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:

Projeto de Gás de Aterro TECIPAR – PROGAT
Version 04
Date: 02/04/2009

A.2. Description of the project activity:

The Projeto de Gás de Aterro TECIPAR – PROGAT aims to capture the landfillgas generated at Ventura landfill and use it to generate electricity.

Applying the state of the art on landfill gas capture technology, BIOPAR Soluções Ambientais Ltda. will install a complete gas collection system in whole Ventura landfill, in order to avoid the emission of methane to the atmosphere. Part of the gas captured will be used to generate electricity and the remaining will be flared. The actual practice of Ventura landfill is to emit all gas produced to the atmosphere, without any control or partial destruction, in a passive way through the existing concrete and/or plastic gas wells. The electricity supplied to the grid will displace the same amount of energy produced by fossil fuels.

The project will have a positive impact over sustainable development:

a) Environmental Benefits
An environmental benefit with the implementation of the Projeto de Gás de Aterro TECIPAR – PROGAT is the destruction of methane that otherwise would be emitted to the atmosphere, increasing the impact on global warming. The project will also have another environmental benefit once it will be used to generate electricity, avoiding the generation of the same amount of energy by fossil fuels to the grid.

b) Social / Income Generation Benefits / Labour Capacitating
As landfill gas electricity generation projects is a wide new venture in Brazil (only a few projects are already generating electricity from the landfill gas), new capacitated job positions will be created. A team of engineers and operators will be hired and trained in order to run the project and to make continuous monitoring and maintenance of the collecting system, gas station and power house. These job positions will receive a salary higher than the one actually payed by the market, as the project needs a more skilled labour.

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)	• BIOPAR Soluções Ambientais Ltda. (Brazilian Private Entity)	No

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

BIOPAR Soluções Ambientais Ltda. is a joint-venture between Esergia Estratégias Energéticas Ambientais and TECIPAR.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

Projeto de Gás de Aterro TECIPAR – PROGAT is located at Av. Ouro Branco, 474, Santana de Parnaíba – SP, Brazil

A.4.1.1. Host Party(ies):

Brazil

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

São Paulo

A.4.1.3. City/Town/Community etc:

Santana de Parnaíba

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

Ventura landfill is located at the following Geographic coordinates

23º24’50” S
46º57’28” W

The picture below presents the detailed location of the landfill

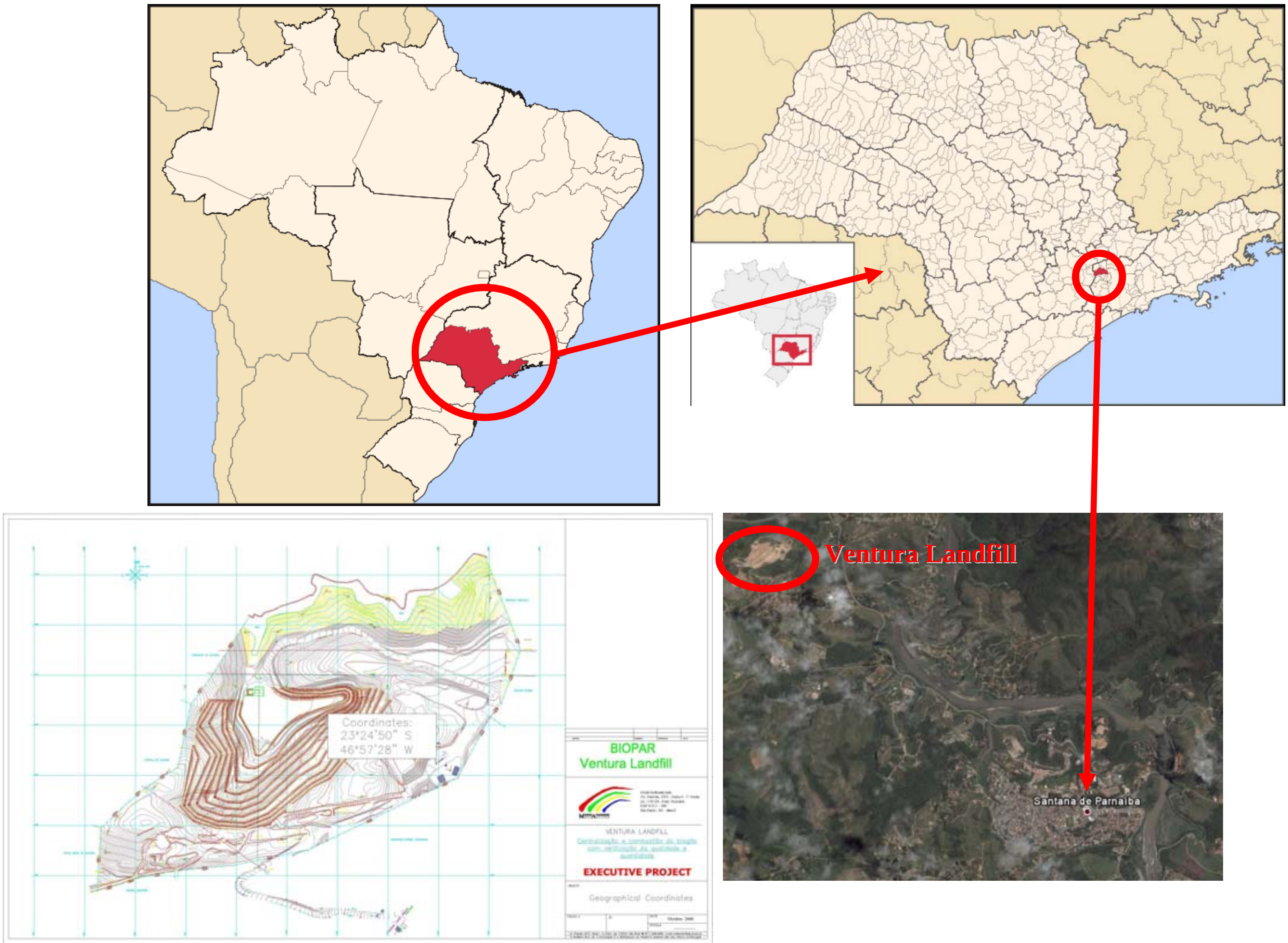


Figure 1. Ventura landfill location
Source: Wikipedia (http://pt.wikipedia.org) and Google Earth

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

The Projeto de Gás de Aterro TECIPAR – PROGAT is categorized in the following Sectoral Scopes:

- *Sectoral Scope 13 – Waste Handling and Disposal:* used to calculate emission reductions due to the production of methane from the decomposition of municipal solid waste to the atmosphere; and

- *Sectoral Scope 1 - Energy industries (renewable - / non-renewable sources):* applied to calculate the grid-emission factor of CO_2e and the emission reductions from the sale of renewable electricity to the grid.

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

The technology to be employed will be the improvement of landfill gas collection and flaring, through the installation of an active recovery system composed by:

- a collection pipeline;

- a transportation pipeline network;
- a blowering system and flaring system (located in the Gas Station); and
- an electricity generation facility.

Figure 2 presents a lay-out of such kind of installation.

Figure 2. Schematic situation of a landfill with active gas recovery

1. Collection System
Considering the dimensions of Ventura landfill, having in mind the LFG capture, the infra-structure was defined based on vertical wells. These elements will be connected to a collection pipeline, which will transport the gas to the Regulation Stations – the Regulation Stations will be used to control the pressure drop from the wells. Some horizontal wells can be drilled if necessary.

BIOPAR Soluções Ambientais Ltda. intends to install initially around 46 new wells directly in the landfill (achieving a total of 68 by the time of the landfill's closure). A cover layer will be installed around the wells in order to avoid gas leakage. Technical analysis might conclude the necessity to install horizontal wells and a final cover layer with HDPE.

The top of the wells will be equipped with a wellhead. This element is important to make the connection between the well and the collection pipeline. Wellheads will be made of HDPE ø 200 mm and 1 m length. In the body of the wellhead, an HDPE ø 90 mm derivation will be constructed and united to a butterfly valve, which will be connected to a HDPE ø 90 mm flexible hose, which will be connected to the collection pipeline.

The collection pipeline will be constructed using HDPE. The dimensioning of the pipeline was made considering the maximum gas production per well. Welding activities will be intense to connect each ramification to the Regulation Station. The cover of the pipeline will be made with any kind of material which does not represent any kind of possible damage to the material.

Some condensate knock-out will be installed in order to drain any quantity of leachate collected with the gas. They will be installed in the lowest points of the collection pipeline and right before the connection to the Regulation Stations. The condensates will be returned to the landfill, via pumps installed in the bottom of the knock-outs.

All wells will be connected to Regulation Stations around the landfill, through the collection pipelines. BIOPAR Soluções Ambientais Ltda. will install 5 Regulation Stations by the time of the landfill's closure around all landfill, each station capable of receiving connections from 12 wells. The basic functions of the stations will be to control and monitor systematically the characteristics of the landfill gas extracted. In each Regulation Station additional condensate separators, regulation valves and flow-valves will be installed.

2. Transmission Pipeline
From the Regulation Stations, the gas is sent to the Gas Station through individual HDPE pipeline. Initially, BIOPAR Soluções Ambientais Ltda. will install 1,183 m of collection pipeline, with the possibility to increase by the time of the landfill's closure.

3. Gas Station
The gas collection will be made through the application of appropriate pressure in each well. The system will be composed by a group of centrifugal multi-stage blowers, connected in apparel with the main collector. The pressuring of the system will depend on the pressure needed by the flares and generators.

The dimensioning of the components is straight connected to the gas production from Ventura landfill; for the project 2 blower of 2,500 Nm^3/h will be installed (one of them as stand-by) and might reach a number of 3 by the time of the landfill's closure, according with the landfill's gas production capacity. Moreover, the Gas Station will have the following elements:

- ON/OFF Security Valve;
- Condensate Separator;
- Gas Analyzer;
- Pressure measurement;
- Temperature measurement;

The gas station will also count with a gas destruction/flaring system. This system will composed by 1 enclosed flares of 2,500 Nm^3/h by the time of the landfill's closure and might reach a number of 2, according with the landfill's gas production capacity. The flare is constructed by a vertical cylindrical combustion chamber, where the biogas is burned in a constant temperature ($\geq$ 1,000°C), controlled by the air admission flow, with a residence time $\geq$ 0.3sec. The flares will have the following characteristics:

Dimensions	Height:	8.5 m

	External Diameter: 2,200 mm
Fuel	Biogas Inlet Pressure: 50 mbar Minimum CH_4 concentration: 30%
Inflaming	Blowed from the base of the flare, through multiple air inlet windows
Load	Maximum: 2,500 Nm^3/h Minimum: 500 Nm^3/h Air ratio: 5:1
Burner	Automatic
Flame Stabilizer:	Continuous control, through UV-sond flame detection
Combustion Chamber	Refractory, 150 mm thick
Combustion Temperature	> 850ºC, for more than >0.3sec;
Crictical Temperature	1,330ºC;
Combustion	Min. 99% (CO_2/CO+CO_2);
Temperature Controller	Continuous, through a Pt–Rh–Pt thermocouple

5. Power House

A Power House will be installed, using appropriate Internal Combustion Engines, to generate electricity. The number of engines will depend on the amount of LFG collected, but it's foreseen that no more than 7 will be in place, by the time of the landfill's closure, achieving a total installed capacity of 6.5 MW. The electricity dispatched to the Brazilian grid will be the total generated minus the internal consumption. While the power house is not installed, the project will consume electricity from the grid. Additionally, an emergency diesel generator will be installed to supply electricity to the project, in cases when grid-supply is interrupted.

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

Years	**Annual estimation of emission reductions in tonnes of CO_2e**
2009	63,292
2010	73,432
2011	80,347
2012	85,083
2013	88,343
2014	90,603
2015	99,054
Total estimated reductions (tonnes of CO_2e)	**580,154**
Total Number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**82,879**

A.4.5. Public funding of the project activity:

There is no public funding involved in Projeto de Gás de Aterro TECIPAR – PROGAT.

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:

Projeto de Gás de Aterro TECIPAR – PROGAT applies the following methodology and tools:

- Version 09.1 of *ACM0001 – Consolidated methodology for landfill gas project activities;*
- Version 05.2 of the *Tool for the demonstration and assessment of additionality;*
- Version 01 of the *Tool to determine project emissions from flaring gases containing methane.*
- Version 01 of the *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* .
- Version 01.1 of the *Tool for calculation of emission factor for electricity systems.*
- Version 02 of the *Tool to calculate project or leakage CO2 emissions from fossil fuel combustion.*
- Version 04 of the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site*.

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

a) ACM0001
Applicability conditions:
This methodology is applicable to landfill 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);
c) The captured gas is used to supply consumers through natural gas distribution network. If emissions reduction are claimed for displacing natural gas, project activities may use approved methodology AM0053.

ACM0001 is applicable to the Projeto de Gás de Aterro TECIPAR – PROGAT because the baseline scenario is the partial or total atmospheric release of the gas (usual practice of the Ventura landfill management) and the project activity includes the flaring and electricity generation of the captured gas.

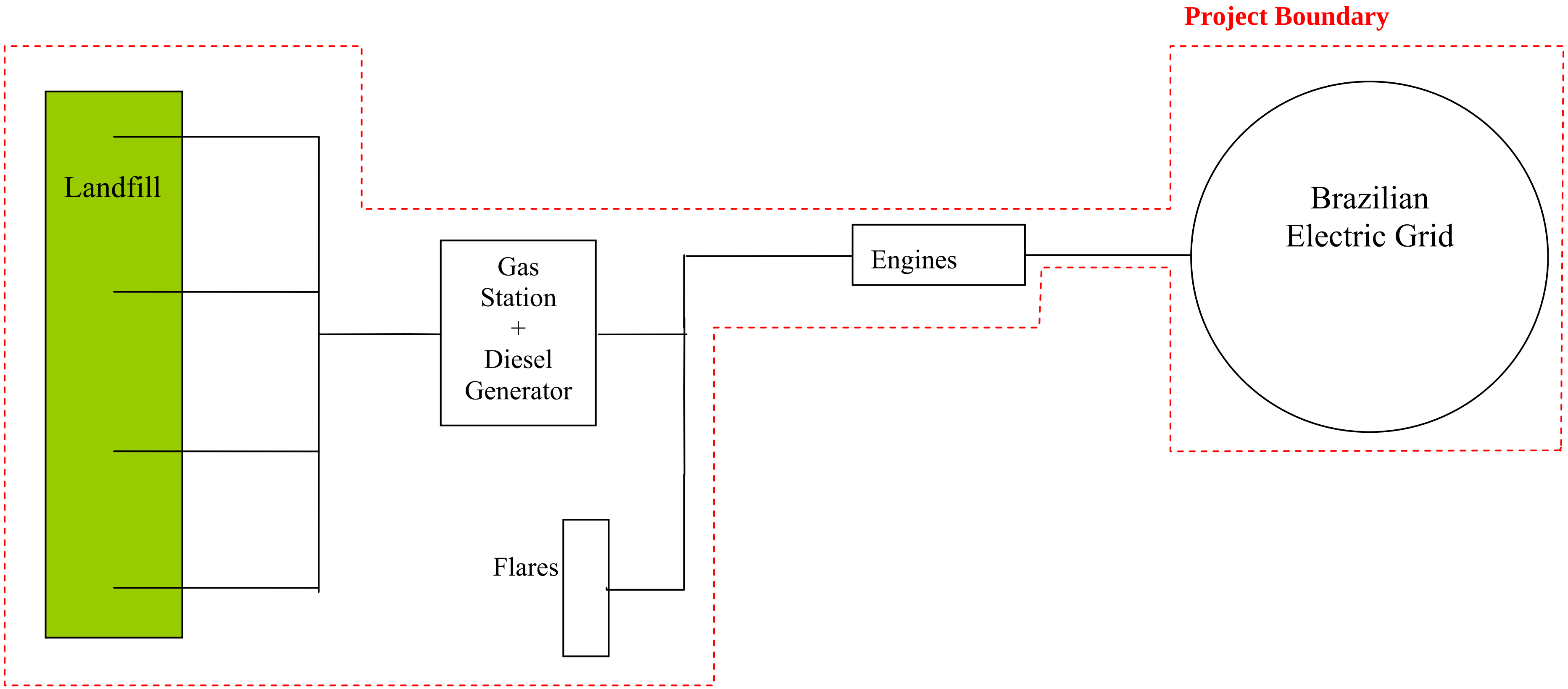
The boundary of the project are Ventura landfill and the all the power generation sources connected to the Brazilian electric grid.

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

	Source	Gas	Included?	Justification / Explanation

Baseline	Emissions from electricity consumption	***CO_2***	***Yes***	***According with the methodology ACM0001, "Electricity may be consumed from the grid or generated onsite/offsite in the baseline scenario".*** ***In the baseline scenario, electricity is consumed to operate the landfill and is assumed to be very small, compared with the project's consumption. For simplification, this source will be excluded from baseline emissions.***
		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 emission source was neglected because the project activity won't consume/generate thermal energy
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
	Emissions from decomposition of waste at the landfill site	CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted.
		CH_4	***Yes***	***The major source of emissions in the baseline.***
		N_2O	No	N_2O emissions are small compared to CH_4 emissions from landfills. Exclusion of this gas is conservative.
Project Activity	On-site fossil fuel consumption due to the project activity other than for electricity generation	CO_2	No	This source of project emissions will be neglected as no fossil fuel will be used on-site.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from on-site electricity use	***CO_2***	***Yes***	***Before the construction of the Power house, electricity used on-site will be consumed from the grid. Additionally, an emergency disesl-generator will be installed to supply electricity to the project in cases of grid-supply interruption.***
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

The following diagram presents the boundaries of the project:


Project Boundary
Landfill
Gas
Station
+
Diesel
Generator
Engines
Brazilian
Electric Grid
Flares

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

a) ACM0001

According with ACM0001, the procedure to select the most plausible baseline scenario is:

Step 1: Identification of alternative scenarios.

The following realistic and credible alternatives are identified to the project, according with the *Tool for the demonstration and assessment of additionality* – version 05.2:

a) Project Activity undertaken without being registered as a CDM Project Activity

b) Continuation of the landfill operation (Business as Usual – BAU scenario);

c) Implementation of the CDM project activity considering only the LFG destruction in flares;

d) Implementation of the CDM project activity considering LFG use in boilers to generate heat;

In Brazil, there are no policies regarding mandatory landfill gas capture or destruction requirements due to safety issues or local environmental regulations nor policies which promote the productive use of landfill gas such as those for the production of renewable energy, or those that promote the processing of organic waste.

Since 2000, the *Política Nacional de Resíduos Sólidos* (National Solid Waste Policy) has been under discussion, but no further conclusion was taken. The scope of the policy is to obligate the use of engineering technologies to transform open dumps on sanitary landfill, applying NBR 81419 (Brazilian Standard on the presentation of landfill design projects). However, the Policy does not foreseen neither obligation on landfill gas destruction and the promotion of the landfill gas use such as those for the production of renewable energy, or those that promote the processing of organic waste.

In 2002, the *PROINFA – Programa de Incentivo a Fontes Alternativas* was created, in order to incentive the generation of 3,300 MW of renewable sources to generate electricity, divided in three groups: wind-energy (1,100 MW), small-hydro power plants (1,100 MW) and biomass (1,100 MW, including bagasse, wood, solid waste, rice husk, etc.). Despite of achieving the goals, no landfill-gas-to-energy project was implemented due to the low price paid for the MWh produced.

The following table presents an analysis of the compliance of the alternatives listed previously with the local/national regulation.

Alternative	Compliance with Local / National Policies	Observations
Project Activity undertaken without being registered as a CDM Project Activity	✓	
BAU scenario	✓	▪ Ventura landfill has an authorization to operate, emitted from the environmental authority;
LFG destruction in flares	✓	▪ There is no law which obligates the landfill do destroy the gas produced nor due to local environmental regulations,

		nor due to GHG reductions;
LFG use to generate electricity	✓	▪ There is no law which obligates the landfill do destroy the gas produced nor due to local environmental regulations, nor due to GHG reductions; ▪ There are no policies to promote the use of LFG to produce electricity;
LFG use in boilers to generate heat	✓	▪ There is no law which obligates the landfill do destroy the gas produced nor due to local environmental regulations, nor due to GHG reductions; ▪ There are no policies to promote the use of LFG to produce heat in boilers;

As will be explained ahead, Ventura landfill does not have any legal/contractual obligation on destroying the methane generated; however, there exists a gas exhaust system made of PDR wells used to alleviate the landfill's internal pressure and some of the gas is destroyed in the top of the system – it's estimated that 5% of the methane generated is destroyed; thus AF = 0.05.

In order to identify the most plausible baseline scenario, it's necessary to demonstrate:

- what would happen with the LFG;
- what would happen with the power generation; and
- what would happen with the heat generation in the absence of the project activity.

The table below presents the alternatives to the LFG and the conclusions for each alternative:

SCENARIO	OBSERVATIONS
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.	This alternative is ***applicable***, as the incomes from the electricity sale could make the project economically attractive (as will be presented in STEP 2 of the Additionality Assessment, despite of the incomes from the electricity sale, the project is not financially attractive and the CERs revenues are an additional income which amortizes the investments in the LFG collection system and electricity generation).
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 odour concerns.	This alternative is ***applicable*** because without the project activity the LFG generated would continue to be emitted to the atmosphere in an uncontrolled manner as there are no legal/contractual obligations to destroy the gas.

Concerning the power generation, the table below presents the realistic and credible alternative(s) and the observations:

SCENARIO	OBSERVATIONS
P1 Power generated from landfill gas undertaken without being registered as CDM project activity.	This alternative is ***applicable***, as the incomes from the electricity sale could make the project economically attractive (as will be presented in STEP 2 of the Additionality Assessment, despite of the incomes from the electricity sale, the project is not financially attractive and the

	CERs revenues are an additional income which amortizes the investments in the LFG collection system and electricity generation).
P2 Existing or construction of a new on-site or off-site fossil fuel fired cogeneration plant.	This alternative is **not applicable** because using fossil fuel is not the best alternative, once LFG is available and in abundance in the landfill. Moreover, BIOPAR Soluções Ambientais Ltda. core business is energetic use of the landfill gas.
P3 Existing or construction of a new on-site or off-site renewable based cogeneration plant.	This alternative is **not applicable** because LFG can be fired directly to generate electricity and there is no need for heat in Ventura landfill. Moreover, BIOPAR Soluções Ambientais Ltda. core business is energetic use of the landfill gas.
P4 Existing or construction of a new on-site or off-site fossil fuel fired captive power plant.	This alternative is **not applicable** because LFG can be fired directly to generate electricity and there is no need for heat in Ventura landfill. Moreover, BIOPAR Soluções Ambientais Ltda. core business is energetic use of the landfill gas.
P5 Existing or construction of a new on-site or off-site renewable based captive power plant.	This alternative is **not applicable** because Ventura landfill has enough gas to generate more electricity than is consumed internally.
P6 Existing and/or new grid-connected power plants.	This alternative is ***applicable*** to the project activity. Electricity could be consumed from the grid if no power generation occurred.

No heat scenarios will be analyzed as the project does not foreseen the heat generation/consumption.

STEP 2: Identify the fuel for the baseline choice of energy source taking into account the national and/or sectoral policies as applicable.
This step is not applicable as no fossil fuel is consumed in the baseline by the Projeto de Gás de Aterro TECIPAR – PROGAT.

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 (e.g. alternatives facing prohibitive barriers or those clearly economically unattractive).
Please, refer to B.5.

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.
According with *Step 2* and *Step 3* of the *Tool for the demonstration and assessment of additionality*, the only alternative remaining, among those presented in *STEP1*, is the BAU scenario (please, refer to B.5).

As per methodology ACM0001, Projeto de Gás de Aterro TECIPAR – PROGAT corresponds to Scenario 1.

Scenario	Baseline			Description of the situation
	Landfill gas	Electricity	Heat	
1	LFG2	P6	N/A	The atmospheric release of landfill gas or landfill gas is partially captured and subsequently flared. The electricity is obtained from the grid.

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):

Application of the *Tool for the demonstration and assessment of additionality***.**

BIOPAR Soluções Ambientais was created in 17/01/2008, with the clear objective to exploit the LFG produced in the Ventura Landfill under the Kyoto Protocol, as stated in the Article 3rd of the Company's Social Contract.

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

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

All alternatives to the project activity were presented in the Item B.4.

Sub-step 1b. Consistency with mandatory laws and regulations:

All alternatives are in accordance with mandatory laws and regulations, as presented in the Item B.4.

STEP 2: Investment analysis

Sub-step 2a: Determine appropriate analysis method

The analysis method chosen was *Option III – Benchmark Analysis*.

Sub-step 2b: Option III. Apply benchmark analysis

Investment analysis will be made through the IRR of the three alternatives (continuation of the BAU practice; flaring of LFG; electricity generation) without the CERs revenues. The economic analysis will be made through a 21-years period.

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Options II and III):

<u>Alternative 1: Continuation of the BAU practice</u>
Under this scenario, methane is emitted in a passive way to the atmosphere and no investment is made in a landfill gas destruction system. Thus, no capital compromise is foreseen.

<u>Alternative 2: Flaring of landfill gas</u>
Under this scenario, the investments needed on the gas collection system and Gas Station are:

INVESTMENT COSTS			
Description	**Num**	**€**	**R$ (1 € = 2.7 R$)**
Flares	1	€ 610,000.00	R$ 1,647,000.00
Pipeline, containers and transformers	1	€ 200,000.00	R$ 540,000.00

Civil Works	1	€	15,000.00	R$	40,500.00
Transport and imports(50% of the flares)	50%	€	305,000.00	R$	823,500.00
Executive Project	1	R$	120,000.00	R$	120,000.00
Blower	1	R$	150,000.00	R$	150,000.00
Installation Costs	1	R$	80,000.00	R$	80,000.00
Rate €/R$	2.7				
		TOTAL			**R$ 3,513,330.62.**
O&M				**R$**	**438,880/year**

As there are no sources of income from the destruction of methane, the capital invested will never return and there is no IRR.

Alternative 3: Electricity Generation
Under this scenario, the sale of electricity is a source of income to the project, which is expected to be operational from 2015 on. In order to analyze if this receipt is financially attractive, a benchmark comparison was undertaken, based on the project's IRR.

BIOPAR Soluções Ambientais Ltda. will install the electricity generators in different steps, according with the gas production capacity of the landfill (please, refer to Annex 3)

The prices of each component are presented below:

ITEM	EQUIPMENTS	€	R$ (1 € = 2.7 R$)
Grid-connection and LFG cleaning systems	A = Supervision, control and anti-fire system	-	R$ 280,800.00
	B = LFG cleaning	-	R$ 1,358,100.00
	C = Connection to the gas lines and instrumentation	-	R$ 189,000.00
	D = Transport and importation (60% of B and C)	-	R$ 928,260.00
Engines and auxiliary equipments	E = 1 individual modular engine (container)	€ 503,000.00	R$ 1,358,100.00
	F = 01 Auxiliary installations and assembly	€ 126,666.67	R$ 342,000.00
	G = 01 Electric sections and connections	€ 60,500.00	R$ 163,350.00
	H = Transport and imports (60% of E, F and G)	-	R$ 1,118,070.00
O&M Costs (R$/year)	Personnel (4 operators)		R$ 120,000.00
	"Full service" maintenance		71.54 R$/MWh
	Lubrificants (included in "full-service")		-
	Electric devices maintenance		R$ 150,000.00

For the financial analysis, the following assumptions were adopted:

- Initial price of the electricity exported = 169 R$/MWh, based on the PROINFA tariff[1];
- Initial operational cost = 71.54 R$/MWh
- Inflation rate = +4% per year;

The costs of the collection and flaring systems are the same presented above.

The following cash-flow is presented:

[1] http://www.nae.gov.br/cadernos_nae/04caderno_mudancasclimaticasquioto.pdf. The PROINFA tariff was adopted, concerning the low price of the MWh paied in the last auction of electricity in Brazil (R$ 150.00/MWh)

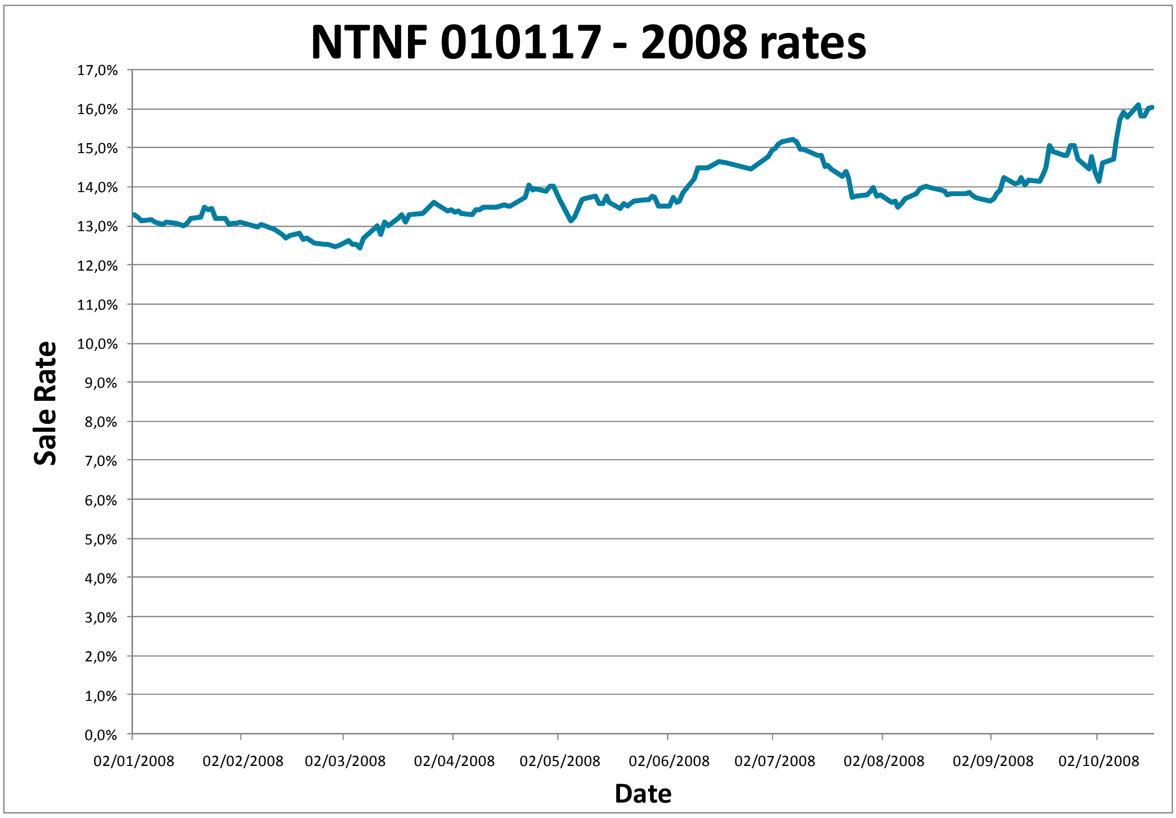
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
R$ 0.00	***R$ 0.00***	***R$ 0.00***	***R$ 0.00***	***R$ 0.00***	***R$ 0.00***	***R$ 0.00***	***R$ 8,298,620.59***	***R$ 8,630,565.41***	***R$ 10,244,049.10***	***R$ 10,932,624.89***	
R$ 0.00	R$ 0.00	R$ 0.00	R$ 0.00	R$ 0.00	R$ 0.00	R$ 0.00	R$ 6,306,269.61	R$ 6,306,269.61	R$ 7,197,333.01	R$ 7,385,689.65	
R$ 0.00	R$ 0.00	R$ 0.00	R$ 0.00	R$ 0.00	R$ 0.00	R$ 0.00	R$ 8,298,620.59	R$ 8,630,565.41	R$ 10,244,049.10	R$ 10,932,624.89	
R$ 0.00	***R$ 0.00***	***R$ 0.00***	***R$ 0.00***	***R$ 0.00***	***R$ 0.00***	***R$ 0.00***	***R$ 8,298,620.59***	***R$ 8,630,565.41***	***R$ 10,244,049.10***	***R$ 10,932,624.89***	
-R$ 438.880,25	**-R$ 2,066,711.19**	**-R$ 2,249,381.70**	**-R$ 2,853,344.66**	**-R$ 2,967,478.45**	**-R$ 3,642,106.68**	**-R$ 3,787,790.95**	**-R$ 4,540,595.49**	**-R$ 4,722,219.31**	**-R$ 5,447,980.26**	**-R$ 5,783,925.15**	
-R$ 438,880.25	**-R$ 456,435.46**	**-R$ 474,692.88**	**-R$ 493,680.59**	**-R$ 513,427.82**	**-R$ 533,964.93**	**-R$ 555,323.53**	**-R$ 577,536.47**	**-R$ 600,637.93**	**-R$ 624,663.45**	**-R$ 649,649.98**	
R$ 0.00	**R$ 0.00**	**R$ 0.00**	**R$ 0.00**	**R$ 0.00**	**R$ 0.00**	**R$ 0.00**	**-R$ 3,963,059.02**	**-R$ 4,121,581.39**	**-R$ 4,823,316.81**	**-R$ 5,134,275.17**	
-R$ 3.513.330,62						**-R$ 30,546,015.81**			**-R$ 4,079,430.63**		
-R$ 3.513.330,62											
						-R$ 30,546,015.81					
									-R$ 4,079,430.63		
R$ 0.00	***R$ 0.00***	***R$ 0.00***	***R$ 0.00***	***R$ 0.00***	***R$ 0.00***	***R$ 0.00***	***-R$ 912,848.26***	***-R$ 949,362.20***	***-R$ 1,126,845.40***	***-R$ 1,202,588.74***	
-R$ 3,952,210.87	***-R$ 456,435.46***	***-R$ 474,692.88***	***-R$ 493,680.59***	***-R$ 513,427.82***	***-R$ 533,964.93***	***-R$ 31,101,339.34***	***R$ 2,845,176.83***	***-R$ 1,120,446.72***	***R$ 3,669,223.44***	***R$ 3,946,111.00***	
1.0000	**1.0400**	**1.0816**	**1.1249**	**1.1699**	**1.2167**	**1.2653**	**1.3159**	**1.3686**	**1.4233**	**1.4802**	
-R$ 3,952,210.87	***-R$ 438,880.25***	***-R$ 438,880.25***	***-R$ 438,880.25***	***-R$ 438,880.25***	***-R$ 438,880.25***	***-R$ 24,579,840.25***	***R$ 2,162,100.56***	***-R$ 818,699.44***	***R$ 2,577,947.72***	***R$ 2,665,851.20***	
Inflation to discount the Cash-Flow											
Free Cash-Flow (R$) - CONSTANT											

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Gross Incomes (R$)	R$ 11,369,929.88	R$ 9,818,742.77	R$ 8,476,570.69	R$ 7,182,006.05	R$ 5,525,311.79	R$ 5,603,613.34	R$ 3,873,574.41	R$ 4,028,517.39	R$ 3,861,143.54	R$ 1,992,102.19	R$ 2,071,786.28
(+) Incomes from Electricity Sale CONSTANT	R$ 7,385,689.65	R$ 6,132,757.77	R$ 5,090,808.70	R$ 4,147,429.54	R$ 3,068,009.51	R$ 2,991,814.97	R$ 1,988,589.47	R$ 1,988,589.47	R$ 1,832,662.53	R$ 909,169.44	R$ 909,169.44
(+) Incomes from Electricity Sale NOM	R$ 11,369,929.88	R$ 9,818,742.77	R$ 8,476,570.69	R$ 7,182,006.05	R$ 5,525,311.79	R$ 5,603,613.34	R$ 3,873,574.41	R$ 4,028,517.39	R$ 3,861,143.54	R$ 1,992,102.19	R$ 2,071,786.28
(=) Gross incomes from electricity sale (R$)	R$ 11,369,929.88	R$ 9,818,742.77	R$ 8,476,570.69	R$ 7,182,006.05	R$ 5,525,311.79	R$ 5,603,613.34	R$ 3,873,574.41	R$ 4,028,517.39	R$ 3,861,143.54	R$ 1,992,102.19	R$ 2,071,786.28
(-) Operational Costs and Expenditures (R$)	-R$ 6,015,282.16	-R$ 5,406,732.99	-R$ 4,888,586.30	-R$ 4,392,593.02	-R$ 3,745,385.87	-R$ 3,834,789.83	-R$ 3,160,948.97	-R$ 3,287,386.93	-R$ 3,279,817.73	-R$ 2,554,440.81	-R$ 2,656,618.45
O&M 1 - Gas - NOM	-R$ 675,635.98	-R$ 702,661.42	-R$ 730,767.88	-R$ 759,998.59	-R$ 790,398.54	-R$ 822,014.48	-R$ 854,895.06	-R$ 889,090.86	-R$ 924,654.50	-R$ 961,640.67	-R$ 1,000,106.30
O&M 2 - Electricity Generation – NOM	-R$ 5,339,646.18	-R$ 4,704,071.57	-R$ 4,157,818.43	-R$ 3,632,594.42	-R$ 2,954,987.34	-R$ 3,012,775.35	-R$ 2,306,053.91	-R$ 2,398,296.07	-R$ 2,355,163.23	-R$ 1,592,800.14	-R$ 1,656,512.14
(-) CAPEX (R$)											
CAPEX 1 (Gas Collection System) NOM											
CAPEX 2 (Acquisition of 6 engines 2014) NOM											
CAPEX 3 (Acquisition of +1 engine 2016) NOM											
(=) EBIT (R$)	R$ 5,354,647.72	R$ 4,412,009.78	R$ 3,587,984.39	R$ 2,789,413.04	R$ 1,779,925.92	R$ 1,768,823.51	R$ 712,625.44	R$ 741,130.46	R$ 581,325.81	-R$ 562,338.62	-R$ 584,832.17
(-) Income Taxes (IR & CSLL = 11%) (R$)	-R$ 1,250,692.29	-R$ 1,080,061.71	-R$ 932,422.78	-R$ 790,020.67	-R$ 607,784.30	-R$ 616,397.47	-R$ 426,093.19	-R$ 443,136.91	-R$ 424,725.79	-R$ 219,131.24	-R$ 227,896.49
Free Cash-Flow (R$) – NOM	R$ 4,103,955.44	R$ 3,331,948.08	R$ 2,655,561.61	R$ 1,999,392.37	R$ 1,172,141.62	R$ 1,152,426.04	R$ 286,532.26	R$ 297,993.55	R$ 156,600.02	-R$ 781,469.86	-R$ 812,728.66
Inflation to discount the Cash-Flow	1.5395	1.6010	1.6651	1.7317	1.8009	1.8730	1.9479	2.0258	2.1068	2.1911	2.2788
Free Cash-Flow (R$) – CONSTANT	R$ 2,665,851.20	R$ 2,081,124.94	R$ 1,594,861.49	R$ 1,154,599.28	R$ 650,848.64	R$ 615,289.68	R$ 147,098.00	R$ 147,098.00	R$ 74,329.01	-R$ 356,652.64	-R$ 356,652.64

The electricity tariff is readjusted every year, according with an estimated inflation rate of +4% per year – the reference tariff was adopted from the value payed by PROINFA to landfill-gas-to-energy projects (R$ 169/$MWh_{exported}$) and the reference operational cost was R$ 71.54/$MWh_{exported}$.

The official benchmark used to compare the attractiveness of the project ws the treasury bonds, a low-risk long-term investment indicator from the National Treasury. For the Projeto de Gás de Aterro TECIPAR – PROGAT, NTNF 010117 was used for comparison.

NTNF 010117 is a Treasury Government's Bond, with pre-fixed remuneration and not indexed to any financial indicator (inflation, interest rate – SELIC rate, foreign currency, etc), thus it's risk-free. As presented in the graphic below, this bond has a regular variation and hasn't dropped below 12% in 2008:



As the decision to proceed with the project was taken in 01/07/2008 (please, refer to C.1), the average of the index from January/2008 to 30/06/2008 (13.35%[2]) was calculated and used to determine the rate reference for the financial analysis comparison. This average NTNF 010117pays much higher interest than the value undetermined for the project activity without CER's revenues.

Sub-step 2d: Sensitivity analysis (only applicable to Options II and III):
The main variables affecting the IRR can be considered the price of the MWh exported, the CAPEX and O&M costs. An analysis was made, considering the variation of from +5% to + 15% in the price of the electricity sold and from -5% to-15% in the CAPEX of the Gas Collection

[2] Tesouro Nacional - Preços e taxas dos títulos públicos disponíveis para compra; available at http://www.tesouro.fazenda.gov.br/tesouro_direto/download/historico/2008/historicoNTNF_2008.xls

system ($CAPEX_{Gas}$), from -5% to -15% in the CAPEX of the Electricity Generation ($CAPEX_{Electricity}$) and from -5% to -15% in the Operational Costs of the Gas Collection (OM_{Gas}) and Electricity Generation ($OM_{Electricity}$). The table below presents the final result of the variation:

Variable	Variation	IRR
CAPEX Gas	-5%	**N/A**
	-10%	**N/A**
	-15%	**N/A**
OPEX Gas	-5%	**N/A**
	-10%	**N/A**
	-15%	**N/A**
CAPEX Electricity	-5%	**N/A**
	-10%	**N/A**
	-15%	**N/A**
OPEX Electricity	-5%	**N/A**
	-10%	**N/A**
	-15%	**N/A**
Price Electricity	+ 5%	**N/A**
	+ 10%	**N/A**
	+ 15%	**1.437%**

The result of no values of IRR calculated is due to the non-existence of positive incomes in the period analyzed.

The results of the sensitivity analysis resulted that even if the electricity sale (the main source of income) vary more than 15%, the project IRR will still be way below the NTNF 010117.

The box below presents the outcome of **Step 2:**

Alternative	Financial Conclusion
BAU situation (landfill's operation)	N/A, as this situation does not involve any kind of investment.
Only flaring of landfill gas	Investment in a gas collection and flaring system will never return, as the only source of income is the sale of CERs.
Generation of electricity	Even when the electricity generation (the main source of income) varies 15%, the result of the cash-flow's IRR, 1.437%, is still below the values of NTNF 010117 (13.35%)

STEP 3. Barrier analysis

The Barrier Analysis will not be applied, as the project proponents decided to demonstrate the financial viability of the project.

STEP 4. Common practice analysis

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

The main national data concerning the actual stage of landfills in Brazil are from SNIS – Sistema Nacional de Informações sobre Saneamento. SNIS evaluated, among other topics, if the Solid Waste Disposal Sites (including open dumps, controlled landfills and sanitary landfills) have implemented a system of LFG use (for electricity/heat generation or other uses). Data was consolidated in the table Up03[3], as presented below:

Table 1. Landfills identified in Table Up03 of SNIS

CITY/STATE	Name of the Site
Alagoinhas/BA	Aterro Sanitário
Alcântara/MA	LIXÃO DO PAVÃO
Alta Floresta D'Oeste/RO	Lixão Municipal
Altos/PI	Lixão
Alvorada do Gurguéia/PI	Lixão do Alvorada do Gurgueia
Amargosa/BA	Lixão
Anápolis/GO	Aterro Sanitário de Anápolis
Antonina/PR	Lixão Antonina
Aparecida de Goiânia/GO	Aterro Sanitário
Aparecida de Goiânia/GO	Lixão desativado e em recuperação
Aquiraz/CE	Aterro Sanitário
Aracaju/SE	Aterro Controlado do Bairro Santa Maria
Araçuaí/MG	Aterro
Araguaína/TO	Aterro Controlado de Resíduos Sólidos
Arapiraca/AL	Aterro Sanitário
Araraquara/SP	Aterro Controlado
Arcos/MG	Aterro Amâncio Alves
Avelino Lopes/PI	Lixão
Bagé/RS	Aterro Sanitário Municipal
Barbacena/MG	Aterro Controlado
Barra do Piraí/RJ	Vazadouro de Lixo Municipal
Bauru/SP	Aterro Sanitário de Bauru
Belém/PA	Aterro Sanitário do Aurá
Belo Horizonte/MG	CTRS BR040
Benevides/PA	Lixão Bairro das Flores
Betim/MG	Aterro Sanitário
Biguaçu/SC	Aterro Proactiva
Biguaçu/SC	Aterro Sanitário Tijuquinhas
Blumenau/SC	Aterro Controlado
Boa Vista/RR	Aterro Sanitário
Bom Jesus/PI	Lixão
Brasília/DF	Aterro do Jóquei
Brumadinho/MG	Aterro Controlado

[3] SNIS – Sistema Nacional de Informações sobre Saneamento; available at http://www.snis.gov.br/arquivos_snis/5_DIAGNOSTICOS/5.2_Residuos_solidos/5.2.5_Diagnostico2006/RSD05_Planilhas.zip (Table RSD05_Up03); accessed on 02 Apr 2009.

Buritis/MG	Lixão
Cáceres/MT	Aterro Controlado de Cáceres
Caicó/RN	Sítio Várzea Redonda ou Gruta do Seridó
Camaçari/BA	Aterro Integrado Camaçari / Dias D'Ávila
Campina Grande/PB	Lixão
Campinas/SP	Aterro Sanitário
Campo Grande/MS	Aterro Sanitário Municipal
Campo Verde/MT	Lixão
Canindé de São Francisco/SE	Unidade de Disposição Final - Lixão
Canto do Buriti/PI	Lixão
Cariacica/ES	Célula de Resíduos Classe II
Carlos Chagas/MG	Aterro Controlado
Caruaru/PE	Aterro Sanitário
Cascavel/PR	Aterro Sanitário
Castanhal/PA	Lixão do Pantanal
Caxias do Sul/RS	Aterro São Giacomo
Chapecó/SC	Aterro Sanitário
Cianorte/PR	Aterro Sanitário SANEPAR
Coimbra/MG	Usina de Lixo
Colatina/ES	CETREU / Aterro Sanitário
Colinas do Tocantins/TO	Lixão
Contagem/MG	Aterro Sanitário Perobas
Corumbá/MS	Aterro Municipal de Corumbá
Criciúma/SC	SANTEC - Resíduos
Cuiabá/MT	Aterro Sanitário
Curaçá/BA	Lixão de Curaçá
Curitiba/PR	Aterro Sanitário da Caximba
Diamantina/MG	Aterro Controlado do Município de Diamantina
Dois Irmãos/RS	Aterro Sanitário
Dourados/MS	Aterro controlado
Dourados/MS	Aterro Sanitário
Engenheiro Coelho/SP	Aterro Sanitário
Erechim/RS	Aterro Controlado
Extremoz/RN	Aterro Controlado Comunidade de Capim
Farroupilha/RS	Aterro Sanitário
Feira de Santana/BA	Aterro Sanitário de Feira de Santana
Floriano/PI	Aterro Sanitário de Floriano-PI
Foz do Iguaçu/PR	Aterro Sanitário
Franca/SP	Aterro Fazenda Municipal
Franca/SP	Aterro Sanitario Ivan Vieira
Goiânia/GO	Aterro Sanitário de Goiânia
Goiás/GO	Lixão
Governador Valadares/MG	Aterro Controlado
Gravataí/RS	Aterro Sanitário Metropolitano de Santa Tecla
Gravataí/RS	Aterro Santa Tecla
Guarapuava/PR	SURG - Cia de Serviços de Urbanização de Guarapuav
Guararema/SP	Aterro Sanitário
Guarulhos/SP	Aterro Sanitário de Guarulhos - Quitauna

Guarulhos/SP	Lixão Quitauna
Horizonte/CE	Aterro da Pedreira
Ibiporã/PR	Aterro Controlado de Ibiporã
Iguape/SP	Aterro Sanitario
Imperatriz/MA	Aterro Controlado
Independência/CE	São Jerônimo
Ipameri/GO	Aterro Controlado de Ipameri
Itabira/MG	Aterro Controlado
Itabuna/BA	Volta da Cobra
Itajaí/SC	Aterro Sanitário Canhanduba
Itajubá/MG	Aterro Controlado do Município de Itajubá
Itapissuma/PE	Lixão
Jaboatão dos Guararapes/PE	Aterro da Muribeca
Jataizinho/PR	PREFEITURA MUNICIPAL DE JATAIZINHO
João Câmara/RN	Liffe
João Monlevade/MG	
João Monlevade/MG	Lixão do Andrade
João Pessoa/PB	Aterro Sanitário Metropoltano
João Pessoa/PB	Lixão do Róger
Joinville/SC	aterro sanitário
José de Freitas/PI	Lixão José de Freitas
Juazeiro/BA	Secretaria de Transporte e Serv. Publicos
Juína/MT	Aterro Controlado
Juiz de Fora/MG	Aterro Sanitário
Lages/SC	Aterro Sanitário do Município de Lages
Lages/SC	Aterro Sanitário do Município de Lages
Lagoa Grande/PE	LIXÃO
Londrina/PR	Aterro Controlado
Macapá/AP	Carapirás
Maceió/AL	Lixão de Cruz das Almas /SLUM
Manaus/AM	Aterro do KM 19
Marabá/PA	Aterro Sanitário de Marabá
Maracaju/MS	Aterro Controlado de Maracaju
Marau/RS	Central Regional de Resíduos Sólidos
Marechal Cândido Rondon/PR	Lixão
Maringá/PR	Aterro Controlado de Maringa
Mauá/SP	LARA Central de Trat. Resíduos
Miracema do Tocantins/TO	Lixão
Monteiro/PB	Unid. de Reciclagem e Compostagem de Res. Sólidos
Montes Claros/MG	Aterro Municipal
Mossoró/RN	Lixão de Cajazeiras
Nísia Floresta/RN	LIXÃO
Niterói/RJ	Aterro Controlado do Morro do Céu
Nossa Senhora da Glória/SE	Lixão
Nossa Senhora do Socorro/SE	ATERRO CONTROLADO DA PALESTINA
Nova Esperança/PR	Aterro Controlado
Nova Friburgo/RJ	Aterro Controlado
Nova Hartz/RS	Lixão

Nova Iguaçu/RJ	CTR - Nova Iguaçu
Nova Lima/MG	Aterro de Inertes
Nova Lima/MG	Aterro Sanitário Norte
Novo Hamburgo/RS	Aterro Sanitário do Bairro Roselândia
Olinda/PE	Aterro de Resíduos Sólidos de Aguazinha
Paço do Lumiar/MA	Lixão
Padre Bernardo/GO	Aterro Sanitário
Palmas/TO	Aterro Sanitário de Palmas
Paracatu/MG	Aterro Controlado de Paracatu
Paranaguá/PR	Lixão do Imbocuí
Parnaíba/PI	Aterro Controlado de Parnaíba
Passo Fundo/RS	Aterro Controlado
Pau dos Ferros/RN	Lixão
Paulínia/SP	Aterro Sanitário de Paulinia - Estre
Paulo Afonso/BA	USINA DE TRIAGEM E COMPOSTAGEM DE LIXO DE PAULO AF
Pelotas/RS	Aterro Colina do Sol
Penápolis/SP	Aterro Sanitário
Picos/PI	Lixão
Piranhas/AL	Lixão
Poços de Caldas/MG	Aterro Controlado
Porto Alegre/RS	Aterro da Extrema
Porto Nacional/TO	Diretoria de Limpeza Urbana (Aterro)
Porto Velho/RO	Lixão Km 18
Presidente Prudente/SP	Lixão
Registro/SP	Lixão Carapiranga
Rio Branco/AC	Aterro Controlado de Lixo
Rio de Janeiro/RJ	CTR - Rio
Rio de Janeiro/RJ	CTR Gericinó
Rio Formoso/PE	Aterro Sanitário, Usina de Recilágem e Compostagem
Rio Grande/RS	Rio Grande
Rio Verde/GO	Aterro Controlado
Rondonópolis/MT	Lixão de Rondonópolis
Sabará/MG	Centro de Disposição de Resíduos - Macaúbas
Salvador/BA	Aterro Controlado de Canabrava
Salvador/BA	Aterro Metropolitano Centro
Santa Bárbara d'Oeste/SP	Aterro Sanitario Municipal de Santa Bárbara d'Oest
Santa Cecília do Pavão/PR	Aterro Sanitário
Santa Cruz/RN	Lixão Municipal de Santa Cruz
Santa Luzia/MA	S. Pinho Costa Limpeza/ME
Santa Maria/RS	Aterro da Gaturrita
Santarém/PA	Aterro Municipal do Perema
Santo André/SP	Aterro Sanitário Municip. (Empreit. Pajoan)
Santos/SP	Aterro Sanitário Sítio das Neves
São Félix do Araguaia/MT	Lixão
São Gonçalo/RJ	Aterro de Itaoca - CTR Alcantara
São João Batista do Glória/MG	Aterro Controlado
São José do Rio Preto/SP	Aterro Municipal
São José dos Campos/SP	Estação de Tratamento de Resíduos Sólidos

São Leopoldo/RS	Aterro Sanitario Municipal
São Luís/MA	Aterro Municipal da Ribeira
São Mamede/PB	Aterro Sanitário
São Mamede/PB	ATERRO SANITÁRIO DE SÃO MAMEDE
São Miguel do Araguaia/GO	Aterro Controlado
São Paulo/SP	Aterro Bandeirantes
São Paulo/SP	Aterro São João
Senhor do Bonfim/BA	Lixão
Serra/ES	Aterro Sanitário de Vila Nova de Colares
Sete Lagoas/MG	Disposição Final de Resíduos Sólidos
Sobral/CE	Aterro Sanitário de Sobral
Sobral/CE	Central de Controle de Lixo do Distr. de Aprazível
Sobral/CE	Central de Controle de Lixo do Distr. de Caracará
Sobral/CE	Central de Controle de Lixo do Distr. de Taperuaba
Sobral/CE	Central de Controle de Lixo do Distr.de Aracatiaçu
Tabatinga/AM	Lixeira Municipal
Taiobeiras/MG	Aterro Controlado
Teresina/PI	Aterro Sanitário
Timbó/SC	Serviço Municipal de Água e Esgoto
Timon/MA	Aterro Sanitário
Toledo/PR	Aterro Sanitário
Torres/RS	Aterro Controlado
Tremembé/SP	Sarpi Sistema Ambiental Cia. Ltda
Uberaba/MG	Aterro Sanitário
Uberlândia/MG	Aterro Sanitário Municipal
União da Vitória/PR	Aterro Sanitário Municipal
Uruguaiana/RS	Lixão
Urussanga/SC	CIRSURES
Valparaíso de Goiás/GO	Lixão do Pacaembú
Vargem Bonita/MG	Aterro Controlado
Vera Cruz/BA	Aterro
Vitória da Conquista/BA	Aterro
Vitória da Conquista/BA	Vala para RSS
Volta Redonda/RJ	Aterro Controlado

From the 211 landfills sampled, only 17 of them answered “Yes” for the question “Gas Final Use”. Excluding those projects developed under the CDM (registered or published for GSC), the result is that only 7 of the 211 projects were implemented without the CDM, or 3.32% of the sample:

Table 2. Solid Waste Disposal Sites indentified in table Up03, which have answered "Yes" to the question "Gas Final Use"

City	Landfill Name	CDM Project (Y/N)
Cariacica (ES)	Célula de Resíduos Classe II	Y (Brazil MARCA Landfill Gas to Energy Project)
Cascavel (PR)	**Aterro Sanitário**	**N**
Cuiabá (MT)	**Aterro Sanitário**	**N**

Goiânia (GO)	**Aterro Sanitário de Goiânia**	**N**
Juína (MT)	**Aterro Controlado**	**N**
Nova Iguaçu (RJ)	CTR - Nova Iguaçu	Y (NovaGerar Landfill Gas to Energy Project)
Paulínia (SP)	Aterro Sanitário de Paulinia - Estre	Y (ESTRE's Paulínia Landfill Gas Project)
Rio de Janeiro (RJ)	**CTR - Rio**	**N**
Salvador (BA)	Aterro Controlado de Canabrava	Y (Canabrava Landfill Gas Project)
Salvador (BA)	Aterro Metropolitano Centro	Y (Salvador da Bahia Landfill Gas Management Project)
Sta Bárbara d'Oeste (SP)	**Aterro Sanitario Municipal de Santa Bárbara d'Oest**	**N**
Santos (SP)	Aterro Sanitário Sítio das Neves	Y (Terrestre Ambiental Landfill Gás Project)
São José dos Campos (SP)	Estação de Tratamento de Resíduos Sólidos	Y (URBAM/ARAUNA - Landfill Gas Project)
São Leopoldo (RS)	**Aterro Sanitario Municipal**	**N**
São Paulo (SP)	Aterro Bandeirantes	Y (Bandeirantes Landfill Gas to Energy Project)
São Paulo (SP)	Aterro São João	Y (São João Landfill Gas to Energy Project)
Tremembé (SP)	Sarpi Sistema Ambiental Cia. Ltda	Y (Onyx gas recovery project – Tremembé, Brazil)

Source: adapted from SNIS – Table Up03

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

This discussion will be focused on those landfills which implemented some kind of gas final use and which were not developed under the CDM. Excluding the CDM projects from Table 2, the table 3 below lists and analyzes how each of the 7 landfills had implemented the "Gas final use" project.

Table 3. Discussion about projects which had implemented "Gas Final Use" projects, without the incentives of CDM.

City	Landfill Name	Type of project implemented
Cascavel (PR)	Aterro Sanitário	Power generation for lightning – pilot-scale.
Cuiabá	Aterro Sanitário	Wrongly answered – the landfill

(MT)		drains the gas and destroy part in the top of the wells (phone call confirmation)
Goiânia (GO)	Aterro Sanitário de Goiânia	Enclosed flare voluntarily, not operating (phone call confirmation)
Juína (MT)	Aterro Controlado	Wrongly answered – the landfill does not even have a gas draining system (phone call confirmation)
Rio de Janeiro (RJ)	CTR – Rio	Wrongly answered. The landfill does not exist and the project was never approved to receive the Environmental Permit[4]. However, the project encompasses the installation of a degassing unit, with a LFG flaring system.
Sta Bárbara d'Oeste (SP)	Aterro Sanitario Municipal de Santa Bárbara d'Oest	Wrongly answered – the landfill drains the gas and destroy part in the top of the wells (internet search confirmation[5])
São Leopoldo (RS)	Aterro Sanitario Municipal	Leachate evaporation and incineration system

Thus, it can be concluded that only 2 landfills had implemented projects without the CDM revenues, from which only one of them is operating and none of them is about the electricity generation, which proves that similar activities to the proposed project activity (landfill gas flaring and electricity generation to the grid) are not widely observed and commonly carried out.

Thus, it can be concluded that the proposed project activity is additional because:

1. there are no laws or regulations obligating the destruction of biogas generated in landfills or the use of the gas to generate electricity;

2. the project is one of the fewest to use the landfill gas to generate electricity, and other LFG capturing projects were developed only under the CDM; similar activities are not widely observed and commonly carried out, being restricted into pilot-scale systems;

3. the project is not the most economic attractive alternative, and only the CDM incentives can make the project economically attractive.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

ACM0001

a) Baseline Emissions

[4] http://www.inea.rj.gov.br/downloads/ata_audit_public_ctr.pdf
[5] http://www.santabarbara.sp.gov.br/v3/index.php?pag=pag_noticia&dir=noticias&id=27715

The Methodology ACM0001 states that greenhouse gas baseline emissions during a given year *"y"* (BE_y) are estimated according with the below equation:

$$BE_y = (MD_{project,y} - MD_{BL,y}) \times GWP_{CH4} + EL_{LFG,y} \times CEF_{elect,BL,y} + ET_{LFG,y} \times CEF_{ther,BL,y} \quad \textbf{(1)}$$

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 *y* (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 tonnes of methane (tCH_4)
GWP_{CH4}	Global Warming Potential of Methane (tCO_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 on-site/off-site fossil fuel based captive power generation, during year y, in megawatt hours (MWh).
$CEF_{elec,BL,y}$	CO_2 emissions intensity of the baseline source of electricity displaced (tCO_2e/MWh), estimated using the *"Tool for calculation of emission factor for electricity systems"* – version 01.
$ET_{LFG,y}$	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, during the year *y* in TJ.
$CEF_{ther,BL,y}$	CO_2 emissions intensity of the fuel used by boiler to generate thermal energy which is displaced by LFG based thermal energy generation (tCO_2e/TJ)

As the Projeto de Gás de Aterro TECIPAR – PROGAT will not replace the heat generation by fossil fuel:

$ET_{LFG,y} = 0$

The equation is updated to:

$$BE_y = (MD_{project,y} - MD_{BL,y}) \times GWP_{CH4} + EL_{LFG,y} \times CEF_{elect,BL,y} \quad \textbf{(2)}$$

As presented in B.4, the Projeto de Gás de Aterro TECIPAR – PROGAT does not have any contractual obligations to burn methane and there is no national/sectoral regulation obligating the landfill gas destruction. However, as per ACM0001 – version 08.1, 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.

$$MD_{BL,y} = MD_{project,y} \times AF \quad \textbf{(3)}$$

Where AF is the baseline adjustment factor and is estimated as follows:

1. Percentage of methane exhausted through passive systems

The Ventura landfill counts with a passive venting system, which is way less efficient the active systems because of the pressure (in the passive system, landfill gas is emitted to the atmosphere due to variation of the barometric pressure). As per measurements made in 11 Dutch landfills, an average collection efficiency of passive system was equal to 37%[6].

2. <u>Percentage of methane destroyed in the passive systems</u>

The PDR wells installed operates just like an open flare, where there is no control of the combustion temperature and of the air flow. As per the *Tool to determine project emissions from flaring gases containing methane*, a maximum efficiency to be adopted in open flares is equal to 50%; thus an efficiency of 50% is adopted in the AF estimative.

3. <u>Percentage of methane actually being destroyed in the passive systems</u>

According with BIOPAR Soluções Ambientais Ltda., the Ventura landfill has 15 PDR wells nowadays, which only an average of 3 are burning the methane (a plant locating the wells installed and the wells which are burning LFG is presented in Annex 3).

Considering the above presented, the calculation of AF is as follows:

$$AF = \eta_{\text{closed landfills}} \times \eta_{\text{open flares}} \times \frac{N_{\text{wells bunring gas}}}{N_{\text{wells total}}} \qquad \textbf{(4)}$$

Where:

AF	Adjustment factor
$\eta_{closed\ landfills}$	Collection efficiency of passive systems in closed landfills (37%)
$\eta_{open\ flares}$	Efficiency of methane destruction in open flares (50%)
$N_{wells\ burning\ gas}$	Number of PDR wells actually burning the landfill gas collected in the passive system (3 wells)
$N_{wells\ total}$	Total number of PDR actually installed in the Ventura landfill (15 wells)

$$AF = 37\% \times 50\% \times \frac{3}{15} = 3.70\%$$

Thus, a conservative AF of 5% was adopted and equation **(2)** is updated to:

$$BE_y = 0.95 \times MD_{\text{project, y}} \times GWP_{CH4} + EL_{\text{LFG, y}} \times CEF_{\text{elect, BL, y}} \qquad \textbf{(5)}$$

The sum of the quantities fed to the flare(s), to the power plant(s), to the boiler(s), to the electricity generator(s) and to the natural gas distribution network, estimated using equation **(5)** will be compared annually with the total quantity of methane generated. The lowest value of the two will be adopted as $MD_{project,y}$.

$$MD_{\text{project, y}} = MD_{\text{flare, y}} + MD_{\text{electricity, y}} + MD_{\text{thermal, y}} + MD_{\text{PL, y}} \qquad \textbf{(6)}$$

[6] http://www.mnp.nl/ipcc/Archive/AR4FOD/ExpRevFOD/FODrev/FOD_AChapter10.doc

Where:

$MD_{flared,y}$	Quantity of methane destroyed by flaring (tCH_4)
$MD_{electricity,y}$	Quantity of methane destroyed by generation of electricity (tCH_4)
$MD_{thermal,y}$	Quantity of methane destroyed for the generation of thermal energy (tCH_4)
$MD_{PL,y}$	Quantity of methane sent to the gas distribution grid (tCH_4)

Right Hand Side of the equation **(6)** is sum over all the points of captured methane use in case the methane is flared in more than one flare, and/or used in more than one electricity generation source, and/or more than one thermal energy generator. As the project will not inject purified methane in the gas distribution grid nor heat,

$MD_{PL,y} = 0$
$MD_{thermal,y} = 0$

And the equation **(6)** is updated to:

$$MD_{project,y} = MD_{flare,y} + MD_{electricity,y} \quad \textbf{(7)}$$

The supply to each point of methane destruction, through flaring or use for energy generation, shall be measured separately.

$$MD_{flare,y} = \left(LFG_{flare,y} \times w_{CH4,y} \times D_{CH4}\right) - \left(\frac{PE_{flare,y}}{GWP_{CH4}}\right) \quad \textbf{(8)}$$

And

$$MD_{electricity,y} = LFG_{electricity,y} \times w_{CH4,y} \times D_{CH4} \quad \textbf{(9)}$$

Where:

$LFG_{flare,y}$	Quantity of landfill gas fed to the flare(s) during the year measured in cubic meters (m^3)
$LFG_{electricity,y}$	Quantity of landfill gas sent to the power house (m^3)
$w_{CH4,y}$	Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3CH_4/m^3_{LFG})
D_{CH4}	Methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4)
$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year *y* (tCO_2e) determined following the procedure described in the *"Tool to determine project emissions from flaring gases containing methane"*. If methane is flared through more than one flare, the $PE_{flare,y}$ shall be determined for each flare using the tool.

a.1) Methane emissions calculation
The *ex-ante* estimatives of the amount of methane that would have been destroyed/combusted during year *y* is calculated using thee *"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"*:

$$MD_{project,y} = \frac{\varphi \times (1-f) \times GWP_{CH_4} \times (1-OX) \times \frac{16}{12} \times F \times DOC_f \times MCF \times \sum_{x=1}^{y}\sum_{j} W_{x,j} \times DOC_j \times e^{-k_j(y-x)} \times (1-e^{-k_j})}{GWP_{CH_4}} \quad \textbf{(10)}$$

Where:

$MD_{project,y}$	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 oxidised 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

According with USEPA[7], collection efficiency for energy recovery between 75% and 85% sounds reasonable "because each cubic foot of gas will have a monetary value to the owner/operator". A conservative value of 60% was adopted, thus equation **(10)** is updated to:

$$MD_{project,y} = 60\% \times \frac{\varphi \times (1-f) \times GWP_{CH_4} \times (1-OX) \times \frac{16}{12} \times F \times DOC_f \times MCF \times \sum_{x=1}^{y}\sum_{j} W_{x,j} \times DOC_j \times e^{-k_j(y-x)} \times (1-e^{-k_j})}{GWP_{CH_4}} \quad \textbf{(10)}$$

a.2) Grid-emission factor calculation

$CEF_{elec,\ BL,\ y}$ will be calculated according with the *Tool for calculation of emission factor for electricity systems* ($EF_{CM,y}$ in the tool). The tool considers the determination of the emissions factor for the grid to which the project activity is connected as the core data to be determined in the baseline scenario.

The Emission Factor is calculated as the *Combined Margin (CM)*, comprised by two components: the *Built Margin (BM)* and the *Operation Margin (OM)*. The BM evaluates the contribution of the

[7] **USEPA**; *Turning a Liability into an Asset: A Landfill Gas-to-Energy Project Development Handbook*; September 1996

power plants which would have been built if the project plant would not have been implemented. The OM evaluates the contribution of the power plants which would have been dispatched in the absence of the project activity.

The CM calculation must be based in data from an official source, preferable the dispatch authority. The capacity additions and the values generated from the power plants registered as CDM project activities must be excluded from the calculation.

As per the steps of the tool:

STEP 1. Identify the relevant electric power system.
According with the Tool, *"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"*. The Brazilian DNA published Resolução nº 8, which makes official the use of a single Electric Grid for CDM project activities applying the tool.

STEP 2. Select an operating margin (OM) method
The Brazilian DNA has calculated the Grid Emission Factor applying option *c) Dispatch data analysis OM*.

STEP 3. Calculate the operating margin emission factor according to the selected method
The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the power units that are actually dispatched at the margin during each hour *h* where the project is displacing electricity.

The Brazilian DNA will calculate and publish regularly the emission factor for each year in their web-site.

STEP 4. Identify the cohort of power units to be included in the build margin
The power units will be identified by the Brazilian DNA

STEP 5. Calculate the build margin emission factor
The Build Margin will be calculated by the Brazilian DNA.

STEP 6. Calculate the combined margin emissions factor
The combined margin emissions factor is calculated as follows:

$$EF_{Grid,\,CM,\,y} = EF_{Grid,\,OM,\,y} \times w_{OM} + EF_{Grid,\,BM,\,y} \times w_{BM} \quad \textbf{(11)}$$

Where:

$EF_{Grid,\,CM,\,y}$	Emission factor for the Brazilian electric grid in year *y* (tCO_2/MWh)
$EF_{Grid,\,OM,\,y}$	Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{Grid,\,BM,\,y}$	Build 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 (%)

According with the Tool, values adopted for w_{OM} and w_{BM} were equal to 0.5 for each one during the 1st crediting period and 0.25 and 0.75, respectively, for the 2nd and 3rd crediting periods.

b) Project Emissions

Project emissions are related to the amount of methane not destroyed in the flares and due to any amount of electricity consumed from the grid or from the emergency captive diesel generator installed inside the landfill, which will operate only when grid-supply is interrupted.

b.1) Project emissions due to the amount of methane not destroyed in the flares

The amount of methane not destroyed will be calculated as per the "*Tool to determine project emissions from flaring gases containing methane*". The project will install enclosed flares and Projeto de Gás de Aterro TECIPAR – PROGAT will make continuous monitoring of methane concentration. The calculation of flare efficiency will be made by the following steps:

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

$$FM_{RG,h} = \frac{P_n}{\frac{R_n}{\sum\left(fv_{i,h} \times MM_i\right)} \times T_n} \times FV_{RG,h} \quad \textbf{(12)}$$

Where:

$FM_{RG,h}$	Mass flow rate of the residual gas in hour *h* (kg/h)*;*
P_n	Atmospheric pressure at normal conditions (101,325 Pa)
R_n	Universal ideal gas constant (8,314 Pa.m^3/kmol.K)
T_n	Temperature at normal conditions (273.15 K)
$fv_{i,h}$	Volumetric fraction of component i in the residual gas in the hour *h*
MM_i	Molecular mass of residual gas component *i* (kg/kmol)
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h* (m^3/h)
i	The components CH_4, CO, CO_2, O_2,H_2, N_2

As a simplified approach, Projeto de Gás de Aterro TECIPAR – PROGAT 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

$$fm_{j,h} = \frac{\sum fv_{i,h} \times AM_j \times NA_{j,i}}{\sum\left(fv_{i,h} \times MM_i\right)} \quad \textbf{(13)}$$

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*
j	The elements carbon, hydrogen, oxygen and nitrogen
P_n	Atmospheric pressure at normal conditions (101 325 Pa)

R_n	Universal ideal gas constant (8 314 Pa.m^3/kmol.K)
T_n	Temperature at normal conditions (273.15 K)
$fv_{i,h}$	Volumetric fraction of component i in the residual gas in the hour *h*
MM_i	Molecular mass of residual gas component *i* (kg/kmol)
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h* (m^3/h)
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

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:

$$TV_{n,FG,h} = V_{n,FG,h} \times FM_{RG,h} \qquad \textbf{(14)}$$

Where:

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

$$V_{n,FG,h} = V_{n,CO_2,h} + V_{n,O_2,h} + V_{n,N_2,h} \qquad \textbf{(15)}$$

Where:

$V_{n,FG,h}$	Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour *h* (m^3/h)
$V_{n,CO2,h}$	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$_{residual\ gas}$)
$V_{n,O2,h}$	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$_{residual\ gas}$)
$V_{n,N2,h}$	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$_{residual\ gas}$)

$$V_{n,O_2,h} = n_{O_2,h} \times MV_n \qquad \textbf{(16)}$$

Where:

$V_{n,O2,h}$	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)

$$V_{n,N_2,h} = MV_n \times \left\{ \frac{fm_{N,h}}{200\ AM_N} + \left(\frac{1 - MF_{O_2}}{MF_{O_2}} \right) \times \left[F_h + n_{O_2,h} \right] \right\} \quad \textbf{(17)}$$

Where:

$V_{n, N2, h}$	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 L/mol)
$n_{O2, h}$	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h* ($kmol/kg_{residual\ gas}$)
$fm_{N, h}$	Volumetric fraction of Nitrogen in the residual gas in the hour *h*
AM_N	Atomic mass of element 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* ($kmol/kg_{residual\ gas}$)

$$V_{n,CO_2,h} = \frac{fm_{C,h}}{AM_C} \times MV_n \quad \textbf{(18)}$$

Where:

$V_{n, CO2, h}$	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* ($m^3/kg_{residual\ gas}$)
$fm_{C, h}$	Volumetric fraction of Carbon in the residual gas in the hour *h*
MV_n	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 L/mol)
AM_C	Atomic mass of element Carbon (kg/kmol)

$$n_{O_2,h} = \frac{t_{O_2,h}}{\left(1 - \frac{t_{O_2,h}}{MF_{O_2}}\right)} \times \left[\frac{fm_{C,h}}{AM_C} + \frac{fm_{N,h}}{2\ AM_N} + \left(\frac{1 - MF_{O_2}}{MF_{O_2}} \right) \times F_h \right] \quad \textbf{(19)}$$

Where:

$n_{O2, h}$	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*
j	The elements carbon (C) and nitrogen (N)

AM_j	Atomic mass of element *j* (kg/kmol)

$$F_h = \frac{fm_{C,h}}{AM_C} + \frac{fm_{H,h}}{4 \times AMH} - \frac{fm_{O,h}}{2 \times AMO} \quad \textbf{(20)}$$

Where:

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*
j	The elements carbon (C), hydrogen (H) and oxigen (O)
AM_j	Atomic mass of element *j* (kg/kmol)

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

$$TM_{FG,h} = \frac{TV_{n,FG,h} \times fv_{CH_4,FG,h}}{1{,}000{,}000} \quad \textbf{(21)}$$

Where:

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

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH_4,FG,h} \times \rho_{CH_4,n} \quad \textbf{(22)}$$

Where:

$TM_{FG,h}$	Mass flow rate of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h* (kg/h)
$FV_{n,RG,h}$	Volumetric flow rate of the residual 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)
$\rho_{CH4,n}$	Density of methane at normal conditions (0.716 kg/m^3)

STEP 6: Determination of the hourly flare efficiency

As the Projeto de Gás de Aterro TECIPAR – PROGAT will install enclosed flares and the monitoring of methane concentration will be made continuously, 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 :

$$\eta_{flare,\,h} = 1 - \frac{TM_{FG,\,h}}{TM_{RG,\,h}} \qquad \textbf{(23)}$$

Where:

$\eta_{flare,\,h}$	Flare efficiency in the hour *h*
$TM_{FG,\,h}$	Methane mass flow rate in exhaust gas averaged in hour *h* (kg/h)
$TM_{RG,\,h}$	Mass flow rate of methane in the residual gas in the hour *h* (kg/h)

STEP 7. Calculation of annual project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions from each hour *h*, based on the methane flow rate in the residual gas ($TM_{RG,h}$) and the flare efficiency during each hour *h* ($\eta_{flare,h}$), as follows:

$$PE_{flare,\,y} = \sum_{h=1}^{8,760} TM_{RG,\,h} \times \left(1 - \eta_{Flare,\,h}\right) \times \frac{GWP_{CH_4}}{1,000} \qquad \textbf{(24)}$$

Where:

$PE_{flare,\,y}$	Project emissions from flaring of the residual gas stream in year *y* (tCO_2e)
$TM_{RG,\,h}$	Mass flow rate of methane in the residual gas in the hour *h* (kg/h)
$\eta_{flare,\,h}$	Flare efficiency in the hour *h*
GWP_{CH4}	Global Warming Potential (tCO_2e/tCH_4) valid for the commitment period

b.2) Project Emissions due to the consumption of electricity from the grid

Project emissions from grid electricity consumption are calculated according with the *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* . The project will consume electricity both from the grid and from a captive diesel generator, which will operate only when grid electricity supply is interrupted.

According with the tool, Projeto de Gás de Aterro TECIPAR – PROGAT will corresponds to to Scenarios:

- Scenario A (for grid-consumption electricity): *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*; and

- Scenarion B (operation of the emergency captive diesel generator): *One or more fossil fuel fired captive power plants are installed at the site of the electricity consumption source and supply the source with electricity. The captive power plant(s) is/are not connected to the electricity grid.*

Despite of consuming electricity from the grid and from a captive power plant, **Scenario C** is not applied because the diesel generator (captive power plant) is ***not*** connected to the grid.

b.2.1) Project Emissions Calculation in Scenario A

For the calculation of project emissions in Scenario A, the following equation will be used:

$$PE_{EC,\,Scenario\,A,\,y} = \sum_j EC_{PJ,\,j,y} \times EF_{EL,j,\,y} \times \left(1 + TDL_{j,\,y}\right) \quad \textbf{(25)}$$

Where:

$PE_{EC,\,Scenario\,A,\,y}$	Project emissions from electricity consumption in Scenario A, 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)
$EF_{EJ,\,j,\,y}$	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

The project will apply option A1 to calculate the emission factor, with the following assumptions:

- Index *j* corresponds to the Electric Grid (EG); and
- $EF_{EL,\,j,\,y} = EF_{EL,\,EG,\,y}$ is calculated according with the *Tool for calculation of emission factor for electricity systems*, previously presented.

Thus, the above equation is updated to:

$$PE_{EC,\,Scenario\,A,\,y} = EC_{PJ,\,EG,y} \times EF_{EL,EG,\,y} \times \left(1 + TDL_{EG,\,y}\right) \quad \textbf{(26)}$$

Where:

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

b.2.2) Project Emissions Calculation in Scenario B

For the calculation of project emissions in Scenario B, the following equation will be used:

$$PE_{EC,\,Scenario\,B,\,y} = \sum_j EC_{PJ,\,j,y} \times EF_{EL,j,\,y} \times \left(1 + TDL_{j,\,y}\right) \quad \textbf{(27)}$$

Where:

$PE_{EC,\,Scenario\,B,\,y}$	Project emissions from electricity consumption in Scenario B, 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)
$EF_{EJ, j, y}$	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*

The project will apply option B1 to calculate the emission factor, with the following assumptions:

- $TDL_{j, y} = 0$, as there are no looses in the electricity transmission once the diesel generator is located inside Ventura landfill;

- Index *j* corresponds to the Emergency Captive Diesel Generator (ECDG); and

- $EF_{EL, j, y} = EF_{EL, DG, y}$ is calculated according as follows:

$$EF_{EL, ECDG, y} = \frac{\sum_{j}\sum_{j} FC_{n,i,t} \times NCV_{i,t} \times EF_{CO2,i,t}}{\sum_{n} EG_{n,t}} \quad \textbf{(28)}$$

Where:

$EF_{EL, ECDG, y}$	Emission factor for the Emergency Captive Diesel Generator (ECDG) in year *y* (tCO_2/MWh)
$FC_{n, i, t}$	Quantity of fossil fuel type *i* fired in the captive power plant *n* in the time period *t* (mass or volume unit)
$NCV_{i, t}$	Average net calorific value of fossil fuel type *i* used in the period *t* (GJ/mass or volume unit)
$EF_{CO2, i, t}$	Average CO_2 emission factor of fossil fuel type *i* used in the period *t* (tCO_2/GJ)
$EG_{n, t}$	Quantity of electricity generated in captive power plant *n* in the time period *t* (MWh)
j	Sources of electricity consumption in the project (ECDG = Emergency Captive Diesel Generator)
n	Fossil fuel fired captive power plants installed at the site of the electricity consumption source *j*. For Projeto de Gás de Aterro TECIPAR – PROGAT, *n* corresponds to Diesel (D);
t	Time period for which the emission factor for electricity generation is determined. For Projeto de Gás de Aterro TECIPAR – PROGAT, *t* corresponds to the monitoring period (e.g. the year *y*)

Thus, the two above equations are updated to:

$$PE_{EC, Scenario B, y} = EC_{PJ, ECDG, y} \times \frac{FC_{ECDG, D, y} \times NCV_{D, y} \times EF_{CO2, D, y}}{EG_{ECDG, y}} \quad \textbf{(29)}$$

Where:

$PE_{EC, Scenario B, y}$	Project emissions from electricity consumption in year y (tCO_2/yr)
$EC_{PJ, ECDG, y}$	Quantity of electricity consumed from the Emergency Captive Diesel Generator (ECDG) in year *y* (MWh/yr)
$FC_{ECDG, D, y}$	Quantity of Diesel fired in the Emergency Captive Diesel Generator (ECDG) in the time period *t* (mass or volume unit)
$NCV_{D, y}$	Average net calorific value of the Diesel used in the period *t* (GJ/mass or volume unit)

$EF_{EJ, j, y}$	Emission factor for the Diesel in year *y* (tCO_2/MWh)
$EG_{ECDG, y}$	Electricity Generated by the Emergency Captive Diesel Generator (ECDG) in the time period *t* (MWh)

As the all electricity produced by the Emergency Captive Diesel Generator will used only to supply the project,

$EC_{PJ, ECDG, y} = EG_{ECDG, y}$

And the equation is updated to:

$$PE_{EC, Scenario B, y} = FC_{ECDG, D, y} \times NCV_{D, y} \times EF_{CO2, D, y} \quad (30)$$

Project emissions from electricity consumption is equal to the sum of

$$PE_{EC, y} = PE_{EC, Scenario A, y} + PE_{EC, Scenario B, y} \quad (31)$$

Project emissions from the inefficiency of flaring methane and from electricity consumption is equal to:

$$PE_y = PE_{EC, y} + PE_{Flare, y} \quad (32)$$

c) Leakage
According with version 09.1 of ACM0001, no leakage needs to be accounted.

d) Emission Reductions
Emission Reductions will be calculated according with the equation below:

$$ER_y = BE_y - PE_y \quad (33)$$

Where:

ER_y	Emission Reductions in year *y* (tCO_2e)
BE_y	Baseline Emissions due to the natural emissions of methane to the atmosphere and due to the displacement of grid-fossil fuel electricity generation in year *y* (tCO_2e)
PE_y	Project Emissions from flare efficiency and electricity consumption from the grid and from the captive diesel generator in year *y* (tCO_2e)

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

ACM0001 – Consolidated methodology for landfill gas project activities

Data / Parameter:	**Regulatory requirements relating to landfill gas projects**
Data unit:	% or m^3
Description:	Regulatory requirements relating to landfill gas projects
Source of data used:	Publicly available information of the host country's regulatory

	requirements relating to landfill gas.
Value applied:	0, as there are no regulatory requirements nor legal obligations to destroy the LFG.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Explained above.
Any comment:	The information though recorded annually, is used for changes to the adjustment factor (AF) or directly $MD_{reg,y}$ at renewal of the credit period – variable ***updated at renewal of each credit period***. The DNA was contacted and provided information that there are no federal laws/regulations which obligates the destruction of methane in landfills. A conservative value of 5% was adopted as the AF.

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2e/tCH_4
Description:	Global Warming Potential of Methane
Source of data used:	IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	21 for the first commitment period. Shall be updated according to any future COP/MOP decisions.
Any comment:	-

Data / Parameter:	**D_{CH4}**
Data unit:	t_{CH4}/m^3_{CH4}
Description:	Methane Density
Source of data used:	-
Value applied:	0.0007168
Justification of the choice of data or description of measurement methods and procedures actually applied :	At standard temperature and pressure (0^oC and 1.013 bar)
Any comment:	-

Data / Parameter:	**$BE_{CH4,SWDS,y}$**
Data unit:	tCO_2e
Description:	Methane generation from the landfill in the absence of the project activity at year *y*
Source of data used:	Calculated as per the *“Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”*
Value applied:	Please, refer to Annex 3.
Justification of the	As per the *“Tool to determine methane emissions avoided from disposal*

choice of data or description of measurement methods and procedures actually applied :	*of waste at a solid waste disposal site"*
Any comment:	Used for ex-ante estimation of the amount of methane that would have been destroyed/combusted during the year

Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site

Data / Parameter:	φ
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per the *"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"*
Any comment:	Oonk et el. (1994) have validated several landfill gas models based on 17 realized 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.

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:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Ventura landfill operates with a clay layer which is compacted when the cell is being closed. As this kind of cover is not considered an oxidising material, OX used for calculations is equal to 0.
Any comment:	

Data / Parameter:	**F**
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually	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.

applied :	
Any comment:	

Data / Parameter:	**DOC_f**
Data unit:	-
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	2006 IPCC 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 :	Standard value applied by IPCC
Any comment:	

Data / Parameter:	**MCF**
Data unit:	-
Description:	Methane correction factor
Source of data used:	2006 IPCC 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 :	According with the 2006 IPCC Guidelines, the Ventura landfill does meet the criteria of managed SWDS and have depths of greater than or equal to 5 meters (50 meters) and/or high water table at near ground level.
Any comment:	The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

Data / Parameter:	**DOC_j**
Data unit:	-
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	(see table below)
Justification of the choice of data or	According with the version of the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* applied for

DOC_j (% wet waste)	**Waste type *j***
43	Wood and wood products
40	Pulp, paper and cardboard
15	Food, food waste, beverages and tobacco
24	Textiles
20	Garden, yard and park waste
0	Glass, plastic, metal, other inert waste

description of measurement methods and procedures actually applied :	the project.
Any comment:	

Data / Parameter:	$\mathbf{W_j}$
Data unit:	Tons
Description:	Total amount of organic waste prevented from disposal in year *x* (tons)
Source of data used:	BIOPAR Soluções Ambientais Ltda.
Value applied:	see table below; OBS: data from 2008 on are estimatives
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Year	**Waste Disposed**
2003	3,511
2004	5,776
2005	45,551
2006	85,549
2007	127,475
2008	*144,000*
2009	*180,000*
2010	*180,000*
2011	*180,000*
2012	*180,000*
2013	*180,000*
2014	*180,000*
2015	*180,000*
2016	*180,000*
2017	*180,000*

OBS: data from 2008 on are estimatives

Data / Parameter:	$\mathbf{p_{n,j,x}}$
Data unit:	-
Description:	Weight fraction of the waste type *j* in the sample *n* collected during the year *x*
Source of data used:	BIOPAR Soluções Ambientais Ltda.
Value applied:	see table below

Type of Waste	**% (wet basis)**
Wood and wood products	0.13%
Pulp, paper and cardboard	0.25%
Food, food waste, beverages and tobacco	93.00%
Textiles	0.13%

	Garden, yard and park waste — 5.00% Glass, plastic, metal, other inert waste — 1.50%
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	**k_j**
Data unit:	-
Description:	Decay rate for the waste type *j*
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	(see table below)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Those values were adopted considering the climate of the Barueri (city next to Santana de Parnaíba): - $MAT_{historical}$ = 20.6°C (data from EMBRAPA – Empresa Brasileira de Pesquisa Agropecuária[8]); - $MAP_{historical}$ = 1,402 mm (data from EMBRAPA – Empresa Brasileira de Pesquisa Agropecuária[8]); - $PET_{historical}$ = 957.0mm (data from EMBRAPA – Empresa Brasileira de Pesquisa Agropecuária[8])
Any comment:	

Waste type *j*		**k_j**
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.070
	Wood, wood products and straw	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.17
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.4

Tool to determine project emissions from flaring gases containing methane

Parameter	Description	Value
MM_{CH4}	Molecular mass of carbon methane	16.04 kg/kmol
MM_{CO}	Molecular mass of carbon monoxide	28.01 kg/kmol
MM_{CO2}	Molecular mass of carbon dioxide	44.01 kg/kmol
MM_{O2}	Molecular mass of oxygen	32.00 kg/kmol
MM_{H2}	Molecular mass of hydrogen	2.02 kg/kmol
MM_{N2}	Molecular mass of nitrogen	28.02 kg/kmol

[8] http://www.bdclima.cnpm.embrapa.br/resultados/balanco.php?UF=sp&COD=264

AM_C	Atomic mass of carbon	12.00 kg/kmol
AM_H	Atomic mass of hydrogen	1.01 kg/kmol
AM_O	Atomic mass of oxygen	16.00 kg/kmol
AM_N	Atomic mass of nitrogen	14.01 kg/kmol

B.6.3 Ex-ante calculation of emission reductions:

a) LFG Generation

Applying the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site*, the following table resumes the calculation:

Table 4. Estimative of methane emissions in the baseline

Year	LFG emissions (Nm^3_{lfg})	Methane Emissions (Nm^3_{CH4})	Year	LFG emissions (Nm^3_{lfg})	Methane Emissions (Nm^3_{CH4})
2003	140,068	70,034	**2021**	4,938,581	2,469,290
2004	325,199	162,599	**2022**	3,450,517	1,725,258
2005	2,037,399	1,018,700	**2023**	2,433,833	1,216,917
2006	4,791,899	2,395,950	**2024**	1,735,973	867,987
2007	8,330,384	4,165,192	**2025**	1,254,239	627,119
2008	11,388,691	5,694,346	**2026**	919,421	459,710
2009	14,902,232	7,451,116	**2027**	684,817	342,408
2010	17,289,787	8,644,894	**2028**	518,858	259,429
2011	18,917,870	9,458,935	**2029**	400,160	200,080
2012	20,032,874	10,016,437	**2030**	314,200	157,100
2013	20,800,567	10,400,284	**2031**	251,087	125,543
2014	21,332,578	10,666,289	**2032**	204,052	102,026
2015	21,704,163	10,852,082	**2033**	168,446	84,223
2016	21,966,136	10,983,068	**2034**	141,056	70,528
2017	22,152,867	11,076,434	**2035**	119,646	59,823
2018	15,106,729	7,553,365	**2036**	102,648	51,324
2019	10,346,775	5,173,387	**2037**	88,953	44,476
2020	7,124,845	3,562,423	**2038**	77,766	38,883

The following data was used to calculate *ex-ante* methane estimatives:

MFC (Methane Conversion Factor):

MCF value is adopted according with the type of SWDS. The Ventura landfill is a managed SWDS with more than 5 meters depth; thus, the MCF adopted is equal to **1.0.**

Applying a collection efficiency of 60%, the final result is:

Year	LFG collected (Nm^3_{lfg})	Methane collected (Nm^3_{CH4})
2003	84,041	42,020
2004	195,119	97,560
2005	1,222,439	611,220
2006	2,875,140	1,437,570
2007	4,998,230	2,499,115
2008	6,833,215	3,416,607
2009	8,941,339	4,470,670
2010	10,373,872	5,186,936
2011	11,350,722	5,675,361
2012	12,019,724	6,009,862
2013	12,480,340	6,240,170
2014	12,799,547	6,399,773
2015	13,022,498	6,511,249
2016	13,179,682	6,589,841
2017	13,291,720	6,645,860
2018	9,064,038	4,532,019
2019	6,208,065	3,104,032
2020	4,274,907	2,137,454

Year	LFG collected (Nm^3_{lfg})	Methane collected (Nm^3_{CH4})
2021	2,963,149	1,481,574
2022	2,070,310	1,035,155
2023	1,460,300	730,150
2024	1,041,584	520,792
2025	752,543	376,272
2026	551,652	275,826
2027	410,890	205,445
2028	311,315	155,657
2029	240,096	120,048
2030	188,520	94,260
2031	150,652	75,326
2032	122,431	61,216
2033	101,068	50,534
2034	84,634	42,317
2035	71,788	35,894
2036	61,589	30,794
2037	53,372	26,686
2038	46,659	23,330

b) Electricity Generation

It's estimated that the project reaches a total installed capacity of 6.5 MW. The table below presents the electricity exportation estimatives (electricity generated minus the electricity consumed internally):

Year	Electricity Export (MWh)
2015	37,315
2016	37,315
2017	42,588
2018	43,702
2019	43,702
2020	36,289
2021	30,123
2022	24,541

Ano	Electricity Export (MWh)
2023	18,154
2024	17,703
2025	11,767
2026	11,767
2027	10,844
2028	5,380
2029	5,380

The electricity consumed internally is estimated as 115 kW times a conservative capacity factor of 8760 hours/year.

c) Grid Emission Factor Calculation.

The data used to calculate the grid emission factor was taken from the Brazilian DNA. The factor will be updated every month, using dispatch data from the ONS from 2007:

BUILT MARGIN	
Average Emission Factor (tCO_2/MWh) – **ANNUAL**	
2007	0.0775

OPERATING MARGIN													
Average Emission Factor (tCO_2/MWh) – **MONTHLY**													
2007	MONTH												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**AVERAGE**
	0.2292	0.1954	0.1948	0.1965	0.1606	0.2559	0.3096	0.324	0.355	0.3774	0.4059	0.4865	0.2909

The Combined Margin (CM) for the Projeto de Gás de Aterro TECIPAR – PROGAT is calculated as the weighted average of the Build Margin (BM) and Operating Margin (OM), as follows:

$CM_{2007} = 0.5 \times (OM_{-2007} \times BM_{2007}) =$ **0.1842 tCO_2/MWh**

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

Year	Estimations of Project Activity Emissions (tCO_2e/year)	Estimations of Baseline Emissions (tCO_2e/year)	Estimation of Leakage (tCO_2e/year)	Estimation of Emission Reductions (tCO_2e/year)
2009	639	63,931	0	63,292
2010	742	74,174	0	73,432
2011	812	81,159	0	80,347
2012	859	85,942	0	85,083
2013	892	89,235	0	88,343
2014	915	91,518	0	90,603
2015	931	99,985	0	99,054
TOTAL	**5,791**	**585,944**	**0**	**580,154**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**1. $LFG_{total, y}$**
Data unit:	m^3
Description:	Total amount of landfill gas captured at Normal Temperature and Pressure
Source of data to be used:	Project participants.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Variable (see item B.6.3.)
Description of measurement methods and procedures to be applied:	Continuous readings from the turbine flow-meter installed. The equipment is connected to a supervisory computer system, which registers continuously the LFG measured. Data to be aggregated monthly and yearly.

QA/QC procedures to be applied:	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy, in compliance with national laws (example in Germany and in Italy, for turbine meters of this size, calibration is never required; in Brazil there are no requirements concerning the device's calibration). The calibration will be undertaken according with the manufacturer's recommendation. The equivalent errors of the flow-meter will be discounted from the total gas measured, in order to assure the conservadorism.
Any comment:	- Monitoring under responsibility of the Projeto de Gás de Aterro TECIPAR – PROGAT's operators (the team, the organizational structure and the management structure will be defined after the project's implementation). - Automatic readings of temperature and pressure will be made by sensors connected to the flow-meter – these data will be used to convert the gas-flow to Nm^3; - All registrations will be kept for 2 years after the end of the crediting period; Initially, there will be one flare installed. While the power-house is not operating, there is no need to measure the total gas collected and the total gas sent to flares, thus only the totalizer flow-meter will be installed and used to calculate ERs. Case a second flare is installed and after the construction of the power house, new flow-meters will be installed for each flare and for each engine, as per the Monitoring Methodology.

Data / Parameter:	**2. $LFG_{flares\ y}$**
Data unit:	m^3
Description:	Total amount of landfill gas sent to flares at Normal Temperature and Pressure
Source of data to be used:	Project participants.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Variable (see itemB.6.3.)
Description of measurement methods and procedures to be applied:	Continuous readings from the annubar + differential pressure transducer installed. The equipments are connected to a supervisory computer system, which registers continuously the LFG measured. Data to be aggregated monthly and yearly. There will be one annubar + differential pressure transducer for each flare installed.
QA/QC procedures to be applied:	Annubar + differential pressure transducer should be subject to a regular maintenance and testing regime to ensure accuracy. The calibration will be undertaken according with the manufacturer's recommendation.
Any comment:	- Monitoring under responsibility of the Projeto de Gás de Aterro TECIPAR – PROGAT's operators (the team, the organizational structure and the management structure will be defined after the

	project's implementation). - Automatic readings of temperature and pressure will be made by sensors connected to the flow-meter – these data will be used to convert the gas-flow to Nm^3; - All registrations will be kept for 2 years after the end of the crediting period; Initially, there will be one flare installed. While the power-house is not operating, there is no need to measure the total gas collected and the total gas sent to flares, thus only the totalizer flow-meter will be installed and used to calculate ERs. Case a second flare is installed and after the construction of the power house, new flow-meters will be installed for each flare and for each engine, as per the Monitoring Methodology.

Data / Parameter:	**3. $LFG_{electricity, y}$**
Data unit:	m^3
Description:	Amount of landfill gas sent to the power house at Normal Temperature and Pressure
Source of data to be used:	Project Participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Variable (see itemB.6.3.)
Description of measurement methods and procedures to be applied:	Continuous readings from the turbine flow-meters installed. The equipments are connected to a supervisory computer system, which registers continuously the LFG measured. Data to be aggregated monthly and yearly. There will be one flow-meter for each engine installed.
QA/QC procedures to be applied:	Turbine flow meters should be subject to a regular maintenance and testing regime to ensure accuracy, in compliance with national laws (example in Germany and in Italy, for turbine meters of this size, a calibration every 12 years is required; in Brazil there are no requirements concerning the device's calibration). The calibration will be undertaken according with the manufacturer's recommendation.
Any comment:	- Monitoring under responsibility of the Projeto de Gás de Aterro TECIPAR – PROGAT operators (the team, the organizational structure and the management structure will be defined after the project's implementation). - Automatic readings of temperature and pressure will be made by sensors connected to the flow-meter – these data will be used to convert the gas-flow to Nm^3; - All registrations will be kept for 2 years after the end of the crediting period;

Data / Parameter:	**4. w_{CH4}**
Data unit:	m^3CH_4/m^3LFG
Description:	Methane fraction in the landfill gas

Source of data to be used:	Continuous measurement using a certified gas analyzer. The analyzer will measure the methane content directly.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50%
Description of measurement methods and procedures to be applied:	The gas samples are taken using a stream system. The analysis is made on the main line for 1 minute. Then, after 1 minute of washing, is made on the first inner line. Then, after 1 minute of washing, the analysis is made on the second inner line, and so on. Since there are 5 measuring points (4 inner + 1 main lines), the analysis on the main line takes place for 1 minute every 10 minutes
QA/QC procedures to be applied:	The gas analyzer should be subjected to a regular maintenance and testing regime to ensure accuracy. The calibration will be undertaken according with the manufacturer's recommendation.
Any comment:	- All registrations will be kept for 2 years after the end of the crediting period; - 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.

Data / Parameter:	**5. $EL_{LFG, y}$**
Data unit:	MWh
Description:	Net amount of electricity generated using LFG
Source of data to be used:	Electricity meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Variable (see itemB.6.3.)
Description of measurement methods and procedures to be applied:	Continuous readings from the electricity-meter installed. The equipment is connected to a supervisory computer system, which registers continuously the electricity exported. The net electricity generated will be registered every hour.
QA/QC procedures to be applied:	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy.
Any comment:	- In cases when the power house is not operating, this variable will correspond to the electricity consumption from the grid. The same QA/QC procedures will be applied; - All registrations will be kept for 2 years after the end of the crediting period;

Data / Parameter:	**6. Operation hours of the energy plant**
Data unit:	Hours
Description:	Operation of the energy plant
Source of data to be used:	Hour-meter

Value of data applied for the purpose of calculating expected emission reductions in section B.5	100%
Description of measurement methods and procedures to be applied:	Continuous readings from the hour-meters installed for each engine. The equipment is connected to a supervisory computer system, which registers continuously the operation time of the engines. Each engine will have one hour-meter connected.
QA/QC procedures to be applied:	No QA/QC procedures are necessary.
Any comment:	- All registrations will be kept for 2 years after the end of the crediting period;

Data / Parameter:	**$PE_{Flare, y}$**
Data unit:	tCO_2e
Description:	Project emissions from flaring of the residual gas stream in year y
Source of data to be used:	Calculated as per the *Tool to determine project emissions from flaring gases containing methane*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	99% of Flare Efficiency, according with the manufacturers recommendation. The values calculated were presented in table from item B.6.4.
Description of measurement methods and procedures to be applied:	As per the *Tool to determine project emissions from flaring gases containing methane*
QA/QC procedures to be applied:	As per the *Tool to determine project emissions from flaring gases containing methane*
Any comment:	Please, see the monitoring below – no number was indexed to this variable as all parameters to monitor the flare efficiency are presented below.

Tool to determine project emissions from flaring gases containing methane

Data / Parameter:	**7. $fv_{i,h}$**
Data unit:	-
Description:	Volumetric fraction of component i in the residual gas in the hour h where *i* = CH_4, CO, CO_2, O_2,H_2, N_2
Source of data to be used:	Measurements by project participants using a continuous gas analyser
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of	Ensure that the same basis (dry or wet) is considered for this

measurement methods and procedures to be applied:	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:	Analysers will be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check will be performed by comparison with a standard certified gas.
Any comment:	Please, refer to the measurements of **4. w_{CH4}** above. As a simplified approach, only the methane content of the residual gas will be measured and the remaining part will be considered as N_2.

Data / Parameter:	**8. $FV_{RG,h}$**
Data unit:	m^3/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	
Description of measurement methods and procedures to be applied:	Ensure that the same basis (dry or wet) is considered for this measurement and the measurement of volumetric fraction of all components in the residual gas ($fv_{i,h}$) when the residual gas temperature exceeds 60 ºC
QA/QC procedures to be applied:	Flow meters are to be periodically calibrated according to the manufacturer's recommendation.
Any comment:	Please, refer to the measurements of **2. LFG_{flare}** above.

Data / Parameter:	**9. $t_{O2,h}$**
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:	Measurements using a continuous gas analyser
Value of data applied for the purpose of calculating expected emission reductions in section B.5	N/A, as the efficiency adopted to calculate ERs was considered as 99%
Description of measurement methods and procedures to be applied:	The gas samples are taken using a stream system. The analysis is made on the exhaust gas of the flare for 1 minute. Then, after 1 minute of washing, the exhaust gas is analyzed again. Since there will be initially 1 measuring points (1 flare), the analysis on the exhaust gas takes place for 1 minute every 2 minutes. The point of measurement (sampling point) shall be in the upper section of the flare (80% of total flare height).
QA/QC procedures to be applied:	The gas analyzer should be subjected to a regular maintenance and testing regime to ensure accuracy. The calibration will be undertaken

	according with the manufacturer's recommendation.
Any comment:	All registrations will be kept for 2 years after the end of the crediting period;

Data / Parameter:	**10. $fv_{CH4, FG, h}$**
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:	Measurements using a continuous gas analyser
Value of data applied for the purpose of calculating expected emission reductions in section B.5	N/A, as the efficiency adopted to calculate ERs was considered as 99%
Description of measurement methods and procedures to be applied:	The gas samples are taken using a stream system. The analysis is made on the exhaust gas of the flare for 1 minute. Then, after 1 minute of washing, the exhaust gas is analyzed again. Since there will be initially 1 measuring points (1 flare), the analysis on the exhaust gas takes place for 1 minute every 2 minutes. The point of measurement (sampling point) shall be in the upper section of the flare (80% of total flare height).
QA/QC procedures to be applied:	The gas analyzer should be subjected to a regular maintenance and testing regime to ensure accuracy. The calibration will be undertaken according with the manufacturer's recommendation.
Any comment:	All registrations will be kept for 2 years after the end of the crediting period;

Data / Parameter:	**11. T_{flare}**
Data unit:	^oC
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	Measurements using thermocouples
Value of data applied for the purpose of calculating expected emission reductions in section B.5	N/A, as the efficiency adopted to calculate ERs was considered as 99%
Description of measurement methods and procedures to be applied:	Measurements by project participants, using thermocouples. There will be one thermocouple installed for each flare.
QA/QC procedures to be applied:	Thermocouples will be replaced or calibrated every year.
Any comment:	All registrations will be kept for 2 years after the end of the crediting period; 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.

Tool for calculation of emission factor for electricity systems

Data / Parameter:	**12. $EF_{OM, 2007}$**
Data unit:	tCO_2e/MWh
Description:	Emission Factor of the Operating Margin for 2007
Source of data to be used:	Brazilian DNA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.2909
Description of measurement methods and procedures to be applied:	This variable will be monitored *ex-post* by the Brazilian DNA and will be updated monthly in their web-site.
QA/QC procedures to be applied:	N/A
Any comment:	

Data / Parameter:	**13. $EF_{BM, 2007}$**
Data unit:	tCO_2e/MWh
Description:	Emission Factor of the Built Margin of 2007
Source of data to be used:	Brazilian DNA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0775
Description of measurement methods and procedures to be applied:	This variable will be monitored *ex-post* by the Brazilian DNA and will be updated monthly in their web-site.
QA/QC procedures to be applied:	N/A
Any comment:	

Data / Parameter:	**14. EF_{2007}**
Data unit:	tCO_2e/MWh
Description:	Electricity Baseline Emission Factor for 2007
Source of data to be used:	Brazilian DNA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.1842
Description of	This variable will be calculated according with the *ex-post* monitoring of

measurement methods and procedures to be applied:	EF_{OM} and EF_{BM} by the Brazilian DNA.
QA/QC procedures to be applied:	N/A
Any comment:	The EF will be calculated every hour, using data from the Brazilian DNA.

Tool to calculate baseline, project and/or leakage emissions from electricity consumption

Data / Parameter:	**15. $EC_{PJ, EG, y}$**
Data unit:	MWh
Description:	Electricity consumed from the grid, to operate the Gas Station
Source of data to be used:	Readings from the electricity-meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0, as electricity will be supplied by the Power House
Description of measurement methods and procedures to be applied:	Continuous readings from the electricity-meter installed. The equipment is connected to a supervisory computer system, which registers continuously the electricity exported.
QA/QC procedures to be applied:	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy.
Any comment:	All registrations will be kept for 2 years after the end of the crediting period

Data / Parameter:	**16. $TDL_{EG, y}$**
Data unit:	%
Description:	Average technical transmission and distribution losses for providing electricity to EG in year y
Source of data to be used:	*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	20%, according with the Tool.
Description of measurement methods and procedures to be applied:	$TDL_{EG,y}$ will be based on references from utilities, network operators or other official documentation. An annually monitoring will be undertaken; in the absence of data from the relevant year, most recent figures will be used, but not older than 5 years.
QA/QC procedures to be applied:	
Any comment:	All registrations will be kept for 2 years after the end of the crediting period.

Data / Parameter:	**17. $FC_{ECDG, D, y}$**

Data unit:	Mass or volume unit
Description:	Quantity of diesel fired in the emergency captive diesel generator in year *y*
Source of data to be used:	Onsite measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0, as the emergency captive diesel generator is a backup system and is expected to operate only in cases when the grid supply is interrupted.
Description of measurement methods and procedures to be applied:	Weight or volume meters
QA/QC procedures to be applied:	The metered fuel consumption quantities will based on purchased quantities and stock changes.
Any comment:	All registrations will be kept for 2 years after the end of the crediting period.

Data / Parameter:	**18. $EG_{DG,y}$**
Data unit:	MWh
Description:	Quantity of electricity generated by the emergency captive diesel generator in year *y*
Source of data to be used:	Onsite measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0, as the emergency captive diesel generator is a backup system and is expected to operate only in cases when the grid supply is interrupted.
Description of measurement methods and procedures to be applied:	Continuous readings from the electricity-meter, aggregated at least annually.
QA/QC procedures to be applied:	Cross check measurement results with records for sold electricity where relevant
Any comment:	All registrations will be kept for 2 years after the end of the crediting period.

Data / Parameter:	**19. $NCV_{D,t}$**
Data unit:	GJ/mass or volume unit
Description:	Average net calorific value of the diesel used in the period *t*
Source of data to be used:	a) Values provided by the supplier; b) if not available, regional or national default values; c) if not available, default IPCC 2006 values at the upper limit
Value of data applied for the purpose of calculating expected emission reductions in section B.5	N/A, as the emergency captive diesel generator is a backup system and is expected to operate only in cases when the grid supply is interrupted.

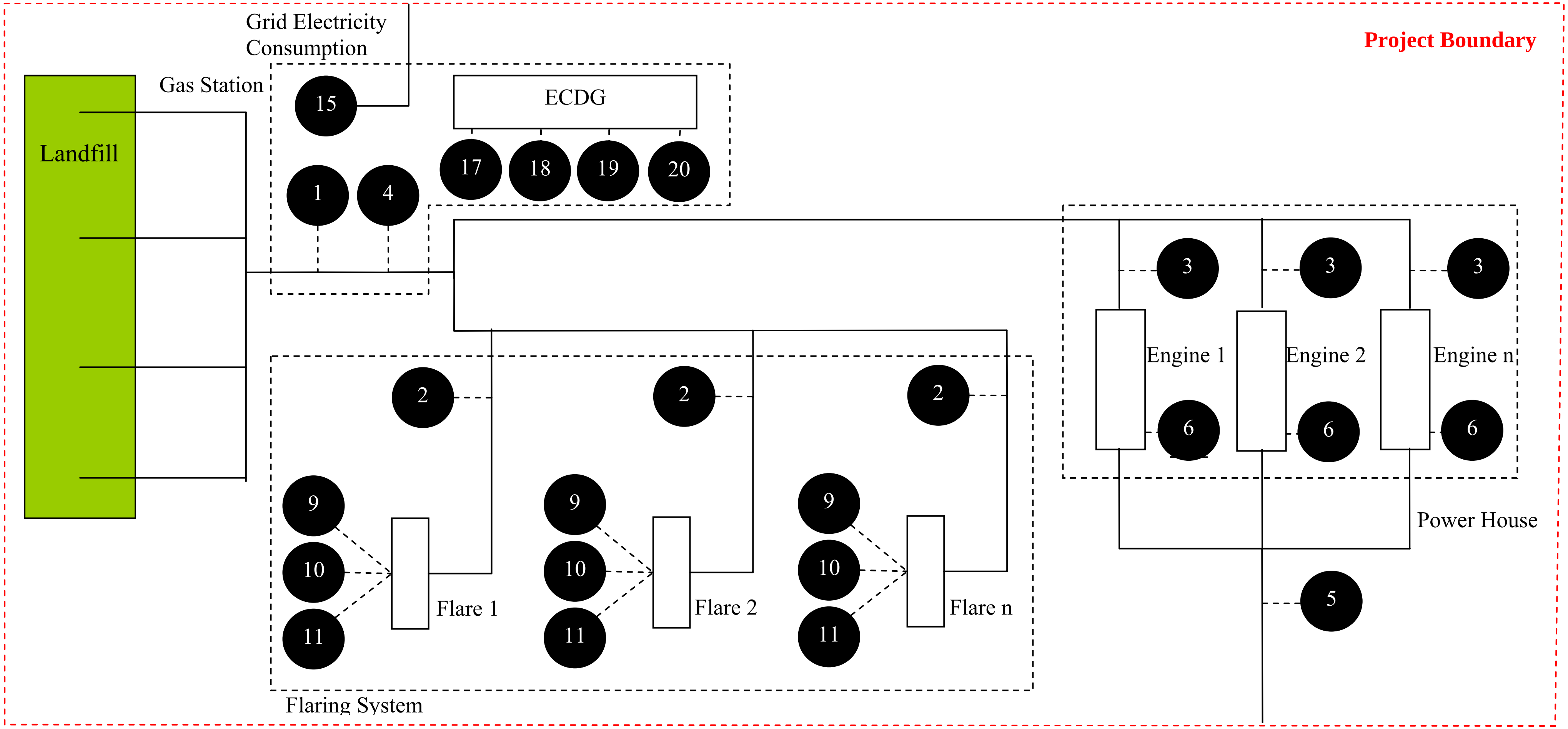
Description of measurement methods and procedures to be applied:	a) and b): The NCV will be obtained for the diesel, from which weighted average values for the year *y* will be calculated For c): Any future revision of the IPCC Guidelines will be taken into account
QA/QC procedures to be applied:	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall out this range, there will be necessary to collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Any comment:	All registrations will be kept for 2 years after the end of the crediting period.

Data / Parameter:	**20. $EF_{CO2, e}$**
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor of the diesel used in the period *t*
Source of data to be used:	a) Values provided by the supplier; b) if not available, regional or national default values; c) if not available, default IPCC 2006 values at the upper limit
Value of data applied for the purpose of calculating expected emission reductions in section B.5	N/A, as the diesel generator is a backup system and is expected to operate only in cases when the grid supply is interrupted.
Description of measurement methods and procedures to be applied:	a) and b): The $EF_{CO2, e}$ will be obtained for the diesel, from which weighted average values for the period *t* will be calculated For c): Any future revision of the IPCC Guidelines will be taken into account
QA/QC procedures to be applied:	
Any comment:	All registrations will be kept for 2 years after the end of the crediting period.

B.7.2 Description of the monitoring plan:

The variables described in item B.7.1 will be measured continuously and the readings will be also registered continuously, in a supervisory computer system. In order to assure conservatism, the standard errors of each equipment will be subtracted from the readings.

The diagram below presents how the monitoring will be made Equipments are indexed to the corresponding number from item B.7.1.:



OBS 1: There will be one flow-meter and one O_2 and CH_4 analyzer installed for each flare;
All data read will be continuously registered in a computer supervisory system, as presented in B.7.1.

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)

The baseline study was initiaited by Econergy Brasil and finished on 02/04/2009 by *ARCADIS Tetraplan*. Contact information:

ARCADIS Tetraplan
C/O Eduardo Cardoso Filho
eduardo@tetraplan.com.br
Tel: +55 (11) 3060-8457
www.tetraplan.com.br

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:

01/07/2008.

This date refers to the signature of a proposal for acquisition of LFG extraction and treatment equipments.

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

21 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:

01/01/2009 or the registration date, whichever is later.

C.2.1.2. Length of the first crediting period:

7 years – 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

N/A

C.2.2.2. Length:

N/A

SECTION D. Environmental impacts

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

Projeto de Gás de Aterro TECIPAR – PROGAT has received the Preliminary, Installation and Operational Licences for the installation of a complete collection and flaring system at the Ventura landfill (Preliminary Licence # 32001928 issued in 14/08/2008; Installation Licence # 32003440, issued in 27/08/2008; and Operational Licence # 32004609, issued in 18/12/2008). The licences foresee the following Technical Demands:

- Not emit any kind of odour substances to the atmosphere;
- Noise emission from the compressors must be in accordance with a National Standard;
- Compressors must be settled in proper bases, in order to avoid vibrations to the neighbourhood;
- Residual water and condensates must be sent to the leachate accumulation lagoon;

Additionally, the Ventura landfill has all environmental licence to the construction and operation of the landfill's. All impacts over soil, water, air and population were described and analyzed at the EIA developed for the landfill and the environmental impacts monitoring plans considered satisfactory by DAIA (Departamento de Avaliação de Impacto Ambiental) and CETESB, which issued the operational licence # 32002608 on 05/12/2005.

The environmental licences from the Power House were not requested yet, but will be once it is necesary to the construction/operation of the installation.

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:

The above described impacts are not considered significant and the proper actions will be undertaken by the time of the Operational Licence´s issuance:

- The use of enclosed flares assure a high rate of oxidation of all compounds, not allowing the emission of odour to the atmosphere;
- All noise and vibration will be properly treated – the compressors will be installed with proper isolation;
- Condensate and residual water will be driven to the leachate lagoon;

Additionally, there are expected no transboundary impacts.

SECÇÃO E. Stakeholders' comments

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

The local stakeholder consultation process was carried out according with Resolução nº7 from the Brazilian DNA.

A copy from the PDD translated to Portuguese and an explanation on how the project will contribute to the promotion of sustainable development was sent to each of the following stakeholders:

Resolução nº7	Stakeholder invited
Prefeitura do município envolvido ***(City Hall of the host-city)***	Prefeitura de Santana de Parnaíba *(City Hall of Santana de Parnaíba)*
Câmara dos vereadores do município envolvido ***(Legislative Chamber of the host-city)***	Câmara dos Vereadores de Santana de Parnaíba *(Legislative Chamber of Santana de Parnaíba)*
Órgão Ambiental Estadual ***(State Environmental Authority)***	CETESB – Companhia de Tecnologia e Saneamento Ambiental *(State Environmental Agency)*
	SMA – Secretaria de Estado do Meio Ambiente *(Environmental State Secretariat)*
Órgão Ambiental Municipal ***(Municipal Environmental Authority)***	Not identified. According with guidelines from the Brazilian DNA, a written justification must be presented when this stakeholder is not identified.
Fórum Brasileiro de ONG's e Movimentos Sociais para o Meio Ambiente e Desenvolvimento ***(Brazilian NGO Forum)***	Brazilian NGO Forum
Ministério Público estadual do estado ***(State Public Attorney)***	Ministério Público de São Paulo (*State Public Attorney*)
Ministério Público Federal ***(Feredal Public Attorney)***	*Federal Public Attorney*
Entidade de classe ***(Other Stakeholders)***	AVEMARE – Associação Vila Esperança de Materiais Recicláveis
	SIEMACO – Sindicato dos Trabalhadores em Empresas de Prestação de Serviços de Asseio e Conservação e Limpeza Urbana de São Paulo
	Rotary Clube de Santana de Parnaíba

E.2. Summary of the comments received:

The following stakeholders made comments about the project:

a) Brazilian NGO Forum
The NGO Forum stated that a 30-day period for comments is not enough to make a complete analysis of the project and suggest the adoption of Gold Standard sustainability criteria.

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

BIOPAR Soluções Ambientais Ltda. appreciated the comments and answered them as follows:

a) Brazilian NGO Forum
As per Resolução nº7, the local stakeholder consultation process is open until the request for registration of the project activity, not being limited to a 30-day length. Concerning the Gold

Standard criteria, BIOPAR Soluções Ambientais Ltda. answered that the verification process of CERs already takes into account sustainability criteria, as hiring and training of personnel and compliance with the environmental licence. However, BIOPAR Soluções Ambientais Ltda. compromises to analyze the possibility of the criteria adoption.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	BIOPAR Soluções Ambientais Ltda.
Street/P.O.Box:	Alameda Madeira, 222 – 11º andar, cj 112 – Alphaville Industrial
Building:	
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Telephone:	+55 (11) 4133-3250
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E-Mail:	
URL:	
Represented by:	Director
Title:	Mr.
Salutation:	
Last Name:	Silva Araújo
Middle Name:	Juarez
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding involved in the development of the Projeto de Gás de Aterro TECIPAR – PROGAT.

Annex 3

BASELINE INFORMATION

1. Grid-Emission Factor Calculation
The calculation of the Built Margin (BM) and Operating Margin (OM) must be developed for each electric system which the CDM project will be implemented. The **project's electric system** is defined by the quantity of power plants which can be dispatched without significant transmission restrictions. Similarly, an **electric connected system** connected to the project's system is defined as an electric system connected by transmission lines to the project's electric system, which the power plants can be dispatched without significant transmission restrictions.

The *Tool for calculation of emission factor for electricity systems* recommends the use the delineation of grid boundaries as provided by the DNA of the host country if available. Initially, the DNA adopted the ONS (National Operator System) division of the national grid in four sub-systems: North (N), Northeast (NE), South (S) and Southeast/Mid-West (SE-CO). However, after a public consultation, analysts of the ONS, MME (Mines and Energy Ministry) and MCT (Science and Technology Ministry) decided do adopt only ***one subsystem***, based that there are no significant looses in the transmission between two proposed subsystems (North-Northeast and South-Southeast/Center West). Simulations appointed that in only 70% of the hours in the year the transmission happened in 90% of more of the full capacity, indicating no significant transmission restrictions.

The unique subsystem is presented in Figure 3.

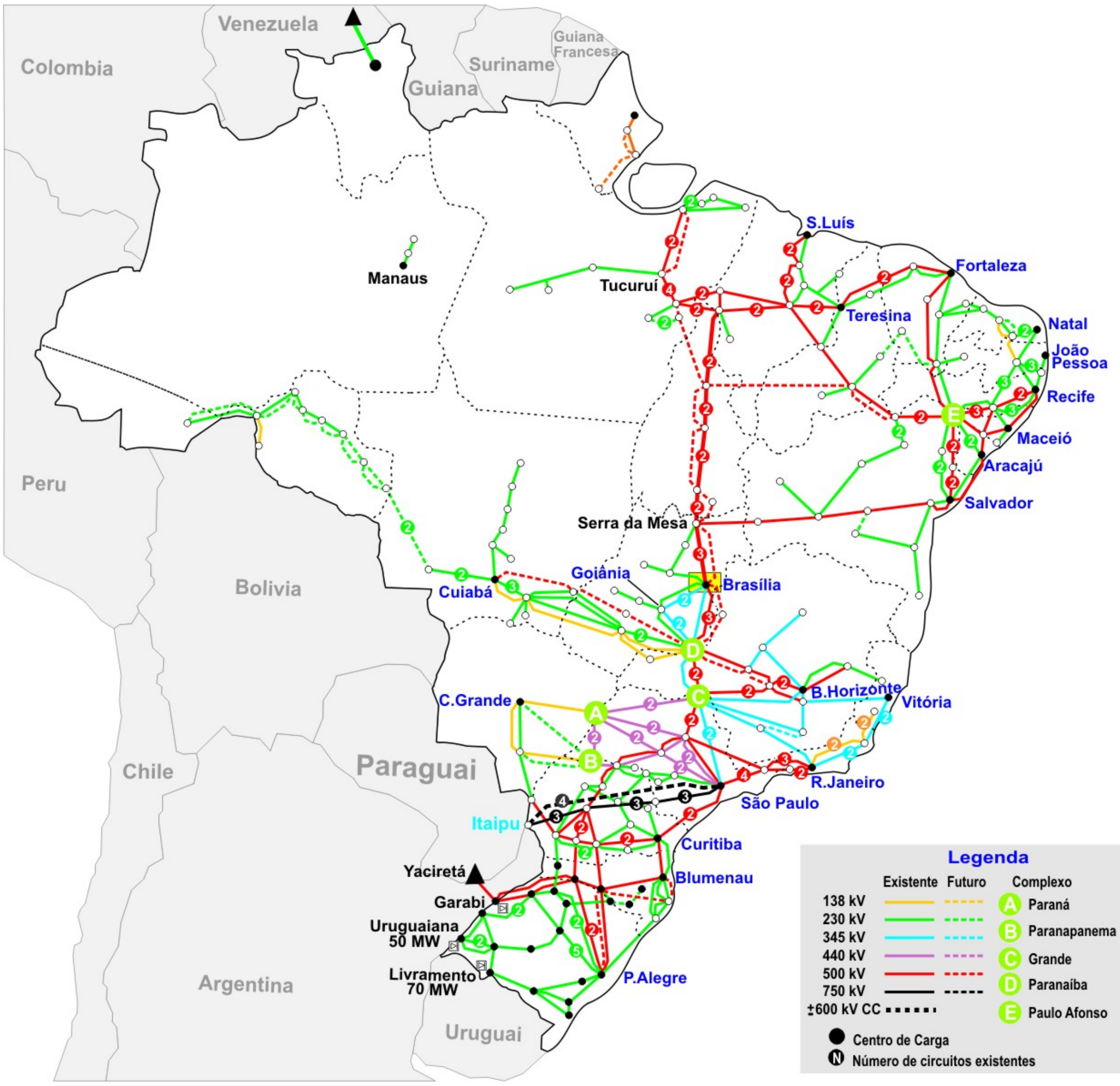

Figure 3. Brazilian Interconnected National System (Source: ONS)

The table below presents the thermoelectric power plants in each sub-market as defined by the ONS, with the type of fuel used.

Table 5. Thermoelectric Power Plants dispatched by ONS (source: ONS)

	Name	Fuel Used Actually	State
Northeast Sub-market	FAFEN	Natural Gas	Bahia
	S.C.JEREISATI	Natural Gas	Ceará
	TERMOBAHIA	Natural Gas	Bahia
	US.CAMACARI	Natural Gas	Bahia
	UT PERNAMBUCO	Natural Gas	Pernambuco
	UT. FORTALEZA	Natural Gas	Ceará
South Sub-market	P.MEDICI	Coal	Rio Grande do Sul
	PORTO ALEGRE	Fuel Oil	Rio Grande do Sul
	SAO JERONIMO	Coal	Rio Grande do Sul
	U. ALEGRETE	Fuel Oil	Rio Grande do Sul
	U. CANOAS	Natural Gas	Rio Grande do Sul

	U.CHARQUEADAS	Coal	Rio Grande do Sul
	U.JLACERDA-A	Coal	Santa Catarina
	U.JLACERDA-B	Coal	Santa Catarina
	U.JLACERDA-C	Coal	Santa Catarina
	U.URUGUAIANA	Natural Gas	Rio Grande do Sul
	US. FIGUEIRA	Coal	Paraná
	ARAUCÁRIA	Natural Gas	Paraná
Southeast-Midwest Sub-market	ANGRA 1	Nuclear	Rio de Janreiro
	ANGRA 2	Nuclear	Rio de Janreiro
	CAMPOS	Natural Gas	Rio de Janreiro
	CARIOBA	Fuel Oil	São Paulo
	CUIABA-ENRON	Natural Gas	Mato Grosso
	IBIRITE	Natural Gas	Minas Gerais
	IGARAPE	Fuel Oil	Minas Gerais
	JUIZ DE FORA	Natural Gas	Minas Gerais IS
	MACAE MERCHAN	Natural Gas	Rio de Janreiro
	NO.FLUMINENSE	Natural Gas	Rio de Janreiro
	NOVA PIRATININGA	Natural Gas	São Paulo
	PIRATININGA	Natural Gas	São Paulo
	SANTA CRUZ	Fuel Oil	Rio de Janreiro
	TER BRASILIA	Diesel	Distrito Federal
	TERMORIO	Natural Gas	Rio de Janreiro
	TRES LAGOAS	Natural Gas	Mato Grosso do Sul
	B.L.SOBRINHO	Natural Gas	Rio de Janreiro
	U. W. ARJONA	Natural Gas	Mato Grosso do Sul

More details of the LFG Estimatives were presented in B.6.2 and B.6.3.

2. Methane Estimatives

The picture below presents the LFG generation estimative, the graphic of engines installation and the location of the wells burning and not-burning LFG in the landfill:

Variable	Value
φ	0,9
f	0
GWP	21
OX	0
F	50%
DOCf	0,5
MCF	1

	DOCj	Wj	k
Wood and wood products	43%	0,13%	0,035
Pulp, paper and cardboard	40%	0,25%	0,07
Food, food waste, beverages and tobacco	15%	93,00%	0,4
Textiles	24%	0,13%	0,07
Garden, yard and park waste	20%	5,00%	0,17
Glass, plastic, metal, other inert waste	0%	1,50%	0

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	$BE_{CH4, SWDS}$ (tCO_2e/year)	Total Methane Emissions (t/year)	Total Methane Emissions (Nm3/year)	Total LFG Emissions (Nm3/year)	Total Collected ($Nm3_{LFG}$/year)	*Total Collected BASELINE (Nm3/year)*
2003	1.054															1.054	50	70.034	140.068	84.041	***79.839***
2004	713	1.734														2.448	117	162.599	325.199	195.119	***185.363***
2005	484	1.173	13.677													15.334	730	1.018.700	2.037.399	1.222.439	***1.161.317***
2006	329	796	9.254	25.687												36.066	1.717	2.395.950	4.791.899	2.875.140	***2.731.383***
2007	225	541	6.276	17.380	38.275											62.698	2.986	4.165.192	8.330.384	4.998.230	***4.748.319***
2008	154	370	4.270	11.788	25.897	43.237										85.716	4.082	5.694.346	11.388.691	6.833.215	***6.491.554***
2009	106	254	2.916	8.019	17.565	29.254	54.047									112.160	5.341	7.451.116	14.902.232	8.941.339	***8.494.272***
2010	74	175	2.000	5.476	11.949	19.842	36.568	54.047								130.130	6.197	8.644.894	17.289.787	10.373.872	***9.855.179***
2011	52	122	1.380	3.756	8.159	13.498	24.802	36.568	54.047							142.383	6.780	9.458.935	18.917.870	11.350.722	***10.783.186***
2012	37	85	959	2.592	5.597	9.217	16.872	24.802	36.568	54.047						150.775	7.180	10.016.437	20.032.874	12.019.724	***11.418.738***
2013	26	60	672	1.800	3.862	6.323	11.521	16.872	24.802	36.568	54.047					156.553	7.455	10.400.284	20.800.567	12.480.340	***11.856.323***
2014	19	43	475	1.261	2.683	4.362	7.904	11.521	16.872	24.802	36.568	54.047				160.558	7.646	10.666.289	21.332.578	12.799.547	***12.159.569***
2015	14	31	340	892	1.879	3.031	5.453	7.904	11.521	16.872	24.802	36.568	54.047			163.354	7.779	10.852.082	21.704.163	13.022.498	***12.371.373***
2016	10	23	246	638	1.329	2.123	3.788	5.453	7.904	11.521	16.872	24.802	36.568	54.047		165.326	7.873	10.983.068	21.966.136	13.179.682	***12.520.698***
2017	8	17	181	463	951	1.502	2.654	3.788	5.453	7.904	11.521	16.872	24.802	36.568	54.047	166.731	7.940	11.076.434	22.152.867	13.291.720	***12.627.134***
2018	6	13	136	341	690	1.075	1.877	2.654	3.788	5.453	7.904	11.521	16.872	24.802	36.568	113.699	5.414	7.553.365	15.106.729	9.064.038	***8.610.836***
2019	5	10	103	255	507	779	1.343	1.877	2.654	3.788	5.453	7.904	11.521	16.872	24.802	77.874	3.708	5.173.387	10.346.775	6.208.065	***5.897.662***
2020	4	8	80	194	379	573	974	1.343	1.877	2.654	3.788	5.453	7.904	11.521	16.872	53.624	2.554	3.562.423	7.124.845	4.274.907	***4.061.162***
2021	3	6	63	150	288	428	717	974	1.343	1.877	2.654	3.788	5.453	7.904	11.521	37.170	1.770	2.469.290	4.938.581	2.963.149	***2.814.991***
2022	3	5	50	118	223	326	536	717	974	1.343	1.877	2.654	3.788	5.453	7.904	25.970	1.237	1.725.258	3.450.517	2.070.310	***1.966.795***
2023	2	4	41	94	176	252	407	536	717	974	1.343	1.877	2.654	3.788	5.453	18.318	872	1.216.917	2.433.833	1.460.300	***1.387.285***
2024	2	4	34	77	141	198	315	407	536	717	974	1.343	1.877	2.654	3.788	13.066	622	867.987	1.735.973	1.041.584	***989.505***
2025	2	3	28	63	114	159	248	315	407	536	717	974	1.343	1.877	2.654	9.440	450	627.119	1.254.239	752.543	***714.916***
2026	1	3	24	53	94	129	198	248	315	407	536	717	974	1.343	1.877	6.920	330	459.710	919.421	551.652	***524.070***
2027	1	2	21	45	79	107	161	198	248	315	407	536	717	974	1.343	5.154	245	342.408	684.817	410.890	***390.346***
2028	1	2	18	39	67	89	133	161	198	248	315	407	536	717	974	3.905	186	259.429	518.858	311.315	***295.749***
2029	1	2	15	33	57	76	112	133	161	198	248	315	407	536	717	3.012	143	200.080	400.160	240.096	***228.091***
2030	1	2	14	29	50	65	95	112	133	161	198	248	315	407	536	2.365	113	157.100	314.200	188.520	***179.094***
2031	1	1	12	26	43	56	81	95	112	133	161	198	248	315	407	1.890	90	125.543	251.087	150.652	***143.119***
2032	1	1	11	23	38	49	70	81	95	112	133	161	198	248	315	1.536	73	102.026	204.052	122.431	***116.310***
2033	1	1	10	20	34	43	61	70	81	95	112	133	161	198	248	1.268	60	84.223	168.446	101.068	***96.014***
2034	1	1	9	18	30	38	54	61	70	81	95	112	133	161	198	1.062	51	70.528	141.056	84.634	***80.402***
2035	0	1	8	16	27	34	48	54	61	70	81	95	112	133	161	901	43	59.823	119.646	71.788	***68.198***
2036	0	1	7	15	24	30	42	48	54	61	70	81	95	112	133	773	37	51.324	102.648	61.589	***58.509***
2037	0	1	6	13	22	27	38	42	48	54	61	70	81	95	112	669	32	44.476	88.953	53.372	***50.703***
2038	0	1	6	12	20	25	34	38	42	48	54	61	70	81	95	585	28	38.883	77.766	46.659	***44.326***
2039	0	1	5	11	18	22	31	34	38	42	48	54	61	70	81	516	25	34.256	68.513	41.108	***39.052***

Figure 4. LFG Generation calculated using the approved tool

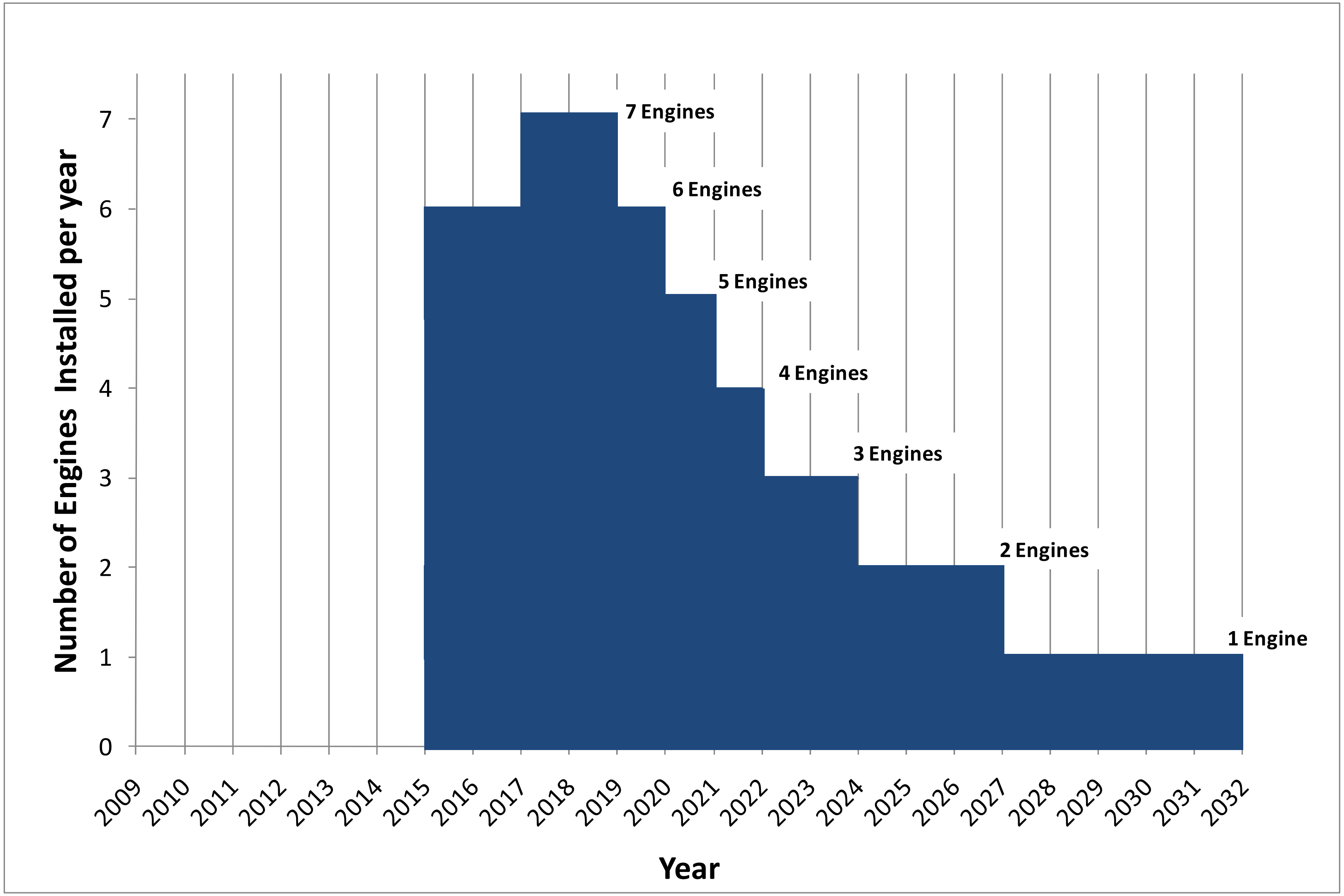

Figure 5. Engines Installation Chronogram

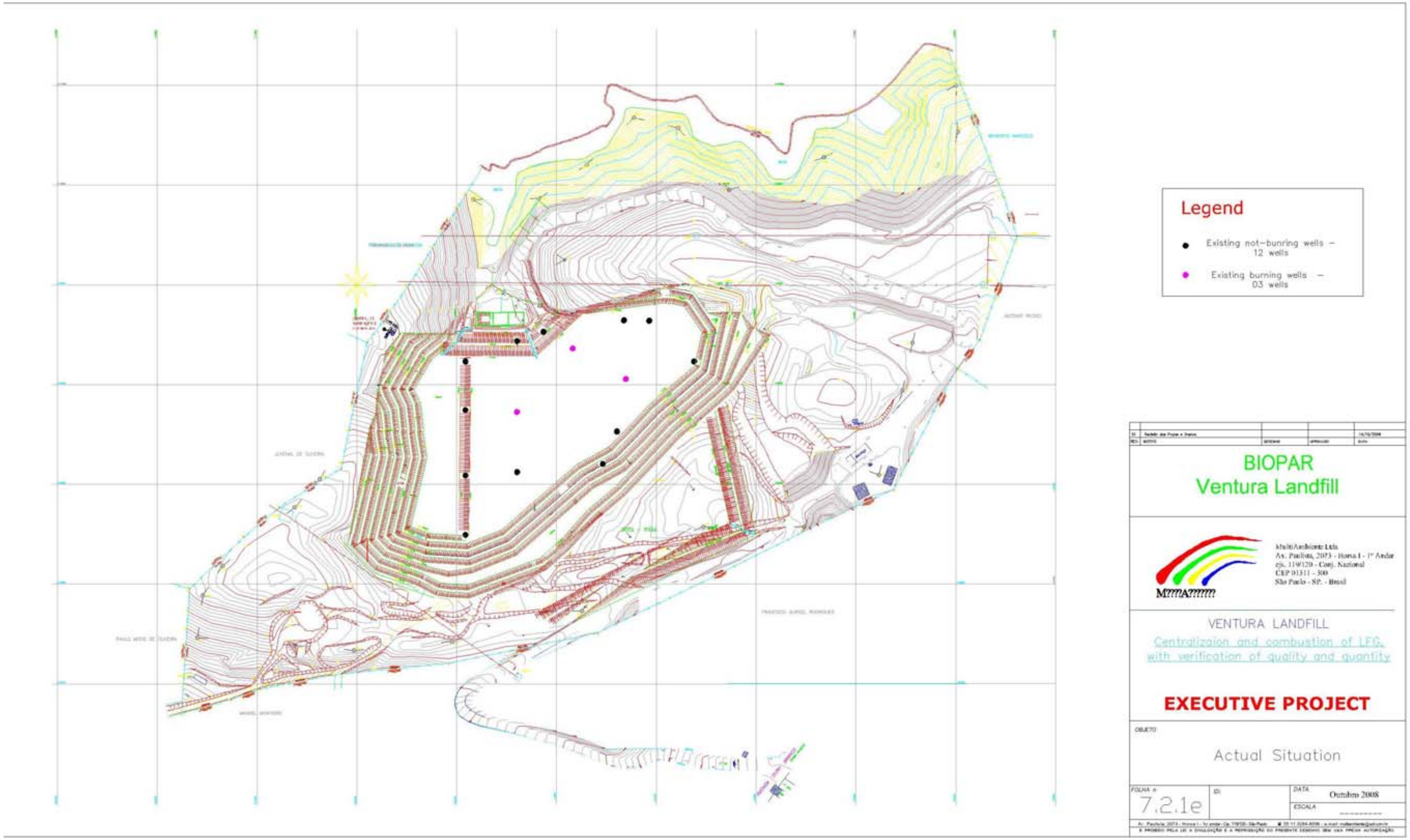

Figure 6. Lay-out of the wells at Ventura Landfill

Annex 4

MONITORING INFORMATION

The whole monitoring of the project will be made via a PLC system. The PLC will also register all data read in the hard disk. Proper back-up procedures will be implemented to assure the data won't be lost.

Data of accumulated gas-flow measured by each flow-meter will be registered every hour and the counter will reset in the end of the day, after the last reading (at 23:59).

The PLC will also calculate the average methane concentration in the collected gas and register it every hour in the PLC's database. The same applies for the methane and oxygen concentrations in the exhaust gas.

Electricity imported/exported will be accumulatively registered by the PLC every hour and the counter will reset in the end of the day, after the last reading.

The operators will be trained to make manual registrations of the data above mentioned in a proper sheet.

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