Ex ante value not applicable. Measurements by project participants using a continuous gas analyser. Data will be continuously monitored, values to be averaged on a minute basis. Analysers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard gas

Management system and quality assurance

An onsite inspection has been performed on 19/09/2018 and it is confirmed that the monitoring arrangements in the monitoring plan are feasible within the project design. The monitoring is based only on data measured. PDD describes that all the measurement instruments will be subject to regular calibration as per manufacturer's specifications. Also, for calibration, CDM project standard for project activities Version 2, paragraph 79 (d) will be used. Thus, the project participants shall apply

	the following unless the applied methodologies, the applied standardized baselines or the other applied methodological regulatory documents state otherwise: (d) The calibration of measuring equipment shall be carried out by an accredited person or institution. PDD describes that Data monitored and required for verification and issuance are kept and archived for at least two years after the end of the final crediting period or the last issuance of CERs, whichever occurs later.
Findings	**CL 12**: data used for the parameter TDL is not the most recent one available. To close CL 12, data for the TD was updated. **CL 13**: PDD describes that the monitoring of the parameters $\boldsymbol{V_{t,db}}$ $\boldsymbol{V_{t,wb}}$ $\mathbf{V_{i,t,db}}$ $\mathbf{V_{i,t,wb}}$ is applied for determination of $F_{CH4,NG,y}$. To close CL 13, PDD was correctly revised. **CAR 5**: Section B.7.3 of the PDD is not updated in accordance with the requirements of updated methodology and tools. To close CAR 5, PDD was updated. **CAR 6**: PDD does not described the provisions to ensure that data monitored and required for verification and issuance are kept and archived for at least two years after the end of the final crediting period <u>or the last issuance of CERs</u>, whichever occurs later, in accordance with the requirements of project standard. To close CAR 6, PDD was correctly updated.
Conclusion	It is RINA's opinion that the monitoring plan is in accordance with the monitoring methodology; the monitoring plan will give opportunity for real measurement of achieved emission reductions. RINA has checked all the parameters presented in the monitoring plan against the requirements of the methodology and methodological tools; no deviations relevant to the project activity have been found in the plan. RINA confirms that the monitoring arrangements described in the monitoring plan, including the data management and quality assurance and quality control procedures, are feasible within the project design, and the means of implementation of the monitoring plan are sufficient to ensure the emission reductions achieved by/resulting from the proposed CDM project activity can be reported ex post and verified.

D.6. Crediting period

Means of validation	The third crediting period starts on 01/07/2018, in line with the end of the second crediting period. The notification of the intention to request a renewal of the crediting period was sent 180 days before the expiration of the second crediting period. /27/ /28/.
Findings	N/A
Conclusion	RINA confirmed that the second crediting period of the registered CDM project activity commences on the day immediately after the expiration of the current crediting period.

D.7. Project participants

Means of validation	The project participants described in the PDD are: Brazil: Haztec Technologia e Planejamento Ambiental S.A.
Findings	**CAR 7**: PP is requested to clarify the name of PP "Haztec" (technologia x tecnologia). In addition, PP Japan Iron and Steel Federation-JISF described in the revised PDD is withdrawn in the project page. Moreover, the PPs are not described in Appendix 1. To close CAR 7, PDD was revised considering the most recent information available in the project page in the UNFCCC web site.
Conclusion	RINA verified that the project participant included in the updated PDD is consistent with the name of the project participant in the project view page and MoCs updates in the UNFCCC page.

D.8. Post-registration changes

Type of post-registration changes (PRCs)	Confirmation (Y/N)	Validation report for PRCs	
		Version	Completion date
Temporary deviations from the registered monitoring plan, applied methodologies or applied standardized baselines	N		
Corrections	N		
Change to the start date of the crediting period of the project activity	N		
Inclusion of a monitoring plan	N		
Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools	N		
Changes to the project design	N		
Changes specific to afforestation and reforestation project activities	N		

SECTION E. Internal quality control

>> The final version of the validation opinion report before being submitted to UNFCCC is subjected to an independent internal technical review to confirm that all activities have been completed according to the pertinent RINA instructions.
The technical review is performed by a technical reviewer(s) qualified in accordance with RINA's qualification scheme for CDM validation and verification.

SECTION F. Validation opinion

>> RINA Service Spa (RINA) has performed a validation of the updated PDD for the project activity "Brazil NovaGerar Landfill Gas to Energy Project" in Brazil, CDM Registration Reference N° 0008. The validation of the updated PDD has performed for the third renewal crediting period (from 01/07/2018 to 30/06/2025) and is based on the information made available to us.

RINA has performed this validation in accordance with CDM validation and verification standard for project activities version 02.0 of 29/11/2018 and included an assessment of:

- An impact of new relevant national and/or sectoral policies and circumstances on the baseline taking into account relevant guidance from the Board with regard to renewal of the crediting period at the time of requesting renewal of crediting period:
- The correctness of the application of an approved baseline methodology for the determination of the continued validity of the baseline or its update, and the estimation of emission reductions for the applicable crediting period.

The review of the PDD version 6 of 29/07/2020 and the subsequent follow-up interviews have provided RINA with sufficient evidence to determine the validity of the original baseline scenario. The project correctly applies the baseline and monitoring methodology ACM0001 "Flaring or use of landfill gas" version 19 of 14/06/2019. The total emission reductions from the Brazil NovaGerar Landfill Gas to Energy Project are estimated to be on an average 257,753 tCO_2e per year over the selected 7 years renewable crediting period. The emission reduction forecast has been checked and it is deemed likely that the stated amount is achieved given that the underlying assumptions do not change.
It is RINA's opinion that the project "Brazil NovaGerar Landfill Gas to Energy Project" in Brazil meets all the relevant requirements for the renewal of the crediting period. Hence RINA requests the renewal of the crediting period of the project activity.

Appendix 1. Abbreviations

Abbreviations	Full texts
BE	Baseline Emissions
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CDM M&P	Modalities and Procedures CDM
CER(s)	Certified Emission Reduction(s)
CH_4	Methane
CL	Clarification Request
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CRT	Coordination and Technical Control Staff
DCI	Certification Division of RINA Services Spa
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
ER	Emission Reductions
FAR	Forward Action Request
GHG(s)	Greenhouse gas(es)
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
LoA	Letter of Approval
LPG	Liquefied Petroleum Gas
MoV	Means of Verification
MR	Monitoring Report
NGO	Non-governmental Organization
ODA	Official Development Assistance
PDD	Project Design Document
PE	Project Emission
PP(s)	Project Participant(s)
Ref.	Document Reference
RINA	RINA Services Spa
SS(s)	Sectoral Scope(s)
TA(s)	Technical Area(s)
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Validation and Verification Standard

Appendix 2. Competence of team members and technical reviewers

RINA

CERTIFICATO DI QUALIFICA
QUALIFICATION CERTIFICATE

Si attesta che il sig./sig.ra: *We declare that Mr/Mrs/Ms:*	**Thais DE LIMA CARVALHO**
è qualificato come[1]: *is qualified as:*	**CDM -TEC, -VAL, -VER, -TL ITRP, REG-EXP[2]**
per le seguenti aree tecniche: for the following technical areas:	**1.1, 1.2, 2.1, 13.1**

AREE TECNICHE *TECHNICAL AREAS*	DESCRIZIONE DELL'AREA TECNICA *TECHNICAL AREA DESCRIPTION*	SCOPO SETTORIALE *SECTORAL SCOPE*
1.1	Thermal energy generation	1
1.2	Renewables	1
2.1	Electricity distribution	2
13.1	Solid waste and wastewater	13

in accordo alle istruzioni della Divisione Certificazione.
in accordance with the instructions of the Certification Division.

REVISIONE *REVISION*	DATA *DATE*	MOTIVAZIONI PER LA REVISIONE *REASON FOR THE REVISION*
0	19-08-2009	-
13	31-03-2017	Added qualification as ITRP
14	20-07-2018	Added qualification as REG-EXP

Il Resp. CCPLS
Head of CCPLS

[1] Legend:

VAL:	Validator	CDM: Clean Development Mechanism
VER:	Verifier	VCS : Verified Carbon Standard:
TEC:	Technical Expert	GS: Gold Standard
TL:	Team Leader	SCS: SocialCarbon Standard
FIN-EXP:	Financial Expert	JI: Joint Implementation
DET:	Determiner	

[2] Argentina, Mexico, Panama, Colombia, Dominican Republic, Honduras, Ecuador, Chile, Cape Verde

RINA Services S.p.A. è accreditato da UNFCCC, quale Entità Operativa Designata (DOE), per condurre la Validazione e la Verifica di Progetti CDM, da VCSA per condurre la Validazione e la Verifica di Progett VCS, da GS Foundation, per condurre la Validazione e la Verifica di Progetti GS, da Ecologica Institute per condurre la Validazione e la Verifica di rapporti SCS

RINA Services S.p.A. is accredited by the UNFCCC, as Designated Operational Entity (DOE), to carry out Validation and Verification of CDM Projects, by the VCSA, to carry out Validation and Verification of VCS Projects, by the GS Foundation, to carry out Validation and Verification of GS Projects and by the Ecologica Institute, to carry out Validation and Verification of SCS Reports

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RINA

CERTIFICATO DI QUALIFICA
QUALIFICATION CERTIFICATE

Si attesta che il sig./sig.ra: *We declare that Mr/Mrs/Ms:*	**Mayra Rocha**
è qualificato come[1]: *is qualified as:*	**CDM-FIN EXP, CDM-TEC**
per le seguenti aree tecniche: for the following technical areas:	1.2

AREE TECNICHE **TECHNICAL AREAS**	**DESCRIZIONE DELL'AREA TECNICA** ***TECHNICAL AREA DESCRIPTION***	**SCOPO SETTORIALE** ***SECTORAL SCOPE***
1.2	Renewable Energy	1

in accordo alle istruzioni della Divisione Certificazione.
in accordance with the instructions of the Certification Division.

REVISIONE ***REVISION***	**DATA** ***DATE***	**MOTIVAZIONI PER LA REVISIONE** ***REASON FOR THE REVISION***
0	05-08-2015	First issue

Il Resp. QPT
Head of QPT

Roma Severino

[1] Legend:

VAL:	Validator	CDM: Clean Development Mechanism
VER:	Verifier	VCS : Verified Carbon Standard:
TEC:	Technical Expert	GS: Gold Standard
TL:	Team Leader	SCS: SocialCarbon Standard
FIN-EXP:	Financial Expert	JI: Joint Implementation
DET:	Determiner	

RINA Services S.p.A. è accreditato da UNFCCC, quale Entità Operativa Designata (DOE), per condurre la Validazione e la Verifica di Progetti CDM, da VCSA per condurre la Validazione e la Verifica di Progetti VCS, da GS Foundation, per condurre la Validazione e la Verifica di Progetti GS, da Ecologica Institute per condurre la Validazione e la Verifica di rapporti SCS

RINA Services S.p.A. is accredited by the UNFCCC, as Designated Operational Entity (DOE), to carry out Validation and Verification of CDM Projects, by the VCSA, to carry out Validation and Verification of VCS Projects, by the GS Foundation, to carry out Validation and Verification of GS Projects and by the Ecologica Institute, to carry out Validation and Verification of SCS Reports

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CERTIFICATO DI QUALIFICA
QUALIFICATION CERTIFICATE

Si attesta che il sig./sig.ra:
We declare that Mr/Mrs/Ms: **TEIXEIRA LEIROZ ANDREA**

è qualificato come[1]:
is qualified as: **TL, VAL, VER and TEC**

per le seguenti aree tecniche:
for the following technical areas: **1.1, 1.2, 5.1, 13.1, 13.2**

AREE TECNICHE TECHNICAL AREAS	DESCRIZIONE DELL'AREA TECNICA *TECHNICAL AREA DESCRIPTION*	SCOPO SETTORIALE *SECTORAL SCOPE*
1.1	Thermal Energy Generation	1
1.2	Renewables	1
5.1	Chemical industry	5
13.1	Solid waste and wastewater	13
13.2	Manure	13

in accordo alle istruzioni della Unità Certification Innovation and Sustainability.
in accordance with the instructions of the Certification Innovation and Sustainability Unit.

REVISIONE *REVISION*	DATA *DATE*	MOTIVAZIONI PER LA REVISIONE *REASON FOR THE REVISION*
0	17/09/2019	First Issue
1	15/11/2019	Update qualification with "Sampling and surveys for CDM PAs and PoAs"

Il Resp. CEINS
Head of CEINS

[1] Legend:

VAL:	Validator	CDM: Clean Development Mechanism
VER:	Verifier	VCS : Verified Carbon Standard:
TEC:	Technical Expert	GS4GG: Gold Standard For Global Goals
TL:	Team Leader	SCS: SocialCarbon Standard
FIN-EXP:	Financial Expert	JI: Joint Implementation
DET:	Determiner	

RINA Services S.p.A. è accreditato da UNFCCC, quale Entità Operativa Designata (DOE), per condurre la Validazione e la Verifica di Progetti CDM, da VCSA per condurre la Validazione e la Verifica di Progetti VCS, da GS Foundation, per condurre la Validazione e la Verifica di Progetti GS, da Ecologica Institute per condurre la Validazione e la Verifica di rapporti SCS

RINA Services S.p.A. is accredited by the UNFCCC, as Designated Operational Entity (DOE), to carry out Validation and Verification of CDM Projects, by the VCSA, to carry out Validation and Verification of VCS Projects, by the GS Foundation, to carry out Validation and Verification of GS4GG Projects and by the Ecologica Institute, to carry out Validation and Verification of SCS Reports

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RINA

CERTIFICATO DI QUALIFICA
QUALIFICATION CERTIFICATE

Si attesta che il sig./sig.ra:
We declare that Mr/Mrs/Ms: **Champok BURAGOHAIN**

è qualificato come[1]:
is qualified as: **CDM –TEC, -VAL, -VER, -TL ITRP, REG-EXP[2]**

per le seguenti aree tecniche:
for the following technical areas: **1.1, 1.2, 2.1, 13.1, 13.2**

AREE TECNICHE TECHNICAL AREAS	DESCRIZIONE DELL'AREA TECNICA *TECHNICAL AREA DESCRIPTION*	SCOPO SETTORIALE *SECTORAL SCOPE*
1.1	Thermal energy generation	1
1.2	Renewables	1
2.1	Electricity distribution	2
13.1	Solid waste and wastewater	13
13.2	Manure	13

In accordo alle Istruzioni dell'unità Certificazione, Innovazione e sostenibilità.
In accordance with the instructions of the. Head of Certification Innovation & Sustainability Unit

REVISIONE *REVISION*	DATA *DATE*	MOTIVAZIONI PER LA REVISIONE *REASON FOR THE REVISION*
0	19-01-2011	-
13	10-10-2019	Update qualification as TEC in TA 1.1

Il Resp. CEINS
Head of CEINS

[1] Legend:

VAL: Validator
VER: Verifier
TEC: Technical Expert
TL: Team Leader
FIN-EXP: Financial Expert
DET: Determiner

CDM: Clean Development Mechanism
VCS : Verified Carbon Standard:
GS: Gold Standard
SCS: SocialCarbon Standard
JI: Joint Implementation

[2] India, Nepal, Sri Lanka, Thailand, Indonesia, Vietnam.

RINA Services S.p.A. è accreditato da UNFCCC, quale Entità Operativa Designata (DOE), per condurre la Validazione e la Verifica di Progetti CDM, da VCSA per condurre la Validazione e la Verifica di Progetti VCS, da GS Foundation, per condurre la Validazione e la Verifica di Progetti GS, da Ecologica Institute per condurre la Validazione e la Verifica di rapporti SCS

RINA Services S.p.A. is accredited by the UNFCCC, as Designated Operational Entity (DOE), to carry out Validation and Verification of CDM Projects, by the VCSA, to carry out Validation and Verification of VCS Projects, by the GS Foundation, to carry out Validation and Verification of GS Projects and by the Ecologica Institute, to carry out Validation and Verification of SCS Reports

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Appendix 3. Documents reviewed or referenced

No.	Author	Title	References to the document	Provider

1	Ecosecurities NovaGerar EcoEnergia Ltda	CDM-PDD for project activity "Brazil NovaGerar Landfill Gas to Energy Project" in Brazil	February 2004 (registered) 5.2 of 25/03/2014 (approved on 26/06/2014)	Project participant
2	Haztec Technologia e Planejamento Ambiental S.A.	CDM-PDD updated for the third crediting period "Brazil NovaGerar Landfill Gas to Energy Project".	version 1 of 18/07/2018 (crediting period renewal) version 3 of 14/11/2019 version 3 of 15/11/2019 version 4 of 26/11/2019 version 6 of 29/07/2020	Project participant
3	CDM Executive Board	CDM project cycle procedure for project activities	version 02.0 of 29/11/2018	Others
4	CDM Executive Board	CDM project standard for project activities	version 02.0 of 29/11/2018	Others
5	CDM Executive Board	CDM validation and verification standard for project activities	version 02.0 of 29/11/2018	Others
6	CDM Executive Board	CDM Executive Board: Baseline and monitoring methodology ACM0001 "Flaring or use of landfill gas"	version 19 of 14/06/2019	Others
7	CDM Executive Board	CDM-PDD-FORM: Project design document form, including its Attachment: Instructions for completing this form	Version 11.0 of 31/05/2019	Others
8	CDM Executive Board	CDM Executive Board: "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period'	version 03.0.1 of 02/03/2012	Others
9	CDM Executive Board	CDM Executive Board: Baseline and monitoring methodology ACM0001 "Consolidated baseline and monitoring methodology for landfill gas project activities "	Version 11 of 28/05/2009	
10	Haztec Technologia e Planejamento Ambiental S.A.	CERs spreadsheet "Novagerar 3rd CP CER Spreadsheet v1 2018 07 18 JAS.xls" "Novagerar 3rd CP CER Spreadsheet v2 2019 10 16 FES" "No PRC - Novagerar 3rd CP CER Spreadsheet v3 2020 07 03 JAS.xls"	Version 1 of 18/07/2018 Version 2 of 16/10/19 Version 3 of 03/07/2020	Project participant
11	MCTI-Brazilian DNA	Resolution number 8, that defines the grid for CDM project	26/05/2017	Others
12	CDM Executive Board	Emissions from solid waste disposal sites	version 08.0 of 04/05/2017	Others
13	IPCC	Fourth Assessment Report: Climate Change 2007, available in English at http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html	Assessed on 27/08/2018	Others
14	CDM	Project emissions from flaring	version 03.0	Other

	Executive Board		dated 28/03/2019	
15	CDM Executive Board	Tool to determine the mass flow of a greenhouse gas in a gaseous stream	Version 03.0 of 27/11/2015	Other
16	CDM Executive Board	Determining the baseline efficiency of thermal or electric energy generation systems	Version 02.0 of 27/11/2015	Others
17	CDM Executive Board	Tool to determine the remaining lifetime of equipment	version 01 of 16/10/2009	Others
18	CDM Executive Board	Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation	Version 03.0 of 22/09/2017	Others
19	CDM Executive Board	Combined tool to identify the baseline scenario and demonstrate additionality	Version 07.0 of 22/09/2017	Others
20	CDM Executive Board	Tool to calculate project or leakage CO2 emissions from fossil fuel combustion	Version 03 of 22/09/2017	Others
21	CDM Executive Board	Project and leakage emissions from transportation of freight	version 1.1.0, dated 23/11/2012	Others
22	CDM Executive Board	Tool to calculate the emission factor for an electricity system	Version 07.0 of 31/08/2018	Others
23	INMET	Data for the temperature and precipitation (Estação - 83743.xlsx)	Accessed on 19/09/2018	Others
24	Haztec Technologia e Planejamento Ambiental S.A.	Feasibility Study: Landfill Gas System Assessment May 2008 Adrianópolis.	05/2008	Others
25	Brazilian Goverment	Law number 12.305: “Politica Nacional de Residuos sólidos” (National Solid Waste Policy)	02/08/2010	Other
26	John Zink	Flare Specifications: John Zink Biogas Flare System.pdf.	-	PP
27	IBRD-Carbon Finance	Mail sent to UNFCCC with the intention to renewal the crediting period and UNFCCC confirmation on 03/01/2018	29/12/2017	PP
28	IBRD-Carbon Finance	CDM-RENN-FORM for the renewal crediting period of the project Brazil NovaGerar Landfill Gas to Energy Project	29/12/2017	PP
29	MCTI (Brazilian DNA)	Brazilian Resolution # 8 of 28/05/2008 defines the Brazilian Interconnected grid for CDM project, available at http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/cimgc/Comissao_Interministerial_de_Mudanca_Global_do_Clima__CIMGC.html	Accessed on 24/10/2017	Other
30	INEA	Operational license for the biogas station number IN044886 (LICENÇA DE OPERAÇÃO LO IN 044886_BIOGAS.pdf) Instalation license of the energy power plant number IN032974 (LI IN032974 - Biogás CTR-NI renovação.pdf)	Dated 08/05/2018 valid until 08/05/2023 Dated 29/12/2015 valid until 29/12/2018 Dated	PP

		Operational license of the landfill number IN018048 (LO IN018048.pdf) and renewal protocol (LO 018048 -Protocolo Requerimento Renovação LO 018048.pdf)	03/11/2011 valid until 03/11/2014; Protocol received on 03/07/2014	
31	MCTI (Brazilian DNA)	Emission factor for the grid, available in Portuguese at http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html	Accessed on 10/09/2018	Others
32	CETRES / GEOTECHIA	Waste characterization study, including Nova Iguaçu landfill- table 20 (Haztec_relatorio_1_COPPETEC.pdf)	09/2010	PP
33	Haztec Technologia e Planejamento Ambiental S.A. and BENG	Revised financial analysis spreadsheet Amend NovaGerar Cash Flow v1 2017 12 28 FES.xlsx Original NovaGerar Cash Flow 2004.xls Updated NovaGerar Cash Flow 2004 v1 2019 10 16 FES.xls	28/12/2017 (original – registration) 16/10/2019	PP
34	DNV	Validation report for the project activity "Brazil NovaGerar Landfill Gas to Energy Project"	03/09/2004	Others
35	AENOR	Validation report for the second crediting period renewal of the project activity "Brazil NovaGerar Landfill Gas to Energy Project	22/11/2011	Others
36	TUV Nord	Validation report for the post registration changes of the project activity "Brazil NovaGerar Landfill Gas to Energy Project	02/04/2013	Others
37		Historical data of the waste received in NovaGerar landfill	-	PP
38	IPEA	Research report: Waste Diagnosis Urban Solids available at: *http://www.ipea.gov.br/agencia/images/stories/PDFs/relatoriopesquisa/121009_relatorio_residuos_solidos_urbanos.pdf*	Accessed on 14/11/2019	Others
39	Haztec Technologia e Planejamento Ambiental S.A.	2019 10 11 - Informações geracao de energia_CTRNI.xls	-	PP
40	World Bank database	Brazilian historycal data for TDL https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS?end=2014&locations=BR&start=1971&view=chart.	Accessed on 14/11/2019	PP

Appendix 4. Clarification requests, corrective action requests and forward action requests

Table 1. CL from this validation

CL ID	1	**Section no.**	D.2	**Date:** 25/09/2018
Description of CL				
PP is requested to provide the evidences that the project activity does not reduce the amount of organic waste that would be recycled in the absence of the project activity, in accordance with the methodology requirements, described in Box 1 of the applied methodology				
Project participant response				**Date:** 14/11/2019
It was included in sections B.2. and D.2. the recycling panorama in Nova Iguaçu region and it is possible to state that recycling percentage in the project activity area is negligible.				
Documentation provided by project participant				
http://www.ipea.gov.br/agencia/images/stories/PDFs/relatoriopesquisa/121009_relatorio_residuos_solidos_urbanos.pdf *IPEA 2012 - Reciclagem NI.xlsx*				
DOE assessment				**Date:** 14/11/2019
PP has provided a public research from IPEA to demonstrate that a small amount od organic waste is recycled in Recife area. This CL is closed.				

CL ID	2	**Section no.**	D.3	**Date:** 25/09/2018
Description of CL				
In the PDD it is not clear the baseline scenario for the landfill gas (LFG) and energy (E) , in the Assessment of the validity of the current baseline for the next crediting period.				
Project participant response				**Date:** 14/11/2019
Included in Step 1: Assess the validity of the current baseline for the next crediting period, section B.4.				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019
Revised PDD describes the baseline scenario: baseline scenario of the project activity is the business as usual (BAU) scenario (passive venting system) and in the baseline scenario, electricity is being generated in existing and/or new grid-connected power plants, other than the project activity power plant. This CL is closed.				

CL ID	3	**Section no.**	D.3	**Date:** 25/09/2018
Description of CL				
Updated PDD does not consider the Assess whether the continuation of the use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which the renewal is requested (flaring and energy baseline)				
Project participant response				**Date:** 14/11/2019
Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested, included.				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019
PDD was revised accordingly. This CL is closed.				

CL ID	4	**Section no.**	D.3	**Date:** 25/09/2018
Description of CL				

Updated PDD describes that $EF_{grid,BM,y}$ will be monitored ex-post, not in line in the description in the section B.6.1. Moreover, the update of the parameters was not limited to the ones related to the emission factor, as described in the section B.4 of the updated PDD.	
Project participant response	**Date:** 14/11/2019
Amended.	
Documentation provided by project participant	
Revised PDD.	
DOE assessment	**Date:** 14/11/2019
PDD was correctly revised. This CL is closed.	

CL ID	5	**Section no.**	D.4	**Date:** 25/09/2018
Description of CL				
PP is requested to clarify the use of ex-ante parameter NCVCH4 described in the section B.6.2				
Project participant response				**Date:** 14/11/2019
Removed according to the project reality.				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019
Parameter was excluded from the revised PDD. This CL is closed.				

CL ID	6	**Section no.**	D.4	**Date:** 25/09/2018
Description of CL				
Paragraph 34 of the updated methodology is not correctly described in the revised PDD.				
Project participant response				**Date:** 14/11/2019
Item a, amended accordingly.				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019
PDD was revised in accordance with the methodology. This CL is closed.				

CL ID	7	**Section no.**	D.4	**Date:** 25/09/2018
Description of CL				
During the onsite visit it was not clear the option chosen to determine the flare efficiency in the case of installation enclosed flares.				
Project participant response				**Date:** 14/11/2019
According to Step 2: Determination of flare efficiency: *Since the project case is open flare, the flare efficiency in the minute m (ηflare,m) is 50% when the flame is detected in the minute m (Flamem), otherwise ηflare,m is 0%.*				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019
Revised PDD describes that an open flare is chosen and monitored parameters were included in the section B.7.1. 2nd round: As a consequence of the request for review received on 03/07/2020 this CAR was opened. PP is requested to review the option chosen to determine the flare efficiency considering the configuration of the plant without the changes proposed for the third crediting period PDD. In addition, PP is also requested to revise section B.7.1 of the PDD.				
Project participant response				**Date:** 23/07/2020
From the request for review received on 03/07/2020, since it becomes clear the understanding of the Paragraph 291 of CDM project cycle procedure for project activities version 02.0, PDD has been amended in order to remove all proposed post registration changes. Thus, the option chosen to determine the flare efficiency considering the configuration of the plant without the changes proposed for the third crediting period PDD is Option B.2 – Measurement of flare efficiency in each minute.				
Documentation provided by project participant				

DOE assessment	Date: 24/07/2020
PDD was correctly revised. This CL is closed.	

CL ID	8	Section no.	D.4	Date: 25/09/2018
Description of CL				
PP is requested to provide the evidences for the historic amount of waste received.				
Project participant response				**Date:** 14/11/2019
Sent to DOE. File: "RES 1 1 Informações de dados técnicos do projeto - Projeto MDL Novagerar (Nova Iguaçu).msg"				
Documentation provided by project participant				
DOE assessment				**Date:** 14/11/2019
PP provided the evidence and RINA was able to check that the values applied are correct. This CL is closed.				

CL ID	9	Section no.	D.4	Date: 25/09/2018
Description of CL				
PDD describes that FCH4,BL,y= FCH4, sent_flare,y, however, project activity does not comply with paragraph 46 of the methodology (amount of methane captured with the existing system can be monitored separately from the amount captured under the project)				
Project participant response				**Date:** 14/11/2019
As there is no monitored or historic data on the amount of methane that was captured in the year prior to the implementation of the project situation, then: $FCH4,BL,sys,y=0.2\times FCH4,PJ,y$ *Thus, CERs spreadsheet as well as PDD have been revised accordingly.*				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019
PDD was correctly revised. This CL is closed.				

CL ID	10	Section no.	D.4	Date: 25/09/2018
Description of CL				
PP is requested to provide the evidences for the energy generation estimative and load factor.				
Project participant response				**Date:** 14/11/2019
Revised CERs spreadsheet describes the sources of the energy generation estimative as well as the calculation of the Load Factor.				
Documentation provided by project participant				
Revised PDD and CERs spreadsheet.				
DOE assessment				**Date:** 14/11/2019
Revised CERs spreadsheet describes the sources of the energy generation estimative. Note: during the validation process, PP has provided an evidence used in the CERs estimative and financial analysis that the load factor considered is 0.92 (please, refer to the post registration report submitted with the renewal crediting period). This CL is closed.				

CL ID	11	Section no.	D.4	Date: 25/09/2018
Description of CL				
Formula for project emissions are not in accordance with the applied methodology (paragraph 65). Moreover, PP is requested to clarify the project emissions from electricity consumption during the crediting period.				
Project participant response				**Date:** 14/11/2019
Formula for project emissions amended. Project emissions from electricity consumption during the crediting period has been amended and considered for 2018 and 2019.				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019

Revised PDD presents formula in accordance with the methodology. This CL is closed.

CL ID	12	**Section no.**	D.5	**Date:** 25/09/2018
Description of CL				
Data used for the parameter TDL is not the most recent one available.				
Project participant response				**Date:** 14/11/2019
Amended				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019
PP updated data for the TDL, considering the World Bank Database (15.775% for 2014 is the most recent data. It was adopted 16%). This CL is closed.				

CL ID	13	**Section no.**	D.5	**Date:** 25/09/2018
Description of CL				
PDD describes that the monitoring of the parameters $V_{t,db}$ $V_{t,wb}$ $V_{i,t,db}$ $V_{i,t,wb}$ is applied for determination of $F_{CH4,NG,y}$.				
Project participant response				**Date:** 14/11/2019
Removed accordingly				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019
PDD was revised accordingly and information of determination $F_{CH4,NG,y}$ in the mentioned parameters were deleted. This CL is closed.				

Table 2. CAR from this validation

CAR ID	1	**Section no.**	D.3	**Date:** 25/09/2018
Description of CAR				
Updated PDD does not describe the relevant mandatory national and/or sectoral policies applicable to the project activity that came into effect after the submission of the project activity for validation (for both scenarios). Moreover, updated PDD describes a registration date not in accordance with registration date of the project activity described in the project page.				
Project participant response				**Date:** 14/11/2019
Date amended accordingly				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019
PDD was correctly revised. This CAR is closed.				

CAR ID	2	**Section no.**		**Date:** 25/09/2018
Description of CAR				
PDD does not does not describe/provide evidences of the parameter SPECflare for the enclosed flares of the project activity				
Project participant response				**Date:** 14/11/2019
SPECflare parameter not needed in case of open flares. Removed from PDD.				
Documentation provided by project participant				
Revised PDD.				

DOE assessment	Date: 14/11/2019
PP has removed the parameter in accordance with tool since the project activity uses an open flare. 2nd round: As a consequence of the request for review received on 03/07/2020 this CAR was opened. Since PP should consider the configuration of the plant without the changes proposed for the third crediting period PDD, PP is requested to review the parameters determined ex-ante considering the enclosed flare installed in the biogas plant.	
Project participant response	**Date:** 23/07/2020
From the request for review received on 03/07/2020, since it becomes clear the understanding of the Paragraph 291 of CDM project cycle procedure for project activities version 02.0, PDD has been amended in order to remove all proposed post registration changes.	
Documentation provided by project participant	
DOE assessment	**Date:** 23/07/2020
PDD was correctly revised. This CAR is closed.	

CAR ID	3	Section no.	D.4	Date: 25/09/2018
Description of CAR				
Data for the emission factor is not consistent through the revised PDD (year, value and data vintage for the Building margin)				
Project participant response				**Date:** 14/11/2019
Amended.				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019
PDD was correctly revised. This CAR is closed.				

CAR ID	4	Section no.	D.4	Date: 25/09/2018
Description of CAR				
Sections B.6.1, B.6.3 and B.7 are not coherent for project emissions from fossil fuel consumption.				
Project participant response				**Date:** 14/11/2019
Amended through the sections.				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019
PDD was correctly revised. This CAR is closed.				

CAR ID	5	Section no.	D.5	Date: 25/09/2018
Description of CAR				
Section B.7.3 of the PDD is not updated in accordance with the requirements of updated methodology and tools.				
Project participant response				**Date:** 14/11/2019
Amended				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 14/11/2019
Section B.7.3 of the PDD was revised accordingly. This CAR is closed.				

CAR ID	6	Section no.	D.5	Date: 25/09/2018
Description of CAR				
PDD does not described the provisions to ensure that data monitored and required for verification and issuance are kept and archived for at least two years after the end of the final crediting period <u>or the last issuance of CERs</u>, whichever occurs later, in accordance with the requirements of project standard.				
Project participant response				**Date:** 14/11/2019
Included in item 4, section B.7.3.				

Documentation provided by project participant	
Revised PDD.	
DOE assessment	**Date:** 14/11/2019
PP included the information in the revised PDD in accordance with requirements of project standard. This CAR is closed.	

CAR ID	7	**Section no.**	D.7	**Date:** 25/09/2018
Description of CAR				
PP is requested to clarify the name of PP "Haztec" (technologia x tecnologia). In addition PP Japan Iron and Steel Federation-JISF described in the revised PDD is withdrawn in the project page. Moreover, the PPs are not described in Appendix 1.				
Project participant response				**Date:** 14/11/2019
PPs list amended in accordance with https://cdm.unfccc.int/Projects/DB/DNV-CUK1095236970.6/view?cp=1				
Documentation provided by project participant				
-				
DOE assessment				**Date:** 14/11/2019
RINA verified that the PDD was revised. However, PPs are not described in accordance with UNFCCC website. PP from Spain was withdrawn as of 06/11/2019.				
Project participant response				**Date:** 15/11/2019
Withdrawn PP from Spain was removed form PDD accordlingy.				
Documentation provided by project participant				
Revised PDD.				
DOE assessment				**Date:** 15/11/2019
PP from Spain was removed in the revised PDD in accordance with UNFCCC website. This CAR is closed.				

Table 3. FAR from this validation

FAR ID	01	**Section no.**		**Date:** 28/07/2020
Description of FAR				
Refer to paragraph: Para 243 (a), CDM project standard for project activities, version 02.0 The PP has argued that the proposed increase in the installed capacity from 4.245 MW in the registered PDD to 16.93 MW is not within the control of the PP, the PP mentions that the company Nova Iguaçu Energia e GasRenovavel LTDA which is responsible for exploration, electricity generation and commercialization made investments related to power generation operations. It is however noted that the revised calculations to demonstrate that the project activity remains financially unattractive without CDM include inputs such as CAPEX on engines and operating costs related to operating the power plants in deriving net cash flows. The PP/DOE shall further justify how they have considered it appropriate to account for revenues and expenses not attributable by the project participant in demonstrating financial unattractiveness of the project activity.				
Project participant response				**Date:** DD/MM/YYYY
Documentation provided by project participant				
DOE assessment				**Date:** DD/MM/YYYY

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Document information

Version	Date	Description
03.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM validation and verification standard for project activities” (CDM-EB93-A05-STAN) and version 02.0 of the “CDM project cycle procedure for project activities” (CDM-EB93-A06-PROC); • Make editorial improvements.
02.0	31 October 2017	Revision to align with the requirements of the “CDM validation and verification standard for project activities” (version 01.0).
01.0	23 March 2015	Initial publication.

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