CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

SECTION A. General description of project activity

A.1. Title of the project activity:

Corpus/Araúna – Landfill Biogas Project.
Version: 04
02/03/2010

A.2. Description of the project activity:

The objective of this Project is to capture, destruct, and produce electricity, using the landfill gas (LFG) generated through the decomposition of the organic waste deposited in the Landfill. The project will involve investment in a LFG capture and destruction system as well as equipments for electricity generation.

The main components of the LFG are methane (CH_4) and carbon dioxide (CO_2), both Greenhouse Gases (GHG) according to the Kyoto Protocol. Electricity generation from LFG involves the destruction of CH_4, which leads to GHG emissions reduction.

Electricity generation from LFG will also create additional GHG emissions reductions, as a consequence of CO_2 emission avoidance that would have been produced if the electricity was generated from a non renewable source. Additionally, the project includes an enclosed flare that will destruct the surplus of the LFG not used for electricity generation, or all the LFG when or until power production is not operational.

Regarding LFG, the only obligation under actual Brazilian Law is passive venting to avoid the risk of explosion by the accumulation of LFG in the lower layers of the landfill. The systems that are commonly established are the passive venting systems, that do not have the efficiency to capture and destruct a significant amount of LFG.

During the crediting period the Project activity will avoid releasing into the atmosphere 15,299 tons of CH_4 by methane destruction. Apart from the avoided methane emissions, the project will also prevent the releasing into the atmosphere of 19,388 tons of CO_2e from the generation of energy using LFG as fuel, that will shift the consumption of energy from fossil sources of the national network. Total emission reductions are estimated in 339,137 tons of CO_2e over the 7 years crediting period.

The Corpus/Araúna Landfill Biogas Project has a strong social responsibility evidenced by cooperation in Educational Environmental Activities, as well as cooperating with the visitors at the landfill; As a summary we can say that this initiative will contribute to the environment through the burning of GHG, reducing the impacts of climate change, local air and water pollution, with the treatment of the leachate generated by the landfill, which will be stored in aerobic lagoons at the site, and exported to a private wastewater treatment plant,contributing to local development and using and training local workers.

The implementation of this Project activity incurs in financial costs, and since there are no laws to obligate LFG destruction, there are no reasons to believe that this project would be implemented without the Kyoto Protocol or the Clean Development (CDM).

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as Project participant (Yes/No)
Brazil (host)	ARAUNA – Energia e Gestão Ambiental Ltda. (Private Entity)	No
Brazil	CORPUS SANEAMENTO E OBRAS LTDA. (Private Entity)	

(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party (country) involved may or may not have provided its approval. At the time requesting registration, the approval by the Party(ies) involved is required.
Further contact information of project participants is provided in Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

The Corpus/Araúna – Landfill Biogas Project is located at a private landfill in the city of **Indaiatuba, São Paulo, Brazil.**

A.4.1.1. Host Party(ies):

Brazil

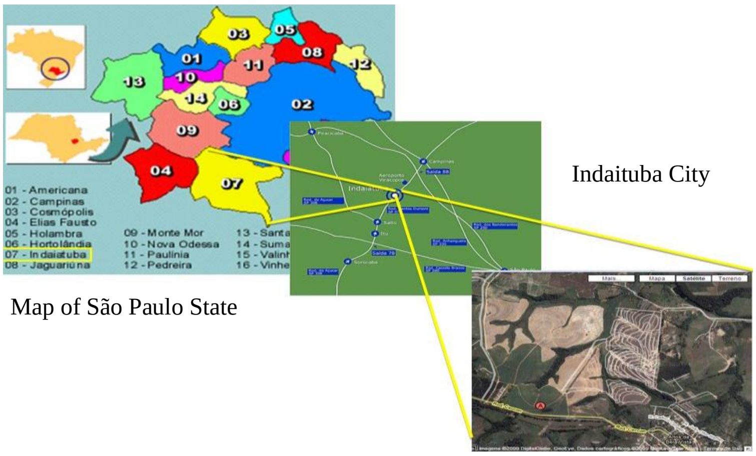
A.4.1.2. Region/State/Province etc.:

State of São Paulo, southeast region of Brazil.

A.4.1.3. City/Town/Community etc.:

Indaiatuba city.

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):



Indaiatuba City

Map of São Paulo State

Air view of the Landfill

Geographic coordinates
Location: -23° 05' 25" south latitude 47° 13' 05" west longitude

A.4.2. Category(ies) of project activity:

Waste Handling and Disposal – scope number 13.

A.4.3. Technology to be employed by the project activity:

The common practice in Brazil is the passive venting in which the LFG is usually burned directly in the top of the well, with incomplete combustion. The landfill object of this Project currently uses a passive venting with occasional flaring, thus most of the LFG produced escapes to the atmosphere.

The technology that will be used shall be a forced exhaustion system in which the LFG extraction is promoted by blowers. The collection efficiency could reach 75 %[1] or more in relation to the total LFG produced.

Moreover, the project activity will use an enclosed flare (see figure 01) and monitoring of compliance with the manufacturer's operation specifications of the flare in order to ensure at least a 90% efficiency of methane destruction.

[1] ABREU, Fernando Castro de; PECORA Vanessa, VELÁZQUEZ, Silvia e COELHO, Suani Teixeira**. Biogás de aterro para geração de eletricidade e Iluminação.** *USP – Universidade de São Paulo; IEE/CENBIO – Instituto de Eletrotécnica e Energia / Centro Nacional de Referência em Biomassa.* http://cenbio.iee.usp.br/download/projetos/aterro.pdf . Accessed on 2009.

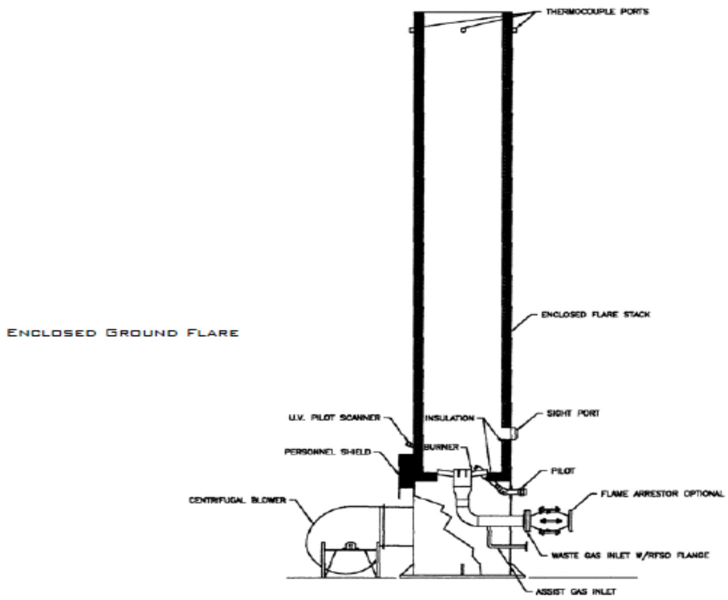


Figure 01: Model of an Enclosed Ground Flare

In order to maximize LFG recovery rates, and thus GHG emission reductions, an active LFG collection system will be installed. The system will consist of a series of vertical and/or horizontal extraction wells interconnected by pipes. The LFG will be extracted from the landfill by a blower and conducted to a single point for flaring and/or electricity production. The essential characteristics of the LFG collection, flaring and electricity generation system are listed below:

- Biogas capture:
  - Construction of vertical wells in intermediate or closed areas. Depending on future development plans, some horizontal wells might be installed, to capture the gas in areas still in operation;
  - Installation of a pipe network to connect the extraction wells, serving the blower/flare station with a specific diameter pipe, suitable for the anticipated flow rates.
  - Installation of a condensate management system. The LFG collection system will be designed to include self-draining condensate traps and condensate manholes with pumps where necessary;

- Biogas flaring:
  - Installation of the blower and flaring station;
  - Automated monitoring system;
  - Automated system controlling flare regulation , blower speed and alarm system in failure case;
  - Gas filtering and drying system which the collection system will go through to avoid excessive liquids in the blower, generator and flare;

- Electricity generation:
  - Generation Unit based on an internal combustion engine using LFG as fuel.

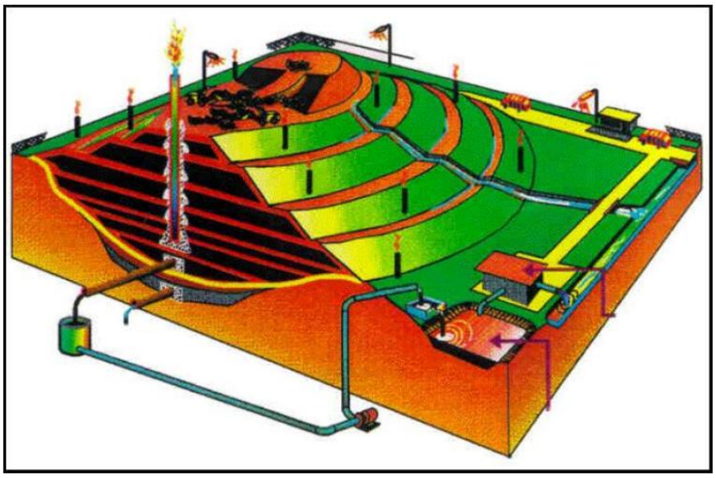


Figure 02: Biogas capture scheme

The technology to be used in the project activity is available in the Brazilian market, consisting basically of a vertical and/or horizontal drain system interconnected to the blower. These materials and equipments are available in Brazil, with the exception of an adequate electricity generation system.

Companies that design and build flares usually operate in wider markets such as combustion, landfill technology or environmental engineering, since the market generated by the CDM projects is still small. However, the interaction with Brazilian companies make noticeable the growing interest on this new market, which means that those projects are stimulating the capturing and flaring systems market. Also Global companies which manufacture many units per annum are interested on the Brazilian New market, which is definitely helping to improve the Brazilian knowledge on active landfill gas capturing.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

In the table below it is shown the crediting period and the estimated total amount of emissions reductions as well as the annual estimates for the chosen crediting period.

TABLE 01 – ANNUAL ESTIMATES OF EMISSIONS REDUCTION IN TONS OF CO_2e

Years	Annual estimates of emissions reduction in tons of CO2e
2010*	11,089
2011	39,131
2012	44,993
2013	48,192
2014	50,763
2015	52,876
2016	54,649
2017**	37,444
Total estimates reductions (in	339,137

tons of CO2e)	
Period of Crediting (years)	**7**
Annual Estimates of Reduction	**48.448**

*Starting at December 1st , 2010

**Ending the first period of credit on December31st 2017

A.4.5. Public funding of the project activity:

There is no public financing for this project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

Approved consolidated baseline methodology ACM0001 "Consolidated baseline and monitoring methodology for landfill gas project activities" Version 11 (Sectoral Scope: 13 – EB 47)

This methodology is applicable to landfill (LFG) gas capture project activities, where the baseline scenario is the partial or total atmospheric release of the gas and the project activities include situations such as:

a) The captured gas is flared; and/or
b) The captured gas is used to produce energy (e.g. electricity/thermal energy). Emission reductions can be claimed for thermal energy generation, only if the LFG displaces use of fossil fuel either in a boiler or in an air heater. For claiming emission reductions for other thermal energy equipment (e.g. kiln), project proponents may submit a revision to this methodology.
c) The captured gas is used to supply consumers through natural gas distribution network. If emissions reductions are claimed for displacing natural gas, project activities may use approved methodologies AM0053.

In addition, the applicability conditions included in the tools, subsequently referred to, also apply:

1. "Tool for the demonstration and assessment of additionality", version 05.2, EB 39;
2. "Tool to determine project emissions from flaring gases containing methane", EB 28;
3. "Combined tool to identify the baseline scenario and demonstrate additionality", version 2.2, EB 28;
4. "Tool to calculate the emission factor for an electricity system", version 2, EB 50;
5. "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site", version 04, EB 41;
6. "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", version 02, EB 41;
7. "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", version 01, EB 39.

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The Project activity consists in capture, destruction and generation of electricity through the gas produced by the decomposition of the solid waste disposed at the Corpus Landfill in Indaiatuba - SP.
As shown at Sub-step B.1, this methodology applies to the Project activity that in agreement with alternative requirements "a" and "b", in which the captured gas is burned and/or the captured gas is used to generate energy (e.g. electricity/thermal energy), respectively.

B.3. Description of the sources and gases included in the project boundary:

The project boundary is the site of the project activity where the gas is captured and destroyed/used.

If the electricity for the Project is provided by the grid or generated by the LFG that could have been produced by the power unit connected to the grid, the Project boundary shall include all electricity sources to which the grid is connected.

In order to determine the baseline emissions of the possible component of electricity generation of the project, the project boundary shall assess the emissions of CO_2 from electricity generation in power units using fossil fuel operating at the electricity network system, which will be replaced by the electricity generated in the project activity.

TABLE 02 – SUMMARY OF SOURCES AND GASES INCLUDED IN THE PROJECT BOUNDARY:

	Source	Gas	Included?	Justification/Explanation
Baseline	Emissions from decomposition of waste at the landfill site	CH_4	Yes	The major source of emissions in the baseline. The CH_4 is produced at the landfills.
		NO_2	No	N_2O emissions are small compared to CH_4 emissions from landfills. Exclusion of this gas is conservative.
		CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted
	Emissions from Electricity consumption	CO_2	Yes	Electricity may be consumed from the grid or generated onsite/offsite in the baseline scenario
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
	Emissions from thermal energy generation	CO_2	No	This project activity does not generate thermal energy, and does not intend to do it so in the future.
		CH_4	No	Excluded for simplification. This is conservative.
		NO_2	No	Excluded for simplification. This is conservative.
Project Activity	On-site fossil fuel consumption due to the project activity other than for electricity generation	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		NO_2	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from	CO_2	Yes	May be an important emission source

	Source	Gas	Included?	Justification/Explanation
	on-site electricity use	CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		NO_2	No	Excluded for simplification. This emission source is assumed to be very small.

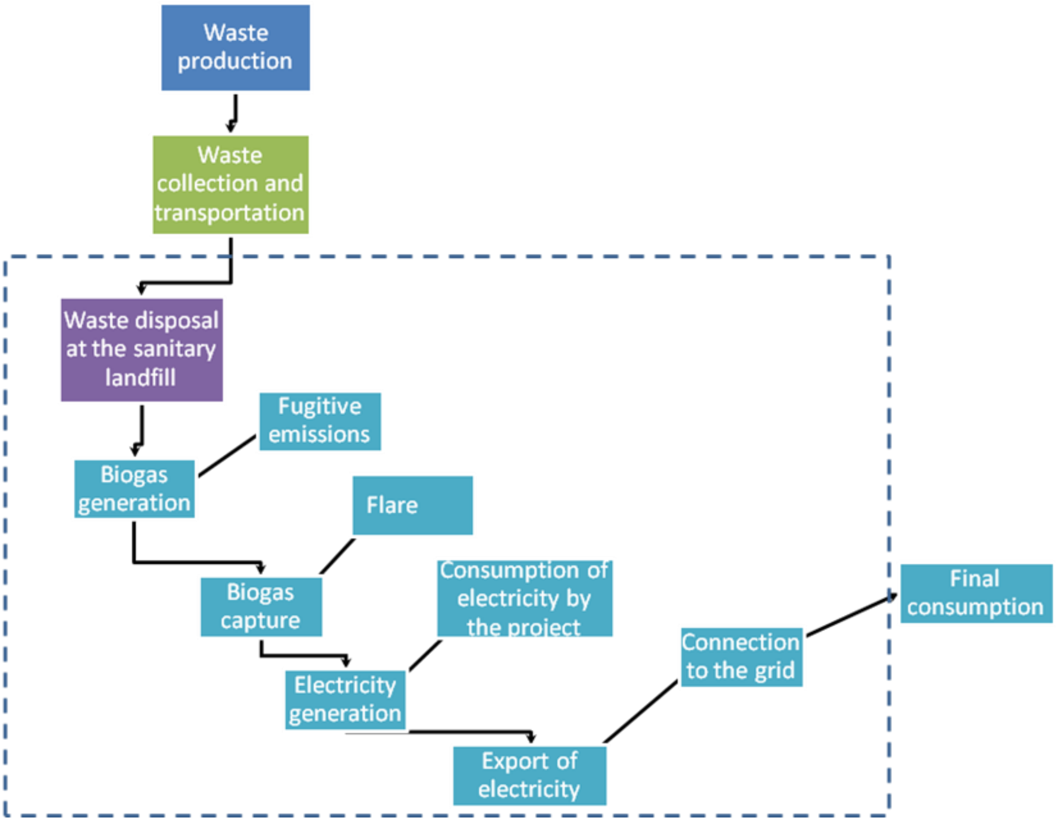


Figure 03: Biogas capture scheme

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

Procedure for the selection of the most plausible baseline scenario

STEP 1: IDENTIFICATION OF ALTERNATIVE SCENARIOS

According to the methodology project participants should use Step 1 of the latest version of the “Tool for the demonstration and assessment of additionality” (version 05.2, adopted at EB39), to identify all realistic and credible baseline alternatives. In applying such tool the outcome is given as follows.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Define realistic and credible alternatives to the project activity through the following sub-steps:

Sub-step 1a. Define alternatives to the project activity:

The alternatives to the disposal of the waste considered are:

LFG1. The project activity (i.e. capture of landfill gas and its flaring and/or its use to generate electricity) undertaken without being registered as a CDM project activity; and
LFG2. Partial capture of landfill gas and destruction to address safety and odor concerns.

Since there is no legislation obligating the landfill to destroy the methane, the landfill owner could continue the current business as usual: final disposal of solid waste with the practice of passive venting (i.e., not collecting and flaring) LFG directly to the atmosphere.

Project participants should use Step 1 of the latest version of the "Tool for the demonstration and assessment of additionality" (version 05.2, EB39), to identify all realistic and credible baseline alternatives. In doing so, relevant policies and regulations related to the management of landfill sites should be taken into account. Such policies or regulations may include mandatory landfill gas capture or destruction requirements because of safety issues or local environmental regulations. Other policies could include local policies promoting productive use of landfill gas such as those for the production of renewable energy, or those that promote the processing of organic waste. In addition, the assessment of alternative scenarios should take into account local economic and technological circumstances.

National and/or sectoral policies and circumstances must be taken into account in the following ways:

- In Sub-step 1b of the "Tool for the demonstration and assessment of additionality", the project developer must show that the project activity is not the only alternative that is in compliance with all regulations (e.g. because it is required by law);
- Via the adjustment factor AF in the baseline emissions project participants must take into account that some of the methane generated in the baseline may be captured and destroyed to comply with regulations or contractual requirements;
- The project participants must monitor all relevant policies and circumstances at the beginning of each crediting period and adjust the baseline accordingly.

Alternatives for the disposal/treatment of the waste in the absence of the project activity, i.e. the scenario relevant for estimating baseline methane emissions, to be analyzed should include, *inter alia*:

LFG1: The project activity (i.e. capture of landfill gas and its flaring and/or its use) undertaken without being registered as a CDM project activity;
LFG2: Atmospheric release of the landfill gas or partial capture of landfill gas and destruction to comply with regulations or contractual requirements, or to address safety and odor concerns.

If LFG is used for generation of electricity or heat to export to a grid and/or to a nearby industry or used on-site, realistic and credible alternatives should also be separately determined for:

- Power generation in the absence of the project activity;
- Heat generation in the absence of the project activity.

For power generation, the realistic and credible alternative(s) may include, *inter alia*:

P1: Power generated from landfill gas undertaken without being registered as CDM project activity;
P2: Existing or construction of a new on-site or off-site fossil fuel fired cogeneration plant;
P3: Existing or construction of a new on-site or off-site renewable based cogeneration plant;
P4: Existing or construction of a new on-site or off-site fossil fuel fired captive power plant;
P5: Existing or construction of a new on-site or off-site renewable based captive power plant;
P6: Existing and/or new grid-connected power plants.

For heat generation, the realistic and credible alternative(s) may include, *inter alia*:

H1: Heat generated from landfill gas undertaken without being registered as CDM project activity;
H2: Existing or Construction of a new on-site or off-site fossil fuel fired cogeneration plant;
H3: Existing or Construction of a new on-site or off-site renewable based cogeneration plant;
H4: Existing or new construction of on-site or off-site fossil fuel based boilers, air heaters or other heat generating equipment (e.g. kilns);
H5: Existing or new construction of on-site or off-site renewable energy based boilers, air heaters or other heat generating equipment (e.g. kilns);
H6: Any other source such as district heat; and
H7: Other heat generation technologies (e.g. heat pumps or solar energy).

Cogeneration plants are not realistic alternatives to Corpus/Araúna – Landfill Biogas Project, because there is no need for heat in the site or nearby facilities. Therefore, the alternatives H1 through H7 are excluded. The construction of a captive power plant is not a realistic alternative, because the national grid is actually connected to the landfill site. Therefore, alternatives P2, P3 for cogeneration are excluded; as well as alternative P4 for captive power plant is excluded.

The average annual consumption of energy is low, around 56 MWh/year. The revenue generated from the landfill biogas represents an estimated annual value of € 6.146, for a total of € 79.902 during the whole period of crediting, which does not justify the deployment of a captive power plant at the landfill. Thus the P5 option is not a realistic option for the project.

Sub-step 1b. Enforcement of applicable laws and regulations:

So far, there is no obligation for an efficient treatment of the LFG in Brazil, neither a national model governing landfill practices. There are only technical norms as provisioned by the Brazilian Association of Technical Norms (ABNT), without any requirement regarding LFG management. The only obligation to capture or burn the gas is due the high risk of explosion, what is achieved by passive LFG collection and venting.

A new National Waste Management Policy (*Política Nacional de Resíduos Sólidos*) is under discussion, but no change is foreseen for the next years. Even the project of such Policy does not specify when and how its legal requirements would be implemented. And it is unlikely to occur for the next years, since the landfills are in need for financial assistance from public and private sectors to operate and to comply with the basic requirements, such as monitoring, groundwater contamination prevention and leachate proper treatment.

All the alternatives listed above, which are to continue with the business as usual situation or implement the proposed CDM project activity without CDM incentives are consistent with Brazilian laws and regulations.

Outcome Step 1:

The alternatives to the disposal of the waste considered are:

LFG1. The project activity (i.e. capture of landfill gas and its flaring and/or its use to generated electricity) undertaken without being registered as a CDM project activity;
LFG2. Atmospheric release of the landfill gas or partial capture of landfill gas and destruction to comply with regulations or contractual requirements, or to address safety and odor concerns.

For power generation, the realistic and credible alternatives to Corpus/Araúna – Landfill Biogas Project are:

P1: Power generated from landfill gas undertaken without being registered as CDM project activity;
P6: Existing and/or new grid-connected power plants.

The possible alternatives are the combinations LFG1+P1 and LFG2+P6.

STEP 2: IDENTIFY THE FUEL FOR THE BASELINE CHOICE OF ENERGY SOURCE TAKING INTO ACCOUNT THE NATIONAL AND/OR SECTORAL POLICIES AS APPLICABLE.

As the used electricity comes from the Brazilian grid, it doesn't fit to accomplish a choice of the fuel, because the emission factor is determined as per " Tool to calculate the emission factor of an electric system". **As a consequence this step is not applicable.**

STEP 3: STEP 2 AND/OR STEP 3 OF THE LATEST APPROVED VERSION OF THE "TOOL FOR DEMONSTRATION AND ASSESSMENT OF ADDITIONALITY" SHALL BE USED TO ASSESS WHICH OF THESE ALTERNATIVES SHOULD BE EXCLUDED FROM FURTHER CONSIDERATION.

Step 2 – Investment Analysis of the "Tool for demonstration and assessment of additionality" is applied to assess the most plausible baseline alternative.

Step 2 - Investment analysis (Step 2 of the Tool)

Following ACM0001 baseline methodology, it must be determined whether the proposed project activity is not:

(a) The most economically or financially attractive; or
(b) Economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs) [2].

To conduct the investment analysis, the following sub-steps are used:

Sub-step 2a. Determine appropriate analysis method

[2] CER´s – Certified Emissions Reductions, herein that nomenclature will be used to represent the Certified Emission Reductions (CERs).

For the waste disposal and power generation alternative:

Alternative LFG1+ P1: the project activity undertaken without being registered as a CDM project activity; when considering the energy generation, does not generate any financial or economic benefit other than CDM related income. Therefore, the benchmark analysis (Option III) is applied.

Sub-step 2b. – Option I. Apply simple cost analysis **(waste disposal alternative)**

> *(2) Document the costs associated with the CDM project activity and the alternatives identified in Step 1 and demonstrate that there is at least one alternative which is less costly than the project activity.*

Option I does not apply to this project activity.

As the activity of electricity generation will create financial or economic benefits in addition to those related to the CDM activity, than an analysis of sub-step 2b option III is done, as follows:

Sub-step 2b: Option II. Apply investment comparison analysis

(3) Identify the financial indicator, such as IRR, NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/kWh or levelized cost of delivered heat in $/GJ) most suitable for the project type and decision-making context.

Option II does not apply to this project activity.

Sub-step 2b: Option III. Apply benchmark analysis **(power generation alternative*)***

(6) Discount and benchmark rates should derive from:
(a) Government Public Bonds, increased by an appropriate risk to reflect the private investment and/or the type of project, such as evidenced by an independent (financial) expert or documented by official financial data publicly available;

Indicator chosen to analyze the investments is the project internal return rate (IRR). It's understood that this parameter is more adequate to assess the value of the financial resources over time than the alternatives such as the method of cost benefit or the unit cost of service which are more indicated for social projects, which take into consideration subjective values.

Corpus/Araúna – Landfill Biogas Project has the possibility to generate power (electricity) in the future and export/sale to the grid, and the possible baseline scenario alternatives are:

> LFG1+P1. The project activity (i.e. capture of landfill gas and its flaring and/or its use to generated electricity) undertaken without being registered as CDM project activity and power generated from the landfill gas;
>
> LFG2+P6. Atmospheric release of the landfill gas or partial capture of landfill gas and destruction to comply with regulations or contractual requirements, or to address safety and odor concerns. The electricity is obtained from an existing and/or new grid-connected power plants.

For the alternative LFG1+P1, option III of the investment analysis is used to assess the attractiveness.

According to sub-step 2c the indicators used to the investment analysis shall be the market index ANDIMA (*National Association of Financial Market Institutions - Associação Nacional das Instituições do Mercado Financeiro*), for being national parameters for fundings for this type of project. Although, to be conservative it will be used the national market index of the BNDES (National Bank Of Economical and Social Development - Banco Nacional de Desenvolvimento Econômico e Social).

Sub-step 2c: Calculation and comparison of financial indicators

10. In cases where benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR.

The most appropriate benchmark for the abstraction of resources of the national market is the National Bank of Economic and Social Development (BNDES), through the credit line for investment in environmental projects, which is charged for direct support of the bank: Long Term Interest Rate - LTIR (TJLP) + BNDES remuneration + Rate of credit risk, what may reach a total of 10,72% p.y.[3]

The revenue received in the project is related to sales of CER´s (Certified Emission Reduction) and energy. The first has its price influenced by international market which showed a decline at the end of 2008 and early 2009 because of the international monetary crisis, but the prices now are moving up again signalized by European Stock Exchange[4], which on February 2nd, 2009 reached € 7,47 for contracts to December of 2010. On March 31st, 2009, the price reached € 11,00, what means a variation of almost 56% in the period observed. Due to this behavior the value given in the project shall be € 11,00, once the market for the reduction of emission is in a strong tendency of recovery.

As a reference for the selling prices of energy in the Brazilian Market in the 1st Auction of Alternative Sources, held in June 18th, 2007, the average price for the marketing of energy from biomass was 138,85 per R$/MWh, according to the Brazilian Chamber of Electric Energy Commercialization (CCEE)[5].

Moreover, the market for electricity appears to be more stable showing a final result for the 7th Auction[6] of new energy held on September 30th, 2008, and submitted a price for energy from bagasse from sugar

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[3] Considering the Long Term Interest Rate - LTIR (TJLP) of 6,25% p.y , according to Central Bank of Brazil + 0,9% p.y of remuneration of National Bank of Economic and Social Development (BNDES) + Rate of Credit risk up to 3,57 % p.y. Source: http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Areas_de_Atuacao/Meio_Ambiente/apoio_meio_ambiente.html

[4] Source: http://www.ecx.eu/index.php/CER-Futures

[5] Source: CCEE http://www.ccee.org.br/cceeinterdsm/v/index.jsp?contentType=RESULTADO_LEILAO&vgnextoid=2de4f87495bd1110VgnVCM1000005e01010aRCRD&qryRESULTADO-LEILAO-CD-RESULTADO-LEILAO=d92e3bbfb9543110VgnVCM1000005e01010a____&x=13&y=9

[6] Source: CCEE http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=9c3225accdb7c110VgnVCM1000005e01010aRCRD

cane, which fits into alternative energy or bioelectricity, a value of 145,00 per R$/MWh, what represents a 4,43% increase in the time period from June 2007 through September of 2008. Its equivalent price in Euro is € 48.17 in accordance with the exchange rate of 02/04/2009, which is 3,01 per R$/€[7]. The value used for the sale of energy will be € 48.17.

Based on the above values of reference, it will be shown the feasibility of the project by the economic indicators required by the "Tool for the demonstration and assessment of additionality" for a period of 14 years.

TABLE 04 – DEMONSTRATION OF ADDITIONALITY

Project IRR without CDM [8]	BNDES
-1,84 %	10,72%

Sub-step 2d. – Sensitivity Analysis

Specific Guidance on the Calculation of Project IRR and Equity IRR

*9. **Guidance:** The cost of financing expenditures (i.e. loan repayments and interest) should not be included in the calculation of project IRR.*
***Rationale:** The purpose of the project IRR calculation is to determine the viability of the project to service debt. Therefore to include the cost of financing as an expense in this calculation would result in a double counting of this cost in the ultimate analysis.*

Considering the above observations and analyzing the project with the reference values previously presented in the sub-step 2c, it appears that the most sensitive parameters in the financial analysis are the selling price of energy and the costs of initial investment.

For the **LFG1+P1** alternative (Power generated from landfill gas undertaken without being registered as CDM project activity) even with a 20% increase on the electricity selling price, unlikely to occur, the IRR would be 6,12% and bellow to the required benchmark, presented in sub-step 2c (see graphic 01).

Even reducing the initial investment in 20% the IRR would be 0,25%, which does not correspond to a realistic investment and bellow to the required benchmark, presented in sub-step 2c, as demonstrated in the graphic 01[9]:

> LFG1: The project activity (i.e. capture of landfill gas and its flaring and/or its use) undertaken without being registered as a CDM project activity; and
> P1: Power generated from landfill gas undertaken without being registered as CDM project activity;

[7] Source: http://www4.bcb.gov.br/pec/taxas/port/ptaxnpesq.asp?id=txcotacao&id=txcotacao
[8] Source:"Cálculo CER Indaiatuba, Spreadsheet Cash Flow LFG2 L6"

[9] The IRR energy curve change over below -9,61%, drawing back to zero due to a mistake generated by Excel, which does not calculate the variations below -10%.

Sensitivity analysis
*16. **Guidance:** Only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation (all parameters varied need not necessarily be subjected to both negative and positive variations of the same magnitude), and the results of this variation should be presented in the PDD and be reproducible in the associated spreadsheets. Where a DOE considers that a variable which constitute less than 20% have a material impact on the analysis they shall raise a corrective action request to include this variable in the sensitivity analysis.*
***Rationale:** The initial objective of a sensitivity analysis is to determine in which scenarios the project activity would pass the benchmark or become more favorable than the alternative.*

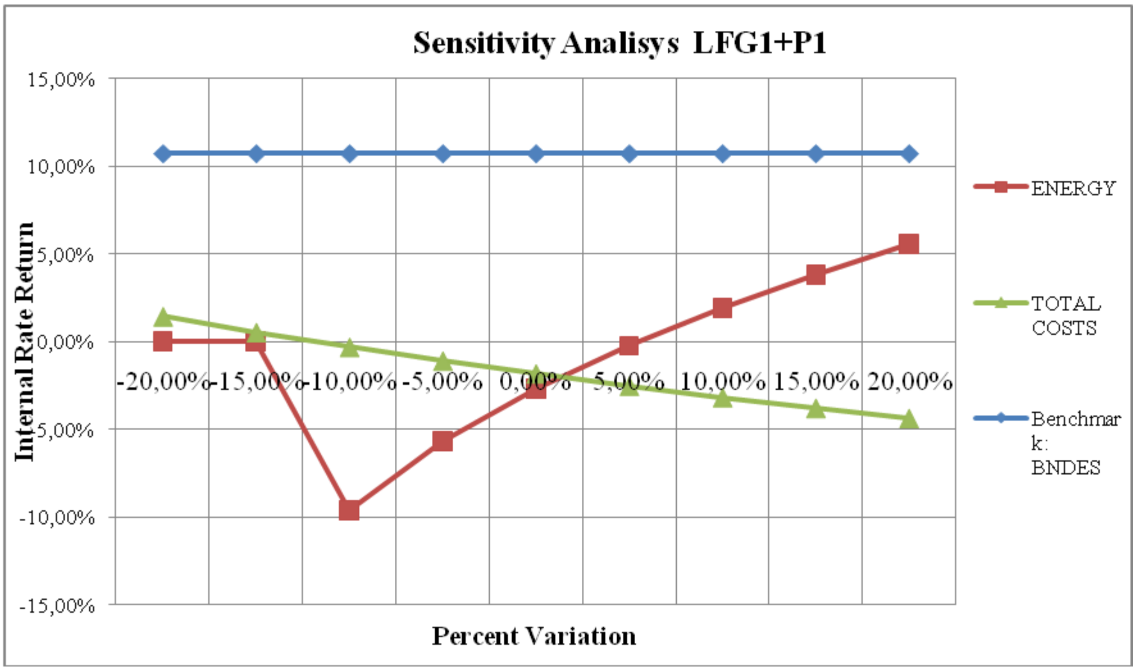
The point of balance of the project is obtained by varying the representative variables of the project: selling price of energy, the acquisition cost of LFG Genset and maintenance costs.

To achieve the same return rate of the reference energy price it should be sold with a increase of 35,70%, that is R$ 196,77 (€ 65,37) for an internal return rate of 10,73% while the value traded in Brazil from R$ 145 as shown in sub step 2C, thus is unlikely to obtain such marketing.

Applying a 82% discount on the cost of the generating set we obtain an Internal Return Rate of 10,70%, which is not plausible in the market.

In order to obtain an IRR of 10,73% it will be necessary a 78% reduction in maintenance costs from 23 €/MWh to 5,06 €/MWh, which does not represent a real cost for maintaining this type of equipment.

Graphic 01: Project's Sensitivity Analysis



STEP 4: WHERE MORE THAN ONE CREDIBLE AND PLAUSIBLE ALTERNATIVE REMAINS, PROJECT PARTICIPANTS SHALL, AS A CONSERVATIVE ASSUMPTION, USE THE ALTERNATIVE BASELINE SCENARIO THAT RESULTS IN THE LOWEST BASELINE EMISSIONS AS THE MOST LIKELY BASELINE SCENARIO. THE LEAST EMISSION ALTERNATIVE WILL BE IDENTIFIED FOR EACH COMPONENT OF THE BASELINE SCENARIO. IN ASSESSING THESE SCENARIOS, ANY REGULATORY OR CONTRACTUAL REQUIREMENTS SHOULD BE TAKEN INTO CONSIDERATION.

There is only one credible and plausible alternative to the project activity which is the continuation of the current operation conditions of the landfill.

Identified Baseline Scenario:

LFG2: Partial capture of landfill gas and destruction to comply with regulations requirements.
P6: Existing and/or new grid-connected power plants.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

The additionality of the project activity is demonstrated using the most recent version of the "*Tool for demonstration and assessment of additionality*" (version 5.2).

STEP 1 - IDENTIFICATION OF ALTERNATIVES TO THE PROJECT ACTIVITY CONSISTENT WITH CURRENT LAWS AND REGULATIONS

The identification of the alternatives is described in Section B.4, Step 1, and the outcome is as following:

The alternatives to the disposal of the waste considered are:
LFG1. The project activity (i.e. capture of landfill gas and its flaring and/or its use to generated electricity) undertaken without being registered as a CDM project activity; and
LFG2. Partial capture of landfill gas and destruction to address safety and odor concerns.

The project activity includes a possibility to use the recovered LFG to generate energy.

For power generation, the realistic and credible alternatives to Corpus/Araúna – Sanitary Landfill Project are:

P1: Power generated from landfill gas undertaken without being registered as CDM project activity;
P6: Existing and/or new grid-connected power plants.

Step 2. Investment analysis

The analysis is described in Section B.4, Step 3, and the outcome is that without carbon credit revenues, the project activity is not financially attractive; and the identified baseline scenario is the continuation of the actual situation as follows:

LFG2: Partial capture of landfill gas and destruction to address safety and odor concerns.
P6: Existing grid-connected power plants.

"*It is concluded that the proposed CDM project activity is more costly than at least one alternative then proceed to Step 4 (Common practice analysis)".*

Step 3. Barrier analysis

Not applied.

Step 4. Common Practice Analysis

Sub-step 4a: Analyze other activities similar to the proposed project activity

In São Paulo State, CETESB - Companhia de Tecnologia de Saneamento Ambiental, the environmental agency, has been acting towards closing dumps and forcing municipalities to give proper destination to the waste. That may be done through concessions to private entities either to build and operate sanitary landfills or to be responsible for the whole municipality's waste management. In all cases, however, active collection and flaring of the landfill gas has never been required.

According to the latest official statistics on urban solid waste in Brazil – *Pesquisa Nacional de Saneamento Básico 2000* (PNSB 2000) – the country produces 228.413 tons of waste per day[10], and population of Brazil is 169,799,170[11] which corresponds to 1,35 kg/person/day. And though there is a worldwide trend towards reducing, reusing and recycling, therefore decreasing the amount of urban solid waste to be disposed in landfills, the situation in Brazil is peculiar. A large part of the waste produced in the country is sent to open dumps which are, in most of the cases, areas without any sort of proper infrastructure to avoid environmental hazards.

In Brazil there are 8.381 final destinations of collected waste[12], 5.993 are open dump landfills, and 1.452 are sanitary landfills, that have no obligation to capture and flare the biogas. There are only 30 sanitary landfills CDM projects registered or under validation at UNFCCC, which demonstrates that the common practice in Brazil to the final destination of the waste is not necessarily to capture, flare and generate energy. Therefore, it´s evident the additionality of the project activity. The landfills, among the final destinations of the collected waste, have the best techniques and less environmental impacts to the final destination of collected waste, although the landfill owners are not obligated to capture and flare the biogas and generate electricity, as demonstrated by the Operational License of Indaiatuba Landfill.

In order to determine the common practice of the market regarding the flare of landfill gas, telephone interviews were conducted by selecting landfills with capacity of 160 to 250 tonnes per day, located in the state of São Paulo, based on the State Inventory Solid Waste 2008[13].

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[10] Source: Table 110 of PNSB 2000, http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/pnsb/lixo_coletado/lixo_coletado110.shtm

[11] Source Table 3 of PNSB 2000, http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/pnsb/pnsb.pdf

[12] Source: Table 109 of PNSB 2000, http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/pnsb/lixo_coletado/lixo_coletado109.shtm

[13] Source: Inventário Estadual de Resíduos Sólidos de 2008 available at http://www.cetesb.sp.gov.br/Solo/publicacoes.asp

It was identified that in 3 of the chosen municipalities there are CDM projects, in 4 of municipalities the landfills were closed, and while they were operating the biogas was vented to the atmosphere without being burned, and the remaining 3 do not perform the burning of biogas and has no CDM project activity.

Thus it is evident that the common practice is not to flare the biogas.

Sub-step 4b: Discuss any similar options that are occurring

As demonstrated this type of project activity is not widely spread in the host country and the landfills that operate this way represent only a small portion of the total existing landfills. In Brazil there are only 30 CDM project activities of sanitary landfills: 19 registered and 11 in validating process at UNFCCC.

The installation of a LFG capture and flaring system, are very costly for the landfill operator and result in no financial compensation. Therefore, this kind of project is only possible with CDM revenues and cannot be considered as an economically interesting activity.

Project Implementation Timelines

The company CORPUS SANEAMENTO E OBRAS LTDA. contracted Araúna to implement the landfill gas recovery and destruction project at the Corpus Landfill in Indaiatuba - SP, together with the registration as a CDM project.

The construction of the LFG capture and destruction system should be started when registered or 15 days after the registration of the CDM project at UNFCCC.

OUTCOME: Project activity is Additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The amount of landfill gas flared by the Project is estimated *ex-ante* using the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”. This *ex-ante* estimate is only for illustrative purposes, since actual emissions reductions will be monitored directly, ex-post, according to the methodology.

The formulae used to calculate emissions reductions are detailed below.

According to ACM0001, version 11, May 29th 2009, emissions reductions can be calculated using the following formula:

Baseline Emissions

$$BE_y = \left(MD_{project,y} - MD_{BL,y}\right) * GWP_{CH4} + EL_{LFG,y} \cdot CEF_{elec,BL,y} + ET_{LFG,y} * CEF_{ther,BL,y}$$

Equation 1

Where:

BE_y Baseline emissions in year y (tCO_2e)

$MD_{project,y}$ The amount of methane that would have been destroyed/combusted during the year, in tones of methane (tCH_4) in project scenario

$MD_{BL,y}$ The amount of methane that would have been destroyed/combusted during the year in the absence of the project due to regulatory and/or contractual requirement, in tones of methane (tCH_4)

GWP_{CH4} Global Warming Potential value for methane for the first commitment period is $21tCO_2e/tCH_4$

$EL_{LFG,y}$ Net quantity of electricity produced using LFG, which in the absence of the project activity would have been produced by power plants connected to the grid or by an onsite/ off-site fossil fuel based captive power generation, during year y, in megawatt hours (MWh).

$CEF_{elecy,BL,y}$ CO_2 emissions intensity of the baseline source of electricity displaced, in tCO_2e/MWh. This is estimated as per equation (9) below.

$ET_{LFG,y}$ The quantity of thermal energy produced utilizing the landfill gas, which in the absence of the project activity would have been produced from onsite/offsite fossil fuel fired boiler/air heater, during the year y in TJ.

$CEF_{ther,BL,y}$ CO_2 emissions intensity of the fuel used by boiler/air heater to generate thermal energy which is displaced by LFG based thermal energy generation, in tCO_2e/TJ. This is estimated as per equation (10) below.

In the case where the $MD_{BL,y}$ is given/defined in the regulation and/or contract as a quantity that quantity will be used. In situations where in the baseline LFG captured and destroyed, for reasons other than regulation and/or contract, historic data on actual amount captured shall be used as $MD_{BL,y}$.
In cases where regulatory or contractual requirements do not specify $MD_{BL,y}$ or no historic data exists for LFG captured and destroyed an “Adjustment Factor” (AF) shall be used and justified, taking into account the project context.

$$MD_{BL,y} = MD_{project,y} * AF$$

Equation 2

GUIDANCE ON ESTIMATING AF:

Step 1: Estimation of the destruction efficiency of the system

(a) In situations where measurements of the amount of methane that is destroyed in baseline scenario are available;
(b) In cases where measurements of the amount of methane that is destroyed are **not** available then the destruction efficiency of the system **mandated by regulatory or contractual requirements** (ε_{BL}) should be assumed.

a. In other cases, a procedure for estimating the amount of landfill gas that would be captured in absence of the project activity shall be **provided** in **the CDMPDD validated by the DOE**. This procedure shall be used to estimate the MD_{Hist} in equation 3 above to estimate the baseline destruction efficiency;

$$\varepsilon_{BL} = MD_{Hist} / MG_{Hist}$$

Equation 3

Where:

ε_{BL} = Destruction efficiency of the baseline system (fraction)
MD_{Hist} = Amount of methane destroyed historically measured for the previous year before the start of project activity (tCH_4)
MG_{Hist} = Amount of methane generated historically for the previous year before the start of project activity, estimated using the actual amount of waste disposed in the landfill as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"tCH_4)

(c) In cases where a specific percentage of the "generated" amount of methane to be collected and destroyed is **specified in the contract or mandated by regulations**, the efficiency of the baseline system (ε_{BL}) is equal to the defined specific percentage.

Step 2: Estimation of the destruction efficiency of the system used in the project activity

Option-1:
The destruction efficiency of the system used in the project activity is estimated once and remains fixed for the whole crediting period and will be estimated as follows:

$$\varepsilon_{PR} = MD_{project,1} / MG_{PR,1}$$

Equation 4

Where:

ε_{PR} = Destruction efficiency of the system used in the project activity that will remain fixed for the whole crediting period (fraction)
$MD_{project,1}$ = Amount of methane destroyed by the project activity during the first year of the project activity (tCH_4)
$MG_{PR,1}$ = Amount of methane generated during the first year of the project activity estimated using the actual amount of waste disposed in the landfill as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" (tCH_4)

Option-2:
The destruction efficiency of the system used in the project activity is estimated every year as follows:

$$\varepsilon_{PR,y} = MD_{project,y} / MG_{PR,y}$$

Equation 5

Where:

$\varepsilon_{PR,y}$ = Destruction efficiency of the system used in the project activity for year *y* (fraction)
$MD_{project,y}$ = Amount of methane destroyed by the project activity during the year *y* of the project activity (tCH_4).
$MG_{PR,y}$ = Amount of methane generated during year y of the project activity estimated using the actual amount of waste disposed in the landfill as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site", see further guidance in Step 1 (tCH_4).

Step 3: Estimation of the adjustment factor (AF)

If Option 1 is used in Step 2 then:

$$AF = \varepsilon_{BL} / \varepsilon_{PR} \qquad \textbf{Equation 6}$$

If Option 2 is used in Step 2 then:

$$AF_y = \varepsilon_{BL} / \varepsilon_{PR,y} \qquad \textbf{Equation 7}$$

Where:

AF_y = Adjustment factor for year *y*, this factor will be used in the equation below in place of AF.

$$MD_{BL,y} = MD_{project,y} * AF$$

NOTE: Option 2 will be used during the project activity.

DETERMINATION OF $MD_{project,y}$

$MD_{project,y}$ will be determined *ex post* by metering the actual quantity of methane captured and destroyed once the project activity is operational.

The methane destroyed by the project activity ($MD_{project,y}$) during a year is determined by monitoring the quantity of methane actually flared and gas used to generate electricity and/or produce thermal energy and/or supply to end users via natural gas distribution pipeline, if applicable, and the total quantity of methane captured.

The sum of the quantities fed to the flare(s), to the power plant(s), to the boiler(s)/air heater(s)/heat generating equipment(s) and to the natural gas distribution network (estimated using equation (3)) must be compared annually with the total quantity of methane generated. The lowest value of the two must be adopted as $MD_{project,y}$.

The following procedure applies when the total quantity of methane generated is the highest. The working hours of the energy plant(s) and the boiler(s) should be monitored and no emission reduction could be claimed for methane destruction in the energy plant or the boiler during non-operational hours.

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y} + MD_{PL,y} \qquad \textbf{Equation 8}$$

Where:

$MD_{project,y}$: the amount of methane that would have been destroyed/combusted during the year, in tones of methane (tCH_4)
$MD_{flared,y}$: is the quantity of methane destroyed by flaring
$MD_{electricity,y}$: is the quantity of methane destroyed by generation of electricity
$MD_{thermal,y}$: is the quantity of methane destroyed for the generation of thermal energy
$MD_{PL,y}$: Quantity of methane sent to the pipeline for feeding to the natural gas distribution network (tCH_4)

Determination of $MD_{flared,y}$

$$MD_{flared,y} = \left(LFG_{flare,y} \times w_{CH4,y} \times D_{CH4}\right) - \left(PE_{flare,y} / GWP_{CH4}\right) \quad \textbf{Equation 9}$$

Where:

$LFG_{flare,y}$: is the quantity of landfill gas flared during the year measured in cubic meters (m^3)
$w_{CH4,y}$: is the average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3CH_4/m^3LFG)
D_{CH4} : is the methane density expressed in tones of methane per cubic meter of methane (tCH_4/m^3CH_4)
$PE_{flare,y}$: are the project emissions from flaring of the residual gas stream in year y (tCO_2), determined following the procedure described in the “Tool to determine project emissions from flaring gases containing methane”;
GWP_{CH4} : Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4

Project emissions from flaring of the residual gas stream (PEflare,y) calculation is described hereinafter.

Determination of $MD_{electricity,y}$

$$MD_{electricity,y} = LFG_{electricity,y} \times w_{CH4,y} \times D_{CH4} \quad \textbf{Equation 10}$$

Where:

$LFG_{electricity,y}$: is the quantity of landfill gas fed into electricity generator

Determination of $MD_{thermal}$

$$MD_{thermal,y} = LFG_{thermal,y} \times w_{CH4,y} \times D_{CH4} \quad \textbf{Equation 11}$$

Where:

$LFG_{thermal,y}$: is the quantity of methane gas fed into the boiler/air heater/ heat generating equipment.

Determination of MD_{PL}

$$MD_{PL,y} = LFG_{PL,y} \times w_{CH4,y} \times D_{CH4} \quad \textbf{Equation 12}$$

Where:

LFG_{PLy} : is the quantity of landfill gas sent to pipeline for feeding to the natural gas distribution network.

DETERMINATION OF $MG_{PR,y}$ (for the AF calculation)

$MG_{PR,1}$ = Amount of methane generated during the first year of the project activity estimated using the actual amount of waste disposed in the landfill as per the latest version of the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” = $BE_{CH4,SWDS,y}$.

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1-e^{-k_j})$$

Equation 13

Where:

$BE_{CH4,SWDS,y}$: Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
φ : Model correction factor to account for model uncertainties (0,9)
f : Fraction of methane captured at the SWDS and flared, combusted or used in another manner
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)
F : Fraction of methane in the SWDS gas (volume fraction) (0,5)
DOC_f : Fraction of degradable organic carbon (DOC) that can decompose
MCF : Methane correction factor
$W_{j,x}$: Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
DOC_j : Fraction of degradable organic carbon (by weight) in the waste type *j*
k_j : Decay rate for the waste type *j*
j : Waste type category (index)
x : Year during the crediting period: x runs from the first year of the first crediting period (x =1) to the year y for which avoided emissions are calculated (x = y)
y : Year for which methane emissions are calculated

Where different waste types *j* are prevented from disposal, determine the amount of different waste types ($W_{j,x}$) through sampling and calculate the mean from the samples, as follows:

$$W_{j,x} = W_x \cdot \frac{\sum_{n=1}^{z} p_{n,j,x}}{z}$$

Equation 14

Where:

$W_{j,x}$: Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
W_x : Total amount of organic waste prevented from disposal in year *x* (tons)
$p_{n,j,x}$: Weight fraction of the waste type *j* in the sample *n* collected during the year *x*
z : Number of samples collected during the year *x*

DETERMINATION OF $CEF_{elec,BL,y}$

In case the baseline is electricity generated by plants connected to the grid the emission factor should be calculated according to “Tool to calculate the emission factor for an electricity system”.

Step 1. Identify the relevant electricity systems

“If the DNA of the host country has published a delineation of the project electricity system and connected

electricity systems, these delineations should be used.”

According to the tool, these delineations should be used. Brazilian DNA defined that there is only one interconnected grid for the whole country.

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

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.

Option II: Both grid power plants and off-grid power plants are included in the calculation.

“Option I corresponds to the procedure contained in earlier versions of this tool.”

Option I was chosen because only grid power plant calculation.

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

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:
(a) Simple OM; or
(b) Simple adjusted OM; or
(c) Dispatch data analysis OM; or
(d) Average OM.

Each method is described under Step 4.

The simple OM method (option a) can only be used if low-cost/must-run resource constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

The dispatch data analysis (Option d) cannot be used if off-grid power plants are included in the project electricity system as per Step 2 above.

Brazilian DNA has selected the dispatch data analysis Operating Margin, which requires hourly monitoring of the energy generation.

The dispatch data analysis OM (c) emission factor ($EF_{grid,OM-DD,y}$) is determined based on the grid power units that are actually dispatched at the margin during each hour h where the project is displacing grid electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of $EF_{grid,OM-DD,y}$.

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

(c) Dispatch data analysis OM

The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the grid power units that are actually dispatched at the margin during each hour *h* where the project is displacing grid 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 per "Tool to calculate the emission factor for an electricity system version2":

Brazilian DNA calculates the operating margin emission factor**.**

Step 5: Identify the group of power units to be included in the build margin

The sample group of power units m used to calculate the build margin consists of either:
(a) The set of five power units that have been built most recently, or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Project participants should use the set of power units that comprises the larger annual generation.

As a general guidance, a power unit is considered to have been built at the date when it started to supply electricity to the grid.

Step 6. Calculate the build margin emission factor

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

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

Equation 15

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available

Step 7. Calculate the combined margin emissions factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$
Equation 16

Where:
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM} = Weighting of operating margin emissions factor (%)
w_{BM} = Weighting of build margin emissions factor (%)

The following default values should be used for w_{OM} and w_{BM}:

• Wind and solar power generation project activities: w_{OM} = 0,75 and w_{BM} = 0,25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods.

• All other projects: w_{OM} = 0,5 and w_{BM} = 0,5 for the first crediting period, and w_{OM} = 0,25 and w_{BM} = 0,75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.

DETERMINATION OF *$CEF_{ther,BL,y}$*

$$CEF_{therm,BL,y} = \frac{EF_{fuel,BL}}{\varepsilon_{boiler/airheater} \cdot NCV_{fuel,BL}} \quad .$$
Equation 17

Where:

$\varepsilon_{boiler/air\ heater}$: the energy efficiency of the boiler/air heater used in the absence of the project activity to generate the thermal energy
$NCV_{fuel,BL}$: Net calorific value of fuel, as identified through the baseline identification procedure, used in the boiler/air heater to generate the thermal energy in the absence of the project activity in TJ per unit of volume or mass
$EF_{fuel,BL}$: Emission factor of the fuel, as identified through the baseline identification procedure used in the boiler/air heater to generate the thermal energy in the absence of the project activity in tCO_2/unit of volume or mass of the fuel

Project Emissions

$$PE_y = PE_{EC,y} + PE_{FC,j,y}$$
Equation 18

Where:

$PE_{EC,y}$ Emissions from consumption of electricity in the project case. The Project emissions from electricity consumption ($PE_{EC,y}$) will be calculated following the latest version of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". If in the baseline a part of LFG was captured then the electricity quantity used in calculation is electricity used in project activity net of that consumed in the baseline

$PE_{FC,j,y}$ Emissions from consumption of heat in the project case. The project emissions from fossil fuel combustion ($PE_{FC,j,y}$) will be calculated following the latest version of "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". For this purpose, the processes j in the tool corresponds to all fossil fuel combustion in the landfill, as well as any other on-site fuel combustion for the purposes of the project activity. If in the baseline part of a LFG was captured then the heat quantity used in calculation is fossil fuel used in project activity net of that consumed in the baseline.

As there will be no additional fossil fuel consumption different from the baseline scenario, $PE_{FC,j,y}$ will be zero.

If the project owner decides not to install the energy generation plant using the recovered LFG, some equipments used in the project activity will consume electricity from the grid.

From the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption":

Scenario A: **Electricity consumption from the grid.** The electricity is purchased from the grid only. Either no captive power plant is installed at the site of electricity consumption or, if any onsite captive power plant exits, it is not operating or it can physically not provide electricity to the source of electricity consumption.

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

Equation 19

Where:

$PE_{EC,y}$ Project emissions from electricity consumption in year *y* (tCO_2/yr)
$EC_{PJ,j,y}$ Quantity of electricity consumed by the project electricity consumption source *j* in year *y* (MWh/yr)
$EF_{EL,j,y}$ Emission factor for electricity generation for source *j* in year *y* (tCO_2/MWh)
$TDL_{j,y}$ Average technical transmission and distribution losses for providing electricity to source *j* in year *y*
J Sources of electricity consumption in the project

Determination of the emission factor for electricity generation ($EF_{EL,j/k/l,y}$)

For Scenario A: Electricity consumption from the grid In this case, project participants may choose among some options. For the Corpus/Araúna project is chosen:
Option A1: 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"
In this case, $EF_{EL,j/k/l,y}$ is equal to the $CEF_{elec,BL,y}$. The calculation is described above, in page 24 (DETERMINATION OF $CEF_{elec,BL,y}$)

Determination of $TDL_{j,y}$

Choose one of the following options:

• Use recent, accurate and reliable data available within the host country;
• Use as default values of 20% for

(a) project or leakage electricity consumption sources;

(b) baseline electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is larger than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies.

• Use as default values of 3% for

(a) baseline electricity consumption sources;
(b) project and leakage electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is smaller than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies.

For Corpus/Araúna project the project electricity consumption is larger than in the baseline consumption, because there is no electricity consumption in baseline scenario. In this case, remain 2 options:

• Use recent, accurate and reliable data available within the host country; or

• Use as default values of 20%.

In order to use local data, $TDL_{j,y}$ 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.

Project emissions from flaring of the residual gas stream ($PE_{flare,y}$)

Not all the methane that reaches the flare is destroyed, and the methodology ACM0001 establishes that project emissions related to this matter shall be determined following the procedures described in the *"Tool to determine project emissions from flaring gases containing methane"*, to be used in the **Equation 9.**

The mentioned tool is applicable under the following conditions:

- *The residual gas stream to be flared contains no other combustible gases than methane, carbon monoxide and hydrogen;*

- *The residual gas stream to be flared shall be obtained from decomposition of organic material (through landfills, bio-digesters or anaerobic lagoons, among others) or from gases vented in coal mines (coal mine methane and coal bed methane).*

The project activity consists of destroying gases released by a landfill. Hence, both applicability conditions are satisfied.

The tool also differentiates between open and enclosed flares. The proposed project will use an enclosed flare, since these are more effective in destroying methane.

For enclosed flares, the Tool proposes two options to determine the flare efficiency:

a) To use a 90% default value. Continuous monitoring of compliance with manufacturer's specification of flare (temperature, flow rate of residual gas at the inlet of the flare) must be performed. If in a specific hour any of the parameters are out of the limit of manufacturer's specifications, a 50% default value for the flare efficiency should be used for the calculations for this specific hour.

b) Continuous monitoring of the methane destruction efficiency of the flare (flare efficiency).

The project activity will use an enclosed flare and continuous monitoring of the destruction efficiency of the flare (option **b** above), in which case the Tool provides the steps described below.

STEP 1. Determination of the mass flow rate of the residual gas that is flared

$$FM_{RG,h} = \rho_{RG,n,h} \times FV_{RG,h}$$ **Equation 20**

Where:

$FM_{RG,h}$ Mass flow rate of the residual gas in hour h (kg/h)
$\rho_{RG,n,h}$ Density of the residual gas at normal conditions in hour h (kg/m³)
$FV_{RG,h}$ Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h (m³/h)

$$\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \times T_n}$$ **Equation 21**

Where:

$\rho_{RG,n,h}$ Density of the residual gas at normal conditions in hour h (kg/m³)
P_n Atmospheric pressure at normal conditions (101.325) (Pa)
R_u Universal ideal gas constant (8,314) (Pa.m³/kmol.K)
$MM_{RG,h}$ Molecular mass of the residual gas in hour h (kg/kmol)
T_n Temperature at normal conditions (273,15) (K)

$$MM_{RG,h} = \sum_i fv_{i,h} \times MM_i$$ **Equation 22**

Where:

$MM_{RG,h}$ Molecular mass of the residual gas in hour h (kg/kmol)
$fv_{i,h}$ Volumetric fraction of component i in the residual gas in the hour h (-)
MM_j Molecular mass of residual gas component i (kg/kmol)
i The components CH_4, CO, CO_2, O_2, H_2, N_2

As a simplified approach, project participants will only measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2).

STEP 2. Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

$$fm_{j,h} = \frac{\sum_i fv_{i,h} \cdot AM_j \cdot NA_{j,i}}{MM_{RG,h}}$$ **Equation 23**

Where:

$fm_{j,h}$ Mass fraction of element *j* in the residual gas in hour *h*
$fv_{i,h}$ Volumetric fraction of component *i* in the residual gas in the hour *h*
AM_j Atomic mass of element *j* (kg/kmol)
$NA_{j,i}$ Number of atoms of element *j* in component *i*
$MM_{RG,h}$ Molecular mass of the residual gas in hour *h*
j The elements carbon, hydrogen, oxygen and nitrogen
i The components CH_4, CO, CO_2, O_2, H_2, N_2

STEP 3. Determination of the volumetric flow rate of the exhaust gas on a dry basis

This step is only applicable when the methane combustion efficiency of the flare is continuously monitored.

Determine the average volumetric flow rate of the exhaust gas in each hour *h* based on a stoichiometric calculation of the combustion process, which depends on the chemical composition of the residual gas, the amount of air supplied to combust it and the composition of the exhaust gas, as follows:

$$TV_{n,FG,h} = V_{n,FG,h} \times FM_{RG,h}$$ **Equation 24**

$TV_{n,FG,h}$: Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour *h* (m^3/h)
$V_{n,FG,h}$: Residual gas Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in hour *h* (m^3/kg)
$FM_{RG,h}$: Mass flow rate of the residual gas in the hour *h* (kg/h)

$$V_{n,FG,h} = V_{n,CO_2,h} + V_{n,O_2,h} + V_{n,N_2,h}$$ **Equation 25**

$V_{n,FG,h}$: Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in the hour *h* (m^3/kg residual gas)
$V_{n,CO_2,h}$: Quantity of CO_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h* (m^3/kg residual gas)
$V_{n,N_2,h}$: Quantity of N_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h* (m^3/kg residual gas)
$V_{n,O_2,h}$: Quantity of O_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h* (m^3/kg residual gas)

$$V_{n,O_2,h} = n_{O_2,h} \times MV_n$$

Equation 26

$V_{n,O2,h}$ Quantity of O_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h* (m^3/kg residual gas)
$n_{O2,h}$ Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h* (kmol/kg residual gas)
MV_n Volume of one mole of any ideal gas at normal temperature and pressure (22,4 L/mol) (m^3/kmol)

$$V_{n,N_2,h} = MV_n * \left\{ \frac{fm_{N,h}}{200AM_N} + \left(\frac{1 - MF_{O_2}}{MF_{O_2}} \right) * \left[F_h + n_{O_2,h} \right] \right\}$$

Equation 27

$V_{n,N2,h}$: Quantity of N_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h* (m^3/kg residual gas)
MV_n : Volume of one mole of any ideal gas at normal temperature and pressure (22,4 m^3/Kmol) (m^3/kmol)
$fm_{N,h}$ - : Mass fraction of nitrogen in the residual gas in the hour *h*
AM_n : Atomic mass of nitrogen (kg/kmol)
MF_{O2} - : O_2 volumetric fraction of air
F_h : Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h* (kmol/kg residual gas)
$n_{O2,h}$: Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h* (kmol/kg residual gas)

$$V_{n,CO_2,h} = \frac{fm_{C,h}}{AM_C} * MV_n$$

Equation 28

$V_{n,CO2,h}$: Quantity of CO_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h* (m^3/kg residual gas)
$fm_{C,h}$ - : Mass fraction of carbon in the residual gas in the hour *h*
AM_C : Atomic mass of carbon (kg/kmol)
MV_n : Volume of one mole of any ideal gas at normal temperature and pressure (22,4 m^3/Kmol) (m^3/kmol)

$$n_{O_2,h} = \frac{t_{O_2,h}}{\left(1 - (t_{O_2,h} / MF_{O_2})\right)} \times \left[\frac{fm_{C,h}}{AM_C} + \frac{fm_{N,h}}{2AM_N} + \left(\frac{1 - MF_{O_2}}{MF_{O_2}} \right) \times F_h \right]$$

Equation 29

$n_{O2,h}$: Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h* (kmol/kg residual gas)
$t_{O2,h}$: Volumetric fraction of O_2 in the exhaust gas in the hour *h*

MF_{O2} : Volumetric fraction of O_2 in the air (0,21)
F_h : Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h* (kmol/kg residual gas)
$fm_{j,h}$ - : Mass fraction of element *j* in the residual gas in hour *h* (from equation 4)
AM_j : Atomic mass of element *j* (kg/kmol)
j : The elements carbon (index C) and nitrogen (index N)

$$F_h = \frac{fm_{C,h}}{AM_C} + \frac{fm_{H,h}}{4AM_H} - \frac{fm_{O,h}}{2AM_O}$$

Equation 30

F_h : Stoichiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h* (kmol O_2/kg residual gas)
$fm_{j,h}$ - : Mass fraction of element *j* in the residual gas in hour *h* (from equation 4)
AM_j : Atomic mass of element *j* (kg/kmol)
j : The elements carbon (index C), hydrogen (index H) and oxygen (index O)

STEP 4. Determination of methane mass flow rate in the exhaust gas on a dry basis

This step is only applicable if the methane combustion efficiency of the flare is continuously monitored.

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

$$TM_{FG,h} = \frac{TV_{n,FG,h} * fv_{CH4,FG,h}}{1000000}$$

Equation 31

$TM_{FG,h}$: Mass flow rate of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h* (kg/h)
$TV_{n,FG,h}$: Exhaust gas Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour *h* (m^3/h)
$fv_{CH4,FG,h}$: Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in hour *h* (mg/ m^3)

STEP 5. Determination of methane mass flow rate in the residual gas on a dry basis

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n}$$ **Equation 32**

Where:

$TM_{RG,h}$ Mass flow rate of methane in the residual gas in the hour *h* (kg/h)
$FV_{RG,h}$ Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h (m^3/h)
$fv_{CH4,RG,h}$ Volumetric fraction of methane in the residual gas on dry basis in hour h (NB: this corresponds to $fv_{i,RG,h}$ where i refers to methane). (-)
$\rho_{CH4,n}$ Density of methane at normal conditions (0,7168) (kg/m³)

STEP 6. Determination of the hourly flare efficiency

In case of enclosed flares and continuous monitoring of the flare efficiency, the flare efficiency in the hour h ($\eta_{flare,h}$) is

• 0% if the temperature of the exhaust gas of the flare (T_{flare}) is below 500 °C during more than 20 minutes during the hour h.

• determined as follows in cases where the temperature of the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour h :

$$\eta_{flare,h} = 1 - \frac{TM_{FG,h}}{TM_{RG,h}}$$

Equation 33

Where:

$\eta_{flare,h}$ Flare efficiency in the hour h

$TM_{FG,h}$ Methane mass flow rate in exhaust gas averaged in a period of time t (hour, two months or year) in kg/h.

$TM_{RG,h}$ Mass flow rate of methane in the residual gas in the hour h in kg/h.

STEP 7. Calculation of annual project emissions from flaring

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \left(1 - \eta_{flare,h}\right) \times \frac{GWP_{CH4}}{1000}$$

Equation 34

Where:

$PE_{flare,y}$ Project emissions from flaring of the residual gas stream in year *y* (tCO_2)
$TM_{RG,h}$ Mass flow rate of methane in the residual gas in the hour *h* (kg/h)
$\eta_{flare,h}$ Flare efficiency in hour *h* (0,9, according with the "*Tool to determine project emissions from flaring gases containing methane*")
GWP_{CH4} Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4

LEAKAGE

No leakage effects need to be accounted under this methodology.

EMISSIONS REDUCTIONS

Emission reductions are calculated as follows:

$$ERy = BEy - PEy$$

Where:

ER_y = Emission reductions in year y (tCO_2e/yr)
BE_y = Baseline emissions in year y (tCO2e/yr)

PE_y = Project emissions in year y (tCO_2/yr)

B.6.2. Data and parameters that are available at validation:

(Copy this table for each data and parameter)

Data / Parameter:	Regulatory requirements relating to landfill gas projects
Data unit:	-
Description:	Regulatory requirements relating to landfill gas projects
Source of data used:	Local Regulatory Agency – CETESB (São Paulo State Environmental Agency)
Value applied:	-
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	The information though recorded annually, is used for changes to the adjustment factor (AF) or directly $MD_{BL,y}$ at renewal of the credit period.

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e / t CH_4
Description:	Global Warming Potential (GWP) of methane
Source of data to be used:	IPCC
Value of data applied for the purpose of calculating expected emission reductions in section B.5	21 for the first commitment period.
Description of measurement methods and procedures to be applied:	Shall be updated according to any future COP/MOP decisions.
QA/QC procedures to be applied:	-
Any comment:	

Data / Parameter:	$\mathbf{D_{CH4}}$
Data unit:	tCH_4/m^3CH_4
Description:	Methane Density
Source of data used:	ACM0001 / version 11
Value applied:	0,0007168
Justification of the choice of data or description of measurement methods	Parameter defined within the methodology ACM0001 / version 11

and procedures actually applied :	
Any comment:	At standard temperature and pressure (0 degree Celsius and 1.013 bar).

Data / Parameter:	**$BE_{CH4,SWDS,y}$**
Data unit:	tCO_2e
Description:	Methane generated by the landfill in the absence of the project activity in the year y
Source of data used:	Calculated as per "Tool to determine methane emissions avoided from disposal waste at a solid waste disposal site".
Value applied:	see table below
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Used for *ex ante* estimation of the amount of methane that would have been destroyed/combusted during the year

Value applied:

Year	**(tCO_2e)**
2010*	11.416
2011	39.365
2012	43.287
2013	46.365
2014	48.839
2015	50.871
2016	52.577
2017**	36.024

*Starting at December 1st, 2010
**Ending the first period of credit on December 31st 2017

The following parameter are required to determine flare efficiency using the *"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"* (for the *ex-ante* estimation of $MD_{proj,y}$).

Data / Parameter:	Φ

Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	According to the Tool
Value applied:	0,9
Justification of the choice of data or description of measurement methods and procedures actually applied :	Oonk et el. (1994) have validated several landfill gas models based on 17 landfill gas projects. The mean relative error of multi-phase models was assessed to be 18%. Given the uncertainties associated with the model and in order to estimate emission reductions in a conservative manner, a discount of 10% is applied to the model results.
Any comment:	Same parameter and value is applied to estimate/calculate Adjustment Factor (AF)

Data / Parameter:	***OX***
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	According to the Tool
Value applied:	0,1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Use 0,1 for managed solid waste disposal sites that are covered with oxidizing material such as soil or compost. Use 0 for other types of solid waste disposal sites. To be validate by DOE, conduct a site visit at the solid waste disposal site in order to assess the type of cover of the solid waste disposal site.
Any comment:	Same parameter and value is applied to estimate/calculate Adjustment Factor (AF) At the renewal of the crediting period, this parameter should be updated according to default values suggested in the most recently published IPCC Guidelines for National Greenhouse Gas Inventories.

Data / Parameter:	***F***
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	According to the Tool, that refers to IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0,5
Justification of the choice of data or description of measurement methods and procedures actually applied :	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0,5 is recommended by IPCC.
Any comment:	Same parameter and value is applied to estimate/calculate Adjustment Factor (AF) At the renewal of the crediting period, this parameter should be updated according to default values suggested in the most recently published IPCC Guidelines for National Greenhouse Gas Inventories.

Data / Parameter:	DOC_f
Data unit:	-
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	According to the Tool, that refers to IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0,5
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	Same parameter and value is applied to estimate/calculate Adjustment Factor (AF) At the renewal of the crediting period, this parameter should be updated according to default values suggested in the most recently published IPCC Guidelines for National Greenhouse Gas Inventories.

Data / Parameter:	***MCF***
Data unit:	-
Description:	Methane correction factor
Source of data used:	According to the Tool, that refers to IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	1,0
Justification of the choice of data or description of measurement methods and procedures actually applied :	• 1,0 is used for **anaerobic managed solid waste disposal sites**. These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste; The disposal site is categorized as controlled landfill by the municipality. And uses cover material and mechanical compacting.
Any comment:	Same parameter and value is applied to estimate/calculate Adjustment Factor (AF) At the renewal of the crediting period, this parameter should be updated according to default values suggested in the most recently published IPCC Guidelines for National Greenhouse Gas Inventories.

Data / Parameter:	DOC_j
Data unit:	-
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*
Source of data used:	According to the Tool, that refers to IPCC 2006 Guidelines for National Greenhouse Gas Inventories, (adapted from Volume 5, Tables 2.4 and 2.5)
Value applied:	(see table below)

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

	(other than sludge) — ; Textiles — 24; Garden, yard and park waste — 20; Glass, plastic, metal, other inert waste — 0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The waste amount disposed in the past in the landfill and the future estimated amount is all in wet basis. Therefore, DOCj in wet basis is used to *ex-ante* estimation.
Any comment:	Same parameter and value is applied to estimate/calculate Adjustment Factor (AF) At the renewal of the crediting period, this parameter should be updated according to default values suggested in the most recently published IPCC Guidelines for National Greenhouse Gas Inventories.

(other than sludge)	
Textiles	24
Garden, yard and park waste	20
Glass, plastic, metal, other inert waste	0

Data / Parameter:	***K_j***
Data unit:	-
Description:	Decay rate for the waste type *j*
Source of data used:	According to the Tool, that refers to IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value applied:	(see table below)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Parameters were chosen accordingly to the climate zone of the project site, Indaiatuba – SP city. Mean Annual Temperature (MAT) = 22 ^{o}C - Tropical climate Mean Annual Precipitation (MAP) = 1.283mm – Wet climate. MAT source: www.indaiatuba.sp.gov.br/cidade/aspectos-fisicos/ MAP source: http://www.saae.sp.gov.br/saae_tratamento.htm
Any comment:	Same parameter and value is applied to estimate/calculate Adjustment Factor (AF) At the renewal of the crediting period, this parameter should be updated according to default values suggested in the most recently published IPCC Guidelines for National Greenhouse Gas Inventories.

Degradation speed	***Waste Type***	***Kj***
Slowly degrading	Wood, wood products	0,035
	Pulp, paper and cardboard (other than sludge)	0,07
	Textiles	0,07
Moderately Degrading	other (non-food) organic putrescible Garden, yard and park waste	0,17
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0,40

B.6.3. Ex-ante calculation of emission reductions:

DETERMINATION OF AF (adjustment factor)

Step 1: Estimation of the destruction efficiency of the system

$MD_{reg,y}$ is neither given/defined as a quantity nor specified by regulatory or contractual requirements. Therefore, the "Adjustment Factor" will be used as described in the above formula. It was estimated following the example provided by the methodology ACM0001, version 11, which is:

"*In cases where a specific system for collection and destruction of methane is mandated by regulatory or contractual requirements, the ratio of the destruction efficiency of that system to the destruction efficiency of the system used in the project activity shall be used."*

> *(b) In cases, where the baseline system for collection and destruction of methane is* ***not*** *installed prior to project implementation and/or measurements of the amount of methane that is destroyed are* ***not*** *available then the destruction efficiency of the system mandated by regulatory or contractual requirements (εBL) should be assumed to be equal to the theoretical efficiency of the specific system for collection and destruction of methane that is defined in the regulation or contract. In other cases, a procedure for estimating the amount of landfill gas that would be captured in absence of the project activity shall be provided in the CDM-PDD validated by the DOE. This procedure shall be used to estimate the MD_{Hist} in equation 3 above to estimate the baseline destruction efficiency;*

A company was hired to study the actual efficiency of the LFG collection and destruction, the result was 1,82%.

ε_{BL} = Conservatly a 2% value will be used.

Step 2: Estimation of the destruction efficiency of the system used in the project activity

For an ex-ante estimation, the LFG recovery system to be implemented in the project activity is estimated to have a 75% extraction rate, with a burning efficiency in the enclosed flare of 98% as mentioned by the manufactor.

ε_{PJ} = 75% x 98% = 73.50%

Step 3: Estimation of the adjustment factor (AF)

Therefore the adjustment factor is: 2,72%

$$AF = \frac{\varepsilon_{BL}}{\varepsilon_{PJ}}$$

DETERMINATION OF $MD_{project,y}$

The ex-ante estimation of the amount of methane that would have been destroyed/combusted during the year, in tones of methane ($MD_{project,y}$) will be done with the latest version of the approved "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site", considering the following additional equation:

$$MD_{project,y} = BE_{CH4,SWDS,y}/GWP_{CH4}$$

Where:

$BE_{CH4,SWDS,y}$ = Methane generation from the landfill in the absence of the project activity at year *y* (tCO_2e), calculated as per the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site". The tool estimates methane generation adjusted for, using adjustment factor (f) any landfill gas in the baseline that would have been captured and destroyed to comply with relevant regulations or contractual requirements, or to address safety and odor concerns. As this is already accounted for in equation 2, "f" in the tool shall be assigned a value 0.

Furthermore the following guidance should be taken into account:
• In the tool x will refer to the year since the landfill started receiving wastes [x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)];
• Sampling to determine the different waste types is not necessary, the waste composition can be obtained from previous studies.

Corpus/Araúna landfill started receiving waste in 2002 and will close in 2017, with a total amount estimated in **1.105.397** tones.

It is projected that all recovered LFG will be utilized to electricity generation.

For an ex-ante estimation, is assumed that from the second year 87% of the LFG will be sent to the power generator, and 13% to the flare, due to any maintenance or system shutdown.

DETERMINATION OF $CEF_{elec,BL,y}$

Brazilian DNA defines the unique national grid system, as well as publishes the parameters necessary to calculate the emission factors. According to the most recent data published, the annual average marginal emission factor is as follows:

Build Margin for 2008: 0,1458 tCO2/MWh
Average Operating Margin for 2008: 0,4766 tCO2/MWh
Combined Margin: 0,5* CM + 0,5*OM = 0,311189852 tCO2/MWh

TABLE 06 - MONTHLY AVERAGE OPERATING MARGIN FOR 2008[14]

January	0,5727
February	0,6253
March	0,5794
April	0,4529
May	0,4579

[14] Source: Ministry of Science and Technology. http://www.mct.gov.br/index.php/content/view/303077.html#ancora

June	0,5180
July	0,4369
August	0,4258
September	0,4102
October	0,4369
November	0,3343
December	0,4686

PROJECT EMISSIONS

Corpus/Araúna project activity requires electricity consumption, by the blowers to force capture of LFG. The plan is that this energy will be supplied by the power generated from the LFG itself, thus there will be no electricity consumption from the grid. In the other hand, this renewable energy consumed by the project activity cannot be claimed for grid displacement emissions reductions.

Conservatly, it is assumed a specific consumption of 0,01 kWh/m^3 LFG to reduce from the baseline emissions of power generated by LFG combustion, displacing grid electricity.

This value was obtained from the blower performace test curves:

Blower Pressure = 300 mbar
LFG (m^3) = 7.867.517 em 2017
LFG(m^3/min) = 15
Conservative value adopted (m^3/min) = 15
Perfomance test curves blower value (kW)= 10 kW
Energy consumption per m^3 of landfill gas (kWh/m^3) = 0,01 kWh/m^3

If the energy is supplied by the grid, it is necessary to know the transmission loss of the grid.

Determination of TDLj,y (technical transmission and distribution losses)

ANEEL (Brazilian National Energy Agency) made the calculation of transmissions losses for all energy distribution companies in Brazil, to revise the energy tariff that each company should apply to the next period.

In Indaiatuba city, the distribution company is part of the CPFL/Piratininga, with a technical loss as follows:

TABLE 07 – CPFL PIRATININGA LOSSES - 2006

Description	Amount (MWh)	% of injected energy
Total inject energy	15.038.764,88	100
Total market energy	13.926.916,02	92,6066
Total losses	1.111.850,85	7,3932
Technical losses	843.180,59	5,606
Commercial losses	268.670,26	1,7865

Source: Annex V, Technical Note 060/2007 – SRD/ANEEL, Annex of Technical Note 279/2007–SRE/ANEEL. Brasilia, October 18th, 2007, page 7[15].

For ex-ante estimation TDL is considered = 5,606% and no project emissions from power consumption.

Emissions reductions (ER) are equal to **322.906 tCO_2e** over the 7 years of crediting period.

Calculation details are provided in the spreadsheet "Calculo CER Indaiatuba.xls"

B.6.4 Summary of the ex-ante estimation of emission reductions:

TABLE 08 – EX-ANTE ESTIMATION OF EMISSION REDUCTIONS

Year	**Estimation of project activity emissions (in tonnes of CO_2e)**	**Estimation of baseline emissions (in tonnes of CO_2e)**	**Estimation of leakages (in tonnes of CO_2e)**	**Estimation of overall emission reductions (in tonnes of CO_2e)**
2010*	17	11.106	0	11.089
2011	38	38.295	0	39.131
2012	0	42.110	0	44.993
2013	0	45.104	0	48.192
2014	0	47.510	0	50.763
2015	0	49.488	0	52.876
2016	0	51.147	0	54.649
2017**	0	35044	0	37.444
Total (in tonnes of CO_2e)	55	**319.804**	0	**339.137**
*Starting at December 1st, 2010 **Ending the first period of credit on December 31st 2017				

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data monitored and required for verification and issuance. All the information listed in this section will be kept for two years after the end of the crediting period or the last issuance of CER's for this project activity, whichever occurs later.

[15] Source: http://www.aneel.gov.br/aplicacoes/audiencia/arquivo/2007/035/resultado/anexo_v_-_nt_279_2007_perdas_tecnicas_cpfl_piratininga__final_.pdf

Data / Parameter:	**AF**
Data unit:	%
Description:	Adjustment Factor
Source of data to be used:	Project Developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2,72%
Description of measurement methods and procedures to be applied:	Calculated in agreement with the methodological procedures, taking into account that the existent system now in the landfill is a passive ventilation system.
QA/QC procedures to be applied:	-
Any comment:	AF has to be determined ex-post as the ε_{PR} has to be monitored at least for the first year.

Data / Parameter:	**$LFG_{Total,y}$**
Data unit:	Nm³
Description:	Total amount of landfill gas captured
Source of data to be used:	On-site measured by a specific flow meter to measure only this parameter.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	see table below
Description of measurement methods and procedures to be applied:	Measured by a flow meter. Data to be aggregated monthly and yearly.
QA/QC procedures to be applied:	Uncertainty level: Low It will be used a flow meter with +/- 1% of accuracy. The flow meter will be calibrated as per manufacturer recommendations by IPT (Instituto de Pesquisa Tecnologica – Technological Research Institute).
Any comment:	This parameter corresponds to the Volumetric flow rate of the residual gas at normal conditions in the hour *h* (***$FV_{RG,h}$***) of the "*Tool to determine project*

Year	$LFG_{Total,y}$
2010*	1.685.383
2011	5.811.435
2012	6.390.438
2013	6.844.840
2014	7.209.959
2015	7.510.057
2016	7.761.917
2017**	5.318.164

*Starting at December 1st , 2010

**Ending the first period of credit on December 31st 2017

	emissions from flaring gases containing methane" and will be monitored considering the recommendations of the referred tool. The flow will be expressed in standard cubic meters per hour. It will be used as reference the following standard conditions: Temperature, 273,15 K (°C) and pressure of 10^5 pascals. IUPAC recommends that the former use of the pressure of 1 atm as standard pressure (equivalent to $1{,}01325 \times 10^5$ Pa) should be discontinued.[16]

Data / Parameter:	$\mathbf{LFG_{Flare,y}}$
Data unit:	Nm^3
Description:	Amount of landfill gas flared.
Source of data to be used:	On-site measured by a specific flow meter to measure only this parameter.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Parameter not used to ex-ante estimation
Description of measurement methods and procedures to be applied:	The gas fed to the flare will be measured continuously by a flow meter. Data will be aggregated monthly and yearly.
QA/QC procedures to be applied:	Uncertainty level: Low Uncertainty level: Low It will be used a flow meter with +/- 1% of accuracy. The flow meter will be calibrated as per manufacturer recommendations by IPT (Instituto de Pesquisa Tecnologica – Technological Research Institute).
Any comment:	Considering that all the LFG is flared, this parameter also corresponds to the Volumetric flow rate of the residual gas at normal conditions in the hour *h* ($FV_{RG,h}$) of the "*Tool to determine project emissions from flaring gases containing methane"* and will be monitored considering the recommendations of the referred tool. The flow will be expressed in standard cubic meters per hour. It will be used as reference the following standard conditions: Temperature, 273,15 K (°C) and pressure of 10^5 pascals. IUPAC recommends that the former use of the pressure of 1 atm as standard pressure (equivalent to $1{,}01325 \times 10^5$ Pa) should be discontinued.

Data / Parameter:	$\mathbf{LFG_{electricity,y}}$
Data unit:	Nm^3
Description:	Amount of landfill gas combusted in power plant at Normal Temperature and Pressure
Source of data to be used:	On-site measured by a specific flow meter to measure only this parameter.
Value of data applied	Parameter not used to ex-ante estimation

[16] Source: http://www.iupac.org/goldbook/S05910.pdf

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	The gas fed to the generator will be measured continuously by a flow meter. Data to be aggregated monthly and yearly
QA/QC procedures to be applied:	
Any comment:	The flow will be expressed in standard cubic meters per hour. It will be used as reference the following standard conditions: Temperature, 273,15 K (°C) and pressure of 10^5 pascals. IUPAC recommends that the former use of the pressure of 1 atm as standard pressure (equivalent to $1{,}01325 \times 10^5$ Pa) should be discontinued.

Data / Parameter:	**$PE_{flare,y}$**
Data unit:	tCO_2
Description:	Project emissions from flaring of the residual gas stream in year y
Source of data to be used:	Calculated
Value of data applied for the purpose of calculating expected emission reductions in section B.5	see table below
Description of measurement methods and procedures to be applied:	The approach selected from the "Methodological Tool to determine project emissions from flaring gases containing methane – version 1" was to monitor the temperature of the exhaust gas of the flare and the flow rate of residual gas at the inlet of the flare. The temperature measurements will be done continuously. The measure will be done by a Type N thermocouple. The readings of temperature will be made by a computer based system, with continuous storage.
QA/QC procedures to be applied:	Thermocouples will be calibrated according with the manufacturer's specifications by IPT (Instituto de Pesquisa Tecnologica – Technological Research Institute).
Any comment:	

Year	**PEflare**
2010*	76
2011	560
2012	87
2013	125
2014	131
2015	137
2016	141
2017**	97

*Starting at December 1st, 2010

**Ending the first period of credit on December 31st 2017

Data / Parameter:	**W_{CH4}**
Data unit:	$m^3 CH_4/m^3$ LFG
Description:	Methane fraction in the landfill gas.

Source of data to be used:	On-site gas analyzer.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	45%
Description of measurement methods and procedures to be applied:	Measured by continuous gas quality analyzer. Methane fraction of the landfill gas to be measured on wet basis. All data are measured and archived electronically.
QA/QC procedures to be applied:	Uncertainty level: Low The gas analyzer will be subject to a regular maintenance, testing and calibration regime in accordance with manufacturer specifications to ensure accuracy. The gas analyzer will be calibrated by IPT (Instituto de Pesquisa Tecnologica – Technological Research Institute).
Any comment:	This parameter corresponds to the Volumetric fraction of component *i* in the residual gas in the hour *h* where *i* = CH_4 ($fv_{i,h}$) of the "*Tool to determine project emissions from flaring gases containing methane*".

Data / Parameter:	**T**
Data unit:	°C
Description:	Temperature of the landfill gas.
Source of data to be used:	Project participant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	Not necessary since a flow meter that automatically measures temperature and pressure will be used, expressing LFG volumes in normalized cubic meters.
QA/QC procedures to be applied:	
Any comment:	It will be used as reference the following standard conditions: Temperature, 273,15 K (°C) and pressure of 10^5 pascals. IUPAC recommends that the former use of the pressure of 1 atm as standard pressure (equivalent to $1,01325 \times 10^5$ Pa) should be discontinued.

Data / Parameter:	**P**
Data unit:	Pa
Description:	Pressure of the landfill gas.
Source of data to be used:	Project Participants
Value of data applied	101.325 (= 1atm)

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Not necessary since a flow meter that automatically measures temperature and pressure will be used, expressing LFG volumes in standard cubic meters.
QA/QC procedures to be applied:	
Any comment:	It will be used as reference the following standard conditions: Temperature, 273,15 K (°C) and pressure of 10^5 pascals. IUPAC recommends that the former use of the pressure of 1 atm as standard pressure (equivalent to $1{,}01325 \times 10^5$ Pa) should be discontinued.

Data / Parameter:	**EL_{LFG}**
Data unit:	MWh
Description:	Net amount of electricity generated using LFG.
Source of data to be used:	Measured electricity sent to the grid.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	This parameter is not used ex-ante estimation
Description of measurement methods and procedures to be applied:	The amounts will be measured through an electricity meter.
QA/QC procedures to be applied:	The measurement instruments will be subject the maintenance and periodic tests in agreement with the supplier appropriate patterns.
Any comment:	Only if project proponent decide to produce energy using the biogas.

Data / Parameter:	**$CEF_{elec,y,BL,y}$**
Data unit:	tCO_2/MWh
Description:	Carbon emission factor of electricity
Source of data used:	NDA – National Designated Authority
Value applied:	0,311189852 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	The electricity consumed in the project is generated by plants connected to the grid. Hence, the emission factor is calculated accordingly to Tool to calculate the emission factor for an electricity system and for the first crediting period, emission factor will be calculated ex post.
Any comment:	Source: http://www.mct.gov.br/index.php/content/view/303077.html#ancora

Data / Parameter:	**Operation of the energy plants**

Data unit:	Hours
Description:	Operation of the energy plant
Source of data to be used:	It will be measured the operating hours of the plant .
Value of data applied for the purpose of calculating expected emission reductions in section B.5	8.760
Description of measurement methods and procedures to be applied:	Measurment by the genset operation hours. Data are measured and archived electronically, and recorded annually.
QA/QC procedures to be applied:	The meters will be calibrated regularly according to manufacturer's specifications.
Any comment:	This is monitored to ensure methane destruction is claimed for methane used in electricity plant when it is operational.

Data / Parameter:	**$PE_{ec,y}$**
Data unit:	tCO_2
Description:	Project emissions from electricity consumption by the project activity during the year y
Source of data to be used:	Calculated as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**Years** / **PEec,y**: 2010: 17,00; 2011: 38,00; 2012: 0,00; 2013: 0,00; 2014: 0,00; 2015: 0,00; 2016: 0,00; 2017: 0,00
Description of measurement methods and procedures to be applied:	Calculated as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".
QA/QC procedures to be applied:	Calculated as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".
Any comment:	To calculate the emission from electricity consumption ex-ante it was used the specific conservative consumption of 0,01 kWh/m^3 LFG to reduce from the baseline emissions of power generated by LFG combustion, displacing grid electricity. This value was obtained from the blower performace test curves: Blower Pressure = 300 mbar LFG (m^3) = 7.867.517 em 2017 LFG(m^3/min) = 15 Conservative value adopted (m^3/min) = 15

Years	PEec,y
2010	17,00
2011	38,00
2012	0,00
2013	0,00
2014	0,00
2015	0,00
2016	0,00
2017	0,00

	Perfomance test curves blower value (kW)= 10 kW Energy consumption per m3 of landfill gas (kWh/m^3) = 0,01kWh/m^3

The following variable is required to determine flare efficiency using the *"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"* (for the calculation of Adjustment Factor-AF)

Data / Parameter:	$MG_{PR,y}$
Data unit:	tCH_4
Description:	Amount of methane generated during year *y* OR during the first year of the project Activity
Source of data to be used:	On-site measurement. Plant records.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	This parameter is not used in the ex-ante estimation.
Description of measurement methods and procedures to be applied:	Estimated using the actual amount of waste disposed in the landfill as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site".
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$p_{n,j,x}$
Data unit:	-
Description:	Weight fraction of the waste type *j* in the sample *n* collected during the year *x*
Source of data to be used:	Composition of the waste
Value of data applied for the purpose of calculating expected emission reductions in section B.5	<table><tr><th>Waste Type</th><th>Proportion</th></tr><tr><td>Wood, wood products</td><td>0,00%</td></tr><tr><td>Pulp, paper and cardboard (other than sludge)</td><td>12,20%</td></tr><tr><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>53,15%</td></tr><tr><td>Textiles</td><td>11,30%</td></tr><tr><td>Other (non-food) organic putrescible Garden, yard and park waste</td><td>10,98%</td></tr><tr><td>Glass, plastic, metal, other inert waste</td><td>12,37%</td></tr></table>
Description of measurement methods and procedures to be applied:	Waste types proportion estimative, based on past disposed wastes. Sampling will be undertaken four times per year.
QA/QC procedures to be applied:	-

Any comment:	As the project activity will contribute to environmental and social awareness, we assume that the recycling of paper and cardboard will increase. Therefore we considered a reduction of 5,04% of this type of waste in the landfill.The monitoring system will be used for monitoring according to methodology ACM 0001 v.11.

Data / Parameter:	**F**
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data used:	Plant records
Value applied:	1,0
Justification of the choice of data or description of measurement methods and procedures actually applied :	All gas captured is planned to be destroyed in the flare or combusted in the power generator. Monitored annually.
Any comment:	Same parameter and value is applied to estimate/calculate Adjustment Factor (AF)

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e /tCH_4
Description:	Global Warming Potential (GWP) of methane
Source of data to be used:	IPCC
Value of data applied for the purpose of calculating expected emission reductions in section B.5	21 for the first commitment period.
Description of measurement methods and procedures to be applied:	Shall be updated according to any future COP/MOP decisions.
QA/QC procedures to be applied:	-
Any comment:	

Data / Parameter:	W_x
Data unit:	Tons
Description:	Total amount of organic waste prevented from disposal in year *y*
Source of data to be used:	Gravimetry records of waste ex ante project.
Value of data applied for the purpose of	**Year** | **Amount (ton)**

calculating expected emission reductions in section B.5	<table><tr><td>2002</td><td>113</td></tr><tr><td>2003</td><td>108</td></tr><tr><td>2004</td><td>113</td></tr><tr><td>2005</td><td>115</td></tr><tr><td>2006</td><td>126</td></tr><tr><td>2007</td><td>130</td></tr><tr><td>2008</td><td>137</td></tr><tr><td>2009</td><td>200</td></tr><tr><td>2010</td><td>250</td></tr><tr><td>2011</td><td>250</td></tr><tr><td>2012</td><td>250</td></tr><tr><td>2013</td><td>250</td></tr><tr><td>2014</td><td>250</td></tr><tr><td>2015</td><td>250</td></tr><tr><td>2016</td><td>250</td></tr><tr><td>2017</td><td>250</td></tr></table> The landfill may be closed in 2017.
Description of measurement methods and procedures to be applied:	On-site measurement of the amount of the collected waste taken to the landfill through waste trucks. Measured continuously, aggregated at least annually.
QA/QC procedures to be applied:	
Any comment:	The data about the waste composition was supplied by Corpus Ltda.

Data / Parameter:	***z***
Data unit:	-
Description:	Number of samples collected during the year *y* OR the first year of the project activity
Source of data to be used:	On site sampling records.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Record the number of samples collected in each sampling to analyze the waste type fraction. Measured continuously, aggregated annually.
QA/QC procedures to be applied:	-
Any comment:	The monitoring system will be used for monitoring according to methodology ACM 0001 v.11.

The following variables are required to determine flare efficiency using the "*Tool to determine project emissions from flaring gases containing methane*".

Data / Parameter:	**$fv_{i,h}$**
Data unit:	-
Description:	Volumetric fraction of component *I* in the residual gas in the hour *h* where *i*=CO_2, CO, O_2, H_2, N_2 and CH_4 (already considered as **$W_{CH4,y}$**, above)
Source of data to be used:	On-site measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	This parameter is not used in the ex-ante estimation.
Description of measurement methods and procedures to be applied:	Continuous gas analyzer. Values to be averaged hourly or at a shorter time interval Ensure that the same basis (dry or wet) is considered for this measurement and the measurement of the volumetric flow rate of the residual gas ($FV_{RG, h}$) when the residual gas temperature exceeds 60 ºC.
QA/QC procedures to be applied:	Analyzers will be periodically calibrated according to the manufacturer’s recommendation by IPT (Instituto de Pesquisa Tecnologica – Technological Research Institute).
Any comment:	As a simplified approach, project participants may only measure the methane content of the residual gas and consider the remaining part as N_2. It will be used as reference the following standard conditions: Temperature, 273,15 K (°C) and pressure of 10^5 pascals. IUPAC recommends that the former use of the pressure of 1 atm as standard pressure (equivalent to $1,01325 \times 10^5$ Pa) should be discontinued.

Data / Parameter:	$FV_{RG,h}$
Data unit:	m³/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*
Source of data to be used:	Measurements by project participants using a flow meter.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	This parameter is not used in the ex-ante estimation.
Description of measurement methods and procedures to be applied:	Measure the volumetric fraction of all components in the residual gas (*fvi,h*) when the residual gas temperature exceeds 60 ºC. The monitoring will be realized hourly or at a shorter time interval.
QA/QC procedures to be applied:	Flow meters are to be periodically calibrated according to the manufacturer’s recommendation by IPT (Instituto de Pesquisa Tecnologica – Technological Research Institute).
Any comment:	It will be used as reference the following standard conditions: Temperature, 273,15 K (°C) and pressure of 10^5 pascals. IUPAC recommends that the former

	use of the pressure of 1 atm as standard pressure (equivalent to 1,01325 × 10^5 Pa) should be discontinued.

Data / Parameter:	$t_{O2,h}$
Data unit:	-
Description:	Volumetric fraction of O_2 in the exhaust gas of the flare in the hour h
Source of data to be used:	On-site measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	This parameter is not used in the ex-ante estimation.
Description of measurement methods and procedures to be applied:	Continuous gas analyzer. Values to be averaged hourly or at a shorter time Interval. Extractive sampling analyzers with water and particulates removal devices or in situ analyzers for wet basis determination. The sampling point shall be in the upper section of the flare (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperatures level (e.g. inconel probes).
QA/QC procedures to be applied:	Analyzers will be periodically calibrated according to the manufacturer's recommendation by IPT (Instituto de Pesquisa Tecnologica – Technological Research Institute).
Any comment:	It will be used as reference the following standard conditions: Temperature, 273,15 K (°C) and pressure of 10^5 pascals. IUPAC recommends that the former use of the pressure of 1 atm as standard pressure (equivalent to 1,01325 × 10^5 Pa) should be discontinued.

Data / Parameter:	$fv_{CH4,FG,h}$
Data unit:	mg/m^3
Description:	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour h
Source of data to be used:	On-site measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	This parameter is not used in the ex-ante estimation.
Description of measurement methods and procedures to be applied:	Continuous gas analyzer. Values to be averaged hourly or at a shorter time interval Extractive sampling analyzers with water and particulates removal devices or in situ analyzers for wet basis determination. The point of measurement (sampling point) shall be in the upper section of the flare (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperatures level (e.g. inconel probes).
QA/QC procedures to be applied:	Analyzers will be periodically calibrated according to the manufacturer's Recommendation by IPT (Instituto de Pesquisa Tecnologica – Technological

	Research Institute).
Any comment:	Measurement instruments may read ppmv or % values. To convert from ppmv to mg/m^3, simply multiply by 0,716. 1% equals 10 000 ppmv. It will be used as reference the following standard conditions: Temperature, 273,15 K (°C) and pressure of 10^5 pascals. IUPAC recommends that the former use of the pressure of 1 atm as standard pressure (equivalent to 1,01325 × 10^5 Pa) should be discontinued.

Data / Parameter:	T_{flare}
Data unit:	ºC
Description:	Temperature in the exhaust gas of the flare.
Source of data to be used:	On-site measurement.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Higher than 500ºC
Description of measurement methods and procedures to be applied:	The measurement of the temperature of the exhaust gas stream in the flare will be done using a Type N thermocouple. A temperature above 500 ºC indicates that a significant amount of gases are still being burnt and that the flare is operating. This parameter will be registered continuously.
QA/QC procedures to be applied:	Thermocouples should be calibrated according to the supplier's recommendation by IPT (Instituto de Pesquisa Tecnologica – Technological Research Institute).
Any comment:	An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow. It will be used as reference the following standard conditions: Temperature, 273,15 K (°C) and pressure of 10^5 pascals. IUPAC recommends that the former use of the pressure of 1 atm as standard pressure (equivalent to 1,01325 × 10^5 Pa) should be discontinued.

The following variable is required to determine the emissions of the consumption of electricity according to the *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"*.

Data / Parameter:	$TDL_{j,y}$
Data unit:	-
Description:	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*
Source of data to be used:	ANEEL (Brazilian National Energy Agency)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	5,606 % for the grid.
Description of measurement methods	Annually update. In the absence of data from the relevant year, most recent figures should be used, but

and procedures to be applied:	not older than 5 years.
QA/QC procedures to be applied:	-
Any comment:	*Source: Annex V, Technical Note 060/2007 – SRD/ANEEL, Annex of Technical Note 279/2007– SRE/ANEEL. Brasilia, October 18th, 2007, page 7*

B.7.2. Description of the monitoring plan:

The responsible entity for the monitoring system is ARAÚNA – Energia e Gestão Ambiental Ltda., (project participant).

The main components covered within the monitoring plan (MP) are:

1. Parameters to be monitored, and how the data will be collected;
2. The equipment to be used in order to carry out monitoring;
3. Operational procedures and quality assurance responsibilities.

As the project activity did not started yet, no technical documentation on monitoring and maintenance plan has been developed at this time.

However the actions of quality guarantee that will be implemented in the context of the Corpus/Araúna project are the following:

Maintenance Plan: The following aspects are the focus on the maintenance of the monitoring system in order to assure the data monitoring during the project:
− Equipment preventive maintenance;
− Spare Parts to avoid unwanted stops;
− Equipment calibration, according to section B.7.1 and the date of validity of documentation of calibration.

Register of Field Monitoring: The monitoring of the variables of the process indicated on section B.7.1 will be carried out electronically on a fully automated system* in order to ensure the follow up of its behavior in time, allowing the verification of any anomalies in the process and the beginning of correctional and/or preventive actions in due time to eliminate its causes.
* A fully automated system is planed for this project, however as it is a very initial phase there might be barriers to implement such a system, not foreseen at this point.

Backup: All the monitoring data will be backed up on a daily basis to 2 different sites from landfill site itself to ensure a minimum loss of data.

Calibration of the measurement equipment: The calibration of the measurement equipment and/or monitoring will be done periodically, considering the date of validity of an official calibration document from, whenever applicable, a qualified companies/entities.
The calibration will be done by IPT (Instituto de Pesquisa Tecnologica – Technological Research Institute).

Periodical Inspection: Inspections will be carried out by the responsible ones in the involved technical team, related to the: accompaniment of the operation; inspection of the equipment and analysis of the data collected and indexes of maintenance and regularity of the functioning of the equipment.

All data will be archived electronically, and data will be kept for the full crediting period, plus two years.

Procedures to deal with erroneous measurements and a manual measurement procedures regarding accuracy will be developed until the date of commencement of the project activity

The monitoring and maintenance plain and the electronic automated system of monitoring will be developed and implemented until the first verification.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

Date of completion: 13/04/2009
Person/entity determining the baseline:
ARAÚNA – Energia e Gestão Ambiental Ltda
Alameda Jaú, 1742 – Conjunto 11 – Jardim Paulista, São Paulo-SP
CEP-01420-002
Brasil
André Paternostro
apater@cdmenergy.com.br
Phone: 55 (71) 9959 0877
Fax: 55 (11) 3791 5435

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

01/12/2010
The construction of the LFG capture and destruction system should be started when registered or until 15 days after the registration of the CDM project at UNFCCC.

C.1.2. Expected operational lifetime of the project activity:

The project activity will start its operation in 2010 and it´s expected to operate until 2023, which totalizes 14 years.

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

The crediting period will begin on 01/12/2010, or on the date of the registration of the CDM project activity, whichever is later.

C.2.1.2. Length of the first crediting period:

7 (seven) years 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

The Corpus/Araúna landfill operation and installations are in fully accordance with Sao Paulo state legislation referent. See following licenses:

Licenses list:

- Previous License
  # 000266 – Process # SMA 13651/99
- Installation License
  # 36000255 – Process # 36/00257/00 – Date 26/06/2000 (dd/mm/yyyy)
- Working License
  # 36000678 – Process # 36/00257/00 – Date 20/03/2002 (dd/mm/yyyy)
- Additional Installation License
  # 36002945 – Process # 36/00251/09 – Date 30/06/2009 (dd/mm/yyyy)

The Additional Installation License refers to increasing the capacity of receiving waste from Indaiatuba city sanitary landfill to receive 250 tons per day.

Therefore environmental impacts which are landfill responsibility are in compliance with regulatory requirements to sanitary landfill respecting environmental requirements within the proper law.

The burning system considered on this project allows GHG emissions reduction. Besides the methane, considered by the present MDL project, there are others gases, which are not quantified on this document, such as sulphur dioxide and volatile organic compounds which will be burned as well.

The result will be emission reduction of other harmful emissions besides the methane. The increased use of electricity network will generate a negative environment impact, however this impact was quantified and deducted from the reduction of GHG emission generated by this project. The increased use of electricity represents approximately 0,034 % of total emissions reduction of the project activity.

The LFG capture and flaring reduces the risks of explosion due to spontaneous combustion on the landfill. This can be classified as a risk mitigation of a negative environment impact as it reduces this event probability. Also, LFG flaring reduces, in a significant way, the impact of odors which are especially relevant for the sanitary landfill neighborhoods.

Reducing GHG emissions, explosion risks and odors are positive environmental impacts which are added to social and economic factors, also present on this project, contributing to sustainable development.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

From all environmental impacts evaluated, no negative impacts were considered relevant.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

According to the Resolution 7 of Brazilian DNA "Comissão Interministerial de Mudança Global do Clima - CIMGC", issued in March 5th 2008, invitations to comment on the project where sent to entities listed in Article 3 item I, II, III , IV, V and VI on the mentioned resolution and, additionally, to other entities to which the subject could interest, allowing commenting on the project. Below is the list of entities invited to comment:

1. Interministerial Commission for the Global Climate Change (Comissão Interministerial de Mudança Global do Clima – CIMGC)
   Executive Secretary
   Esplanada dos Ministérios, Bloco E,
   CEP: 70067-900, Brasília, DF
   Att: Dr. José Domingos Miguez

2. CETESB - São Paulo State Environmental Agency
   Unified Environmental Agency of Jundiaí city
   Rua João Ferrara, 555
   Jardim Pitangueiras II – Jundiaí - SP
   Cep: 13206 - 714
   Att: Mr. Domenico Tremanholi

3. Brazilian Forum of NGO´s
   Edifício Venâncio-2000
   SCS-Quadro 08-Bloco B-50-Salas 105
   Brasília-DF-CEP: 70.333-900
   Att: Mrs. Esther Neuhaus

4. Brazilian Forum of Climate Change
   IVIG - Virtual Institute of Global Change
   Av. Pedro Calmon, s/nº
   Prédio Anexo ao Centro de Tecnologia
   Cidade Universitária - Ilha do Fundão

CEP: 219495-970
Rio de Janeiro – RJ

5. Federal Public Prosecution Office
SHF Sul Quadra 4 Conjunto C
Brasília, Distrito Federal
CEP: 70050-900

6. Federal Public Prosecution Office
Federal Attorney Service in the State of São Paulo
Rua Peixoto Gomide, 768
Cerqueira César - São Paulo - SP
Cep: 01409-904
Att: Dr. Adriana Zawada Melo

7. São Paulo State Public Prosecution Office
Rua Ademar de Barros, nº 632 - Cidade Nova
Indaiatuba – SP
CEP: 13.330-000
Att: Dr. Fernando Goes Grosso

8. Inadaiatuba City Hall
Avenida Eng. Fábio Roberto Barnabé, 2800
Jardim Esplanada II – Indaiatuba - SP
CEP: 13330 - 900
Att: Mr. Reinaldo Nogueira

9. Indaiatuba City Council
Rua Humaitá, 1167 - Centro
Indaiatuba - SP - CEP 13339-140
Att: Dr. Luis Carlos Chiaparine

No comments where received at this point.

E.2. Summary of the comments received:

No comments where received at this point.

E.3. Report on how due account was taken of any comments received:

No comments where received at this point.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public financing for the project.

Annex 3

BASELINE INFORMATION

Refer to Section B.4

Annex 4

MONITORING INFORMATION

Refer to Sections B.7.1 and B.7.2

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