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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Manaus Landfill Gas Project
Version 3
25/10/2010 *(DD/MM/YYYY)*

A.2. Description of the project activity:

The Manaus Landfill Gas Project (hereinafter referred to as "Project") will be developed by Conestoga-Rovers & Associates Capital Limited (CRA). The Manaus landfill (project site), originally called *Aterro Municipal de Manaus*, has received non-hazardous solid municipal, industrial, commercial, institutional, and some agricultural wastes for approximately 20 years. Landfills normally emit carbon dioxide (CO_2) and methane (CH_4) into the atmosphere, with these compounds being generated by the anaerobic decomposition of the above-noted wastes placed at the project site. Prior to the implementation of the Project, the Manaus landfill was basically a landfill with has minimal control of surface water and leachate and no control of landfill gas (LFG).

The Project consists of two phases: (1) the construction of a LFG collection and flaring system and (2) the construction of a LFG-fired power. The LFG power plant is expected to have approximately 19.2 MW installed capacity once it is completely installed – twelve engines with 1.6 MW each are expected, but actual equipment to be installed may vary according to the equipment available in the market at the time of actual implementation of phase 2 of the Project.

The LFG collection system will consist of a grid of horizontal collection system, centrifugal blower(s), and all other supporting mechanical and electrical subsystems and appurtenances necessary to collect the LFG. The power generation facility will be comprised of LFG engine generator sets of high performance standards. The engine-generator sets will be the primary equipment to combust the collected LFG once they are installed. A fraction of the collected LFG will be diverted to flares, which will be used to combust any gas in excess of the fuel demand for the engines, as well as a contingency backup.

To combust the non-utilized LFG collected from the site, it will be used enclosed LFG flares with full process controls and instrumentation, capable of providing sufficient temperature and retention time of the extracted LFG for complete destruction of hydrocarbons.

Purpose of the Project Activity:

The purpose of the proposed project activity is to collect LFG at the Manaus landfill and combust the extracted LFG utilizing LFG engines and high-efficiency enclosed flares, thereby reducing greenhouse gas emissions (GHGs).

Contribution of the Project Activity to Sustainable Development:

The project will make a strong contribution to sustainable development in Brazil. In addition to reducing emissions of GHGs and generating clean electricity, the Project provides other sustainable development benefits as follows:

a) **Contribution to human health and the environment:**

With the combustion of LFG, the population living around the landfill will have an environment that is cleaner and healthier, with improved air quality and reduced risk due to LFG subsurface migration. Further, potential for fires resulting from uncontrolled LFG will be minimized, as will potential for groundwater contamination. Additionally, the electrical generation in the second phase of the Project will displace electricity generated by fossil fuel-fired power plants.

b) Contribution to the improvement of working conditions and employment creation:

Local manpower will be used in the Project implementation, which entails installation of vertical wells, horizontal collection system and assembly and operation of equipment such as blowers, flares, and engine-generators sets. During the operational phase, which will take place 24 hours/day, 7 days/week, there will be new jobs created locally for duties related to operations and maintenance, landscaping, plumbing, monitoring and security personnel. These people will be fully trained by CRA on their duties and tasks.

c) Contribution to income generation:

In addition to the local jobs created during its implementation and operation, the Project will share the revenues with the municipality of Manaus throughout its crediting period.

d) Contribution to regional integration and co-operation with other sectors:

Manaus will serve as a reference for other municipalities that are willing to implement similar projects at their landfill sites. Other sectors of the economy will be stimulated by the innovative nature of the project and the prospect of investing revenue derived from the project to bring about social and environmental benefits. The electricity supplied to the Manaus Electricity Grid[1] derived by the Project will also contribute to local programs of expansion of electricity generation capacity, improving sustainable economic growth.

Since Manaus is in the heart of the Brazilian Amazon, its grid is not integrated into the national electric grid of Brazil. The development of new electricity generation projects is particularly important for this region.

A.3. Project participants:

[1] The Manaus electricity grid is an isolated and independent system with no connection to the overall Brazilian national grid (ELETRONORTE, http://www.eln.gov.br/).

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)	TUMPEX – Empresa Amazonense de Coleta de Lixo Ltda. (Private Entity)	No
	Enterpa Engenharia Ltda. (Private Entity)	No
Canada	Conestoga-Rovers & Associates Capital Limited (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.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil

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

Amazonas

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

Manaus

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

The Manaus landfill (2°57’29.92” S and 60°00’54.74” W) is located 3.5 kilometers (km) north of the City of Manaus, State of Amazonas at Km 19 of Highway AM-010. The Manaus landfill covers an area of 60 hectares (ha) and the current waste fill area of the Site is disposed in 41 ha and there is available space for continued filling. Below is a map indicating the Project location and a photograph of the Manaus landfill site.

Figure 1 - Geographical position of Manaus, Brazil

(Source: http://www.ibge.gov.br/cidadesat/default.php)

Figure 2 - Aerial view of Manaus landfill before the Project

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

Sectoral Scope: 13 - waste handling and disposal.

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

As there is no legal requirement to capture LFG in landfill sites in Brazil, the baseline scenario is LFG release to the atmosphere. This is also the scenario prior to the Project implementation. Therefore, the

Project Participants need some incentive to make this investment in a LFG recovery and destruction system at the Manaus landfill.

The baseline scenario is LFG release to the atmosphere and a landfill without any legal requirement to capture this LFG. This is also the scenario prior to the project implementation. Therefore, an extra-incentive is needed for CRA to make additional investments and install an appropriate facility to properly burn the methane produced at the site.

a) Collecting System

Following concrete examples from other LFG projects in the world, the Project will involve the installation of horizontal collecting system and vertical wells to avoid the emission of methane to the atmosphere. An example of configuration that could be used is shown in the Figure 3 below.

Figure 3 - Example of horizontal collection system (trench)

The horizontal collecting system and vertical wells will only be implemented due to the project activity. Usually the horizontal colleting systems are made of Polyvinyl chloride (PVC) or High Density Polyethylene (HDPE), due to the flexibility and the corrosion resistance.

The horizontal collecting system and vertical wells are connected to the transmission pipeline. This pipeline usually transports the LFG to the manifolds or gas regulation stations. The manifold is designed to regulate the concentration of the gas (methane, oxygen and others).

Figure 4 - Gas Regulation Station

b) Transmission Pipeline

The transmission pipeline is the last step of the collecting system. It transports the collected LFG to the flare station. The transmission pipeline might be connected to all manifolds or gas regulation stations around the landfill.

Figure 5 - Example of transmission pipelines

The collecting pipeline and the transmission pipeline are both usually in HDPE, because this material can support high pressures and is flexible. The transmission pipeline is finally connected to the flare station. A common practice all over the world is to use HDPE. It has the advantage to be more flexible and more resistant to high pressure, if compared to metal or concrete equipment. The disadvantage is represented by the high cost involved.

c) Blowering System

The blowering system is responsible to give negative pressure to the landfill, blowing the gas to the pipeline. The dimensioning of the blower will depend on the final use of the gas (flare, boiler, electricity).

In order to preserve the operation of the blowers, a dewatering system is installed to remove the condensate. This equipment is a single knock-out dewatering component.

Figure 6 - Blower system

Figure 7 - Condensate knockout

d) Flare System

The destruction of the methane content in the LFG collected will be made via enclosed flares, in order to assure a higher methane destruction (minimum 98%).

Basically, the flare is constructed using refractory material, a gas inlet, dampers to control the air inlet, an ignition spark, flame viewer and points to sample collection, as presented in the pictures below:

Figure 8 - Detail of Enclosed Flare

e) Power generation

The power generation system will be comprised of around 12 engines - 1.6 MW or similar equipment with similar capacity. The electricity generated by the Project will be supplied to the Manaus Electricity Grid.

This kind of technology is still not widely applied in Brazil. Very few landfills have already installed equipment for the collection and flare of LFG. Therefore, the company will need engineers and other specialists with experience in this area to advice the company while implementing the project. These professionals will also train local operators and engineers on operations and maintenance of the facilities.

Technology will have to come from abroad and mainly from the United States, Canada and Europe. Hence, technology transfer will occur from countries with strict environmental legislative requirements and environmentally sound technologies.

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

For the first crediting period (from 01/03/2011 to 28/02/2018) the estimation of emission reductions is:

Years	**Annual estimation of emission reductions in tonnes of CO_2e**
01/03/2011	657,961
2012	884,596
2013	956,546
2014	1,026,211
2015	1,094,646
2016	1,160,752
2017	1,225,423
28/02/2018	214,882
Total estimated reductions (tonnes of CO_2e)	**7,221,016**
Total Number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	1,031,574

A.4.5. Public funding of the project activity:

There is no Annex I public funding involved in the Manaus Landfill Gas Project.

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:

The following methodologies are applicable to this project activity:

- ACM0001 - Consolidated baseline and monitoring methodology for landfill gas project activities, version 11;

- Tool for the demonstration and assessment of additionality – version 5.2;
- Combined tool to identify the baseline scenario and demonstrate additionality – version 2.2.
- Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site – version 5;
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption – version 1;
- Tool to determine project emissions from flaring gases containing methane – EB 28, annex 13;
- Tool to calculate the emission factor for an electricity system – version 2;
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion – version 2;

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

The methodology ACM0001 is applicable for project activities that comprise one of the following scenarios:

- The captured gas is flared; and/or
- The captured gas is used to produce energy (e.g. electricity/thermal energy);
- The captured gas is used to supply consumers through natural gas distribution network.

The project activity corresponds to both first and second alternative of these three scenarios. In the first phase the LFG will be only flared and during the second phase will be installed power generators. So, the methodology ACM0001 was deemed appropriate.

- “Combined tool to identify the baseline scenario and demonstrate additionality” could be applied as all alternatives are available options of the project participants. However, for this project activity, the “tool for demonstration and assessment of additionality” was used to evaluate the additionality, as required in the ACM0001 version 11.

- “Tool for demonstration and assessment of additionality” is applicable to this project activity, as it is included in the ACM0001 methodology.

- “Tool to determine project emissions from flaring gases containing methane” is applicable to this project activity as:
    - The residual gas stream to be flared contains no other combustible gases than methane, carbon monoxide and hydrogen;
- The residual gas stream to be flared is obtained from decomposition of organic material (through landfill). “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” is also applicable to Manaus Landfill Gas Projects during this project activity, electricity will be consumed from the grid.

- The “Tool to calculate the emission factor for an electricity system” is applicable as this project will supply electricity to the grid.

- “Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site” is applicable as the solid waste disposal site is clearly identified, there are no hazardous wastes and this is not a stockpile case.

- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” is applicable to the project activity because electricity can be occasionally generated using a standby diesel generator located on site.

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

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

Note: On-site fossil fuel consumption due to the project activity other than for electricity generation will be due to LPG consumption.

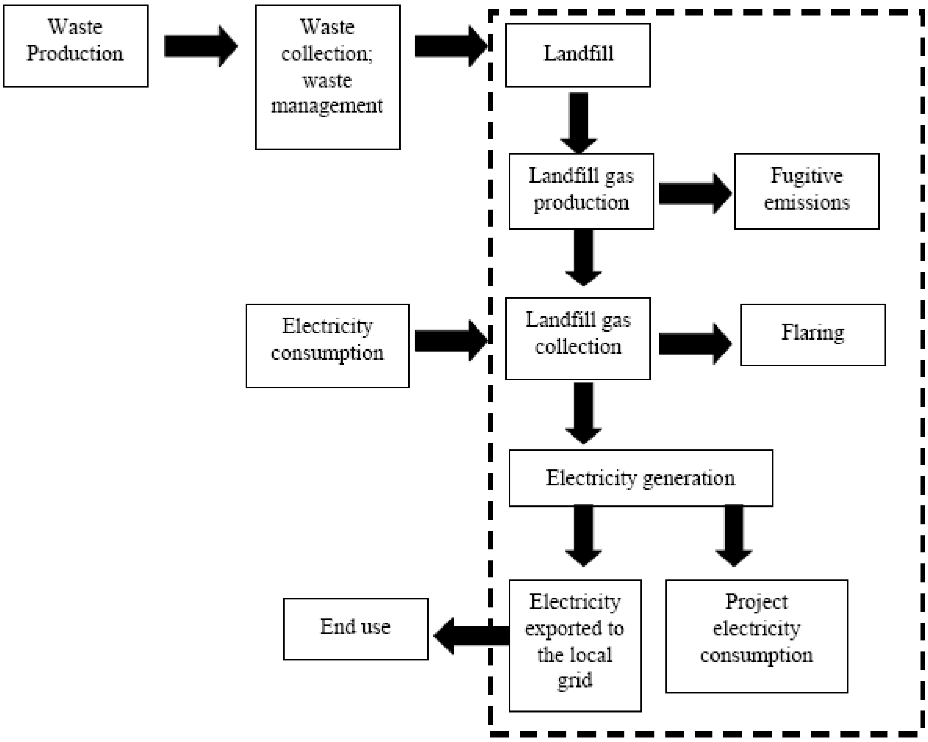

Figure 9 - Project boundary

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

The baseline scenario for the project activity is identified using step 1 of the 'Tool for demonstration and assessment of additionality" (Version 05.2), as agreed in ACM0001 "Consolidated baseline and monitoring methodology for landfill gas project activities" (version 11).

Realistic and credible alternatives to the project activity that can be part of the baseline scenario are defined through the following sub-steps:

Step 1: Identification of alternative scenarios

The project participants will monitor all relevant policies and circumstances at the beginning of each crediting period and adjust the baseline accordingly.

The identified alternatives for the disposal/treatment of the waste in the absence of the project activity include:

LFG1	The project activity (capture of landfill gas and power generation) undertaken without being registered as a CDM project activity;
LFG2	Atmospheric release of the landfill gas.

For power generation, the realistic and credible alternatives include:

Since the project uses LFG for generating electricity, according to ACM0001 Version 11 realistic and credible alternatives also may include the following:

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

As there is no alternative to use heat inside the landfill and there is no consumer nearby the project activity, the heat generation was not considered a realistic alternative by the project participants (P2 and P3). The alternatives P4 and P5 were not considered realistic as there is no need for power at the landfill site and power generation is not CRA's core business; consequently no captive power is required to be built in the project surroundings.

The only remaining real alternatives to the project activity are LFG1, LFG2, P1 and P6.

Outcome of Step 1a: Four realistic and credible alternative scenarios to the project activity were identified.

Alternatives LFG1 and P1 comply with all applicable laws and regulations. In Brazil there is no regulation or policy requesting the LFG capture and flare, neither is forecasted any policy of this kind.

Alternatives LFG2 and P6, a continuation of the current situation (partial or total release of LFG to the atmosphere) represents the business as usual practice for the project site as well as for most of the landfills in Brazil, according to "Sistema Nacional de Informações sobre Saneamento: diagnóstico do manejo de resíduos sólidos urbanos – 2007".[2]

The project participants will monitor all relevant policies and circumstances at the beginning of each crediting period and adjust the baseline accordingly.

Step 2: Identify the fuel for the baseline choice of energy source taking into account the national and/or sectoral policies as applicable.

The power consumed by the project activity could be bought from Manaus Electricity Grid where the emission factor is 0.7160 tCO_2e/MWh (see section B.6.3). The project activity will supply energy to the Manaus Electricity Grid, displacing energy from fossil fuel fired power plants connected to this grid.

Step 3: Assessment using Step2 and/or Step 3 of the latest approved version of the "Tool for demonstration and assessment of additionality"

Applying this step for the waste disposal:

The alternative LFG1 was not deemed a realistic and credible alternative as showed in item B.5. So, the only plausible alternative is the continuation of the baseline scenario, LFG2.

Applying this step for the power generation:

The alternative P1 was not deemed a realistic and credible alternative as showed in item B.5.

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[2] SNIS – 2007, page II.281 (http://www.pmss.gov.br/snis/PaginaCarrega.php?EWRErterterTERTer=80)

The only plausible alternative is to continue electricity generation from existing and/or new grid-connected power plants, P6.

Thus, the most plausible baseline scenario for the LFG is identified as atmospheric release of LFG with electricity supplied from grid connected power plants, being applicable to version 11 of ACM0001.

The project participants identified the scenario A: Electricity consumption from the grid from the *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"* for the project electricity consumption during the first phase and if necessary the electricity consumption in the subsequent phase.

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

The following table shows the timeline of the Project showing that the CDM benefits were taken into account when deciding to implement it.

Table 1 - Implementation timeline of the Project

Key Events	Date
PDD submitted to SGS for validation	2 December 2005
PDD in Global Stakeholder Consultation (GSC) for the first time	07 December 2005 to 06 January 2006
PDD public comments availability closes	6 January 2006
SGS issues validation report	29 May 2006
Host country approval submitted	2 June 2006
CRA signed a contract (including CDM consideration) with Tumpex (landfill operator), Manaus City Hall and Enterpa to develop the proposed project (starting date of the project activity).	25 July 2008
Construction works started	October 2008
CRA notifies SGS of revised PDD submittal for new validation	5 November 2008
CRA develops revised PDD and submits to SGS for validation	4 December 2008
PDD in GSC for the second time	21 January 2009 to 19 February 2009
PDD public comments availability closes	19 February 2009
PDD in GSC for the third time	26 May 2010 to 24 June 2010

As can be seen from the Table above, several actions were taken at an early stage, indicating that consideration of applying for CDM was taken seriously well before the final investment decision was made.

The additionality of the project activity will be demonstrated and assessed using version 5.2 of the "Tool for the demonstration and assessment of additionality" agreed by the CDM Executive Board.

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

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

The identified alternatives for the disposal of the waste in the absence of the project activity include:

LFG1 – The project activity (capture of landfill gas and power generation) undertaken without being registered as a CDM project activity;

LFG2 – Atmospheric release of the landfill gas;

For power generation, the realistic and credible alternatives include:

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

The only remaining real alternatives to the project activity are LFG1, LFG2, P1 and P6.

Outcome of Step 1a: Four realistic and credible alternative scenarios to the project activity were identified.

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

In Brazil, there is no regulation or policy that obliges the landfill operator to burn the LFG generated in the landfill. In documents below, there is no regulation or obligation about burning LFG in landfill. Following below the source of this statement:

Documents	Elaborated by	Reference
Solid Waste Integrated Management	Ministry of Environment and Ministry of Cities	http://www.ibam.org.br/publique/media/01-girs.pdf
SNIS	Ministry of Cities	SNIS: Secretaria Nacional de Informações sobre Saneamento Sistema Nacional de Informações sobre Saneamento: diagnóstico do manejo de resíduos sólidos urbanos, page II.281 http://www.pmss.gov.br/snis/PaginaCarrega.php?EWRErterterTERTer=80

The project participants will monitor all relevant policies and circumstances at the beginning of each crediting period and adjust the baseline accordingly.

Step2. Investment analysis

Sub-step2a. Determine appropriate analysis method

As the proposed project activity will generate financial benefits other than CDM related income, the Option III is chosen.

Sub-step2b. – Option III. Apply benchmark analysis

For the purpose of assessing the financial/economic attractiveness, the most appropriate financial indicator for the decision context is the Internal Rate of Return (IRR).

The benchmark parameter used for this comparison was the government bond rates increased by a suitable risk premium, calculated as follows:

Table 2 - Benchmark calculation method

Benchmark real terms	
A	Brazilian Government Bond Rate NTN-B, maturity 2024 (maturity similar to the project lifetime, real terms)
B	Market Risk Premium (S&P 500 - T-Bonds)
C	Unlevered Beta (in lack of open companies with the same risk profile)
D = A + B x C	**Benchmark - Real Terms**

The government bond rate chosen in the Brazilian Bond NTN-B 15082024, with a similar tenor of the project activity. The yield is based on the inflation rate (*IPCA - Indice Nacional de Preços ao Consumidor Amplo*) increased by a fixed rate at the moment of the acquisition.[3] The fixed rate used for the benchmark calculation was based on 3 years prior to the project investment decision (i.e. 2005, 2006 and 2007[4]), resulting in 7.9%. The inflation rate was not considered in this analysis, as the investment analysis is done in real terms.

In order to calculate this spread, the project participants used the risk premium calculated by the average historical difference between the US T-bonds and the S&P 500. This would result in a Market risk premium of 6.42%.[5]

To estimate the risk in investing in a power generation project, the project participants should consider also the beta of companies with the same risk profile (such as public held companies with the same portfolio). However, there is no other company with a comparable portfolio to CRA listed in a stock exchange. Therefore, the project proponents considered the beta of all utilities (0.63).[6] This approach is deemed conservative as most of those companies operates with widely known technologies, less risky than LFG to energy projects. With these input data, the benchmark calculated follows:

Table 3 - Benchmark value

Benchmark real terms		
A	Brazilian Government Bond Rate NTN-B, maturity 2024 (maturity similar to the project lifetime, real terms)	7.90%
B	Market Risk Premium (S&P 500 - T-Bonds)	6.42%
C	Unlevered Beta (in lack of open companies with the same risk profile)	0.63

[3] Source: http://www.tesouro.fazenda.gov.br/tesouro_direto/consulta_titulos/consultatitulos.asp, accessed on 13 May 2010.

[4] Source: http://www.tesouro.fazenda.gov.br/tesouro_direto/historico.asp, accessed on 13 May 2010

[5] http://www.stern.nyu.edu/~adamodar/pc/datasets/histretSP.xls

[6] http://www.stern.nyu.edu/~adamodar/pc/archives/betas07.xls

D = A + B x C	**Benchmark - Real Terms[7]**	**11.94%**

[7] Note: It was not considered the currency risk. Consequently, this benchmark calculation is deemed conservative.

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

The following assumptions were taken for the purpose of the calculation of the financial indicator:

Table 4 - Main assumptions

	Parameter	Value	Unit	Reference
Assumptions	Asset's Life time	25	Years	Tool to determine the remaining lifetime of equipment (EB 50 - Annex 15, page 4)
	Installed capacity for each engine	1.6	MW	gas engine technical data.pdf
	Total installed capacity	19.2	MW	-
	Load factor	99.06%	%	Parasitic Losses and Load Factor april 08.pdf
	Exchange Rate	1.57	R$/US$	"Banco Central do Brasil" on 25/07/2008 (http://www4.bcb.gov.br/?TXCONVERSAO)
	Electricity price	156.78	R$/MWh	notatcnicamanaus276_31_08.pdf, page 8, table III-A, Breitener (Jaraqui).
	Price per MW installed	2,637,433.98	US$/MWinstalled	LFG Utilization System.pdf
	Power plant operation cost	26.36	US$/MWh	Agreement and Proposal for operation and maintenance services.pdf
	Tax (PIS)	1.65%	%	Contribution to the Social Integration Program and Civil Service Asset Formation Program – PIS/PASEP (http://www.receita.fazenda.gov.br/principal/Ingles/SistemaTributarioBR/Taxes.htm)
	Tax (Confins)	7.60%	%	COFINS - Contribution to Social Security Financing (http://www.receita.fazenda.gov.br/principal/Ingles/SistemaTributarioBR/Taxes.htm)
	Tax (IRPJ)	15%	%	Art. 541. (http://www.receita.fazenda.gov.br/Legislacao/rir/L2Parte3.htm)
	Tax (IRPJ additional)	10%	%	Art. 542. (http://www.receita.fazenda.gov.br/Legislacao/rir/L2Parte3.htm)
	Tax (CSLL)	9%	%	(Social contribution on net profit) Art. 3o - II (http://www.planalto.gov.br/ccivil_03/LEIS/L7689.htm)
	Contingency	5%	%	“Landfill Full Cost Accounting Guide” (5% Contingency Factor.pdf) http://www.mfe.govt.nz/publications/waste/landfill-full-cost-accounting-guide-mar04/html/page7.html

Note: The documents above were made available to DOE in validation visit.

For the project alternative: LFG1 – The project activity (capture of landfill gas and power generation) undertaken without being registered as a CDM project activity, the estimated project cash flow is presented below:

	YEAR	0	1	2	3	4	5	6
		2008	2009	2010	2011	2012	2013	2014
Electricity dispatched (MWh)			0	0	0	40,823	54,707	68,591
Electricity price (USD/MWh)			99.86	99.86	99.86	99.86	99.86	99.86
Gross Revenues			-	-	-	4,076,554	5,463,034	6,849,513
PIS/Cofins	9.25%		-	-	-	(377,081.29)	(505,330.63)	(633,579.98)
Net revenues			-	-	-	3,699,473.20	4,957,703.26	6,215,933.31
O&M		0	(1,500,610.00)	(1,500,610.00)	(1,500,610.00)	(2,653,474.78)	(3,037,763.04)	(3,422,051.30)
Variable costs			(82,883.69)	(82,883.69)	(82,883.69)			
Total Costs			(1,583,493.69)	(1,583,493.69)	(1,583,493.69)	(2,653,474.78)	(3,037,763.04)	(3,422,051.30)
Gross Margin			(1,583,493.69)	(1,583,493.69)	(1,583,493.69)	1,045,998.42	1,919,940.21	2,793,882.01
SG&A								
EBITDA			(1,583,493.69)	(1,583,493.69)	(1,583,493.69)	1,045,998.42	1,919,940.21	2,793,882.01
Depreciation			(627,056.43)	(705,255.18)	(783,453.93)	(2,726,728.10)	(3,248,015.76)	(3,769,303.42)
EBIT			(2,210,550.12)	(2,288,748.87)	(2,366,947.62)	(1,680,729.68)	(1,328,075.55)	(975,421.41)
Income Taxes (IRPJ+CSLL)	34.00%		-	-	-	-	-	-
NET EARNINGS			(2,210,550.12)	(2,288,748.87)	(2,366,947.62)	(1,680,729.68)	(1,328,075.55)	(975,421.41)
CAPEX		(6,270,564)	(781,988)	(781,988)	(19,432,742)	(5,212,877)	(5,212,877)	(5,212,877)
Depreciation			627,056.43	705,255.18	783,453.93	2,726,728.10	3,248,015.76	3,769,303.42
Account Receivable (35 days)			-	-	-	(390,902.49)	(523,852.56)	(656,802.64)
Account payable (30 days)			130,150.17	130,150.17	130,150.17	218,093.82	249,679.15	281,264.49
Working Capital			130,150.17	130,150.17	130,150.17	(172,808.67)	(274,173.41)	(375,538.15)
+/- Working Capital increase			130,150.17	-	-	(302,958.83)	(101,364.74)	(101,364.74)
FCF		**(6,270,564.27)**	**(2,235,331.03)**	**(2,365,481.19)**	**(21,016,235.45)**	**(4,469,837.00)**	**(3,394,301.11)**	**(2,520,359.32)**

IRR	4.29%
Benchmark	11.94%
NPV	(20,530,849.37)

7	8	9	10	11	12	13	14	15	16
2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
82,475	96,360	110,244	124,128	138,012	151,897	165,781	165,781	165,781	165,781
99.86	99.86	99.86	99.86	99.86	99.86	99.86	99.86	99.86	99.86
8,235,993	9,622,472	11,008,951	12,395,431	13,781,910	15,168,390	16,554,869	16,554,869	16,554,869	16,554,869
(761,829.32)	(890,078.67)	(1,018,328.01)	(1,146,577.36)	(1,274,826.70)	(1,403,076.04)	(1,531,325.39)	(1,531,325.39)	(1,531,325.39)	(1,531,325.39)
7,474,163.36	8,732,393.41	9,990,623.47	11,248,853.52	12,507,083.57	13,765,313.62	15,023,543.67	15,023,543.67	15,023,543.67	15,023,543.67
(3,806,339.56)	(4,190,627.82)	(4,574,916.08)	(4,959,204.34)	(5,343,492.60)	(5,727,780.86)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)
(3,806,339.56)	(4,190,627.82)	(4,574,916.08)	(4,959,204.34)	(5,343,492.60)	(5,727,780.86)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)
3,667,823.80	4,541,765.59	5,415,707.38	6,289,649.17	7,163,590.97	8,037,532.76	8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55
3,667,823.80	4,541,765.59	5,415,707.38	6,289,649.17	7,163,590.97	8,037,532.76	8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55
(4,290,591.08)	(4,811,878.74)	(5,333,166.39)	(5,854,454.05)	(5,748,685.28)	(6,191,774.19)	(6,634,863.10)	(4,769,787.68)	(4,326,698.77)	(3,883,609.86)
(622,767.28)	(270,113.15)	82,540.99	435,195.12	1,414,905.68	1,845,758.56	2,276,611.45	4,141,686.87	4,584,775.78	5,027,864.69
-	-	(28,063.94)	(147,966.34)	(481,067.93)	(627,557.91)	(774,047.89)	(1,408,173.54)	(1,558,823.77)	(1,709,473.99)
(622,767.28)	(270,113.15)	54,477.05	287,228.78	933,837.75	1,218,200.65	1,502,563.56	2,733,513.34	3,025,952.02	3,318,390.70
(5,212,877)	(5,212,877)	(5,212,877)	(5,212,877)	(5,212,877)	(5,212,877)	(781,988)	(781,988)	(781,988)	(781,988)
4,290,591.08	4,811,878.74	5,333,166.39	5,854,454.05	5,748,685.28	6,191,774.19	6,634,863.10	4,769,787.68	4,326,698.77	3,883,609.86
(789,752.72)	(922,702.80)	(1,055,652.88)	(1,188,602.96)	(1,321,553.04)	(1,454,503.12)	(1,587,453.20)	(1,587,453.20)	(1,587,453.20)	(1,587,453.20)
312,849.83	344,435.16	376,020.50	407,605.84	439,191.17	470,776.51	502,361.85	502,361.85	502,361.85	502,361.85
(476,902.90)	(578,267.64)	(679,632.38)	(780,997.12)	(882,361.87)	(983,726.61)	(1,085,091.35)	(1,085,091.35)	(1,085,091.35)	(1,085,091.35)
(101,364.74)	(101,364.74)	(101,364.74)	(101,364.74)	(101,364.74)	(101,364.74)	(101,364.74)	-	-	-
(1,646,417.53)	**(772,475.74)**	**73,402.12**	**827,441.51**	**1,368,281.71**	**2,095,733.52**	**7,254,074.41**	**6,721,313.51**	**6,570,663.28**	**6,420,013.05**

17	18	19	20	21	22	23	24	25
2025	2026	2027	2028	2029	2030	2031	2032	2033
165,781	165,781	165,781	165,781	165,781	165,781	165,781	165,781	165,781
99.86	99.86	99.86	99.86	99.86	99.86	99.86	99.86	99.86
16,554,869	16,554,869	16,554,869	16,554,869	16,554,869	16,554,869	16,554,869	16,554,869	16,554,869
(1,531,325.39)	(1,531,325.39)	(1,531,325.39)	(1,531,325.39)	(1,531,325.39)	(1,531,325.39)	(1,531,325.39)	(1,531,325.39)	(1,531,325.39)
15,023,543.67	15,023,543.67	15,023,543.67	15,023,543.67	15,023,543.67	15,023,543.67	15,023,543.67	15,023,543.67	15,023,543.67
(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)
(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)	(6,112,069.13)
8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55
8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55	8,911,474.55
(3,440,520.95)	(2,997,432.04)	(2,554,343.13)	(2,111,254.23)	(1,668,165.32)	(1,225,076.41)	(781,987.50)	(781,987.50)	(781,987.50)
5,470,953.60	5,914,042.51	6,357,131.42	6,800,220.32	7,243,309.23	7,686,398.14	8,129,487.05	8,129,487.05	8,129,487.05
(1,860,124.22)	(2,010,774.45)	(2,161,424.68)	(2,312,074.91)	(2,462,725.14)	(2,613,375.37)	(2,764,025.60)	(2,764,025.60)	(2,764,025.60)
3,610,829.37	3,903,268.05	4,195,706.73	4,488,145.41	4,780,584.09	5,073,022.77	5,365,461.45	5,365,461.45	5,365,461.45
(781,988)	(781,988)	(781,988)	(781,988)	(781,988)	(781,988)	(781,988)	(781,988)	(781,988)
3,440,520.95	2,997,432.04	2,554,343.13	2,111,254.23	1,668,165.32	1,225,076.41	781,987.50	781,987.50	781,987.50
(1,587,453.20)	(1,587,453.20)	(1,587,453.20)	(1,587,453.20)	(1,587,453.20)	(1,587,453.20)	(1,587,453.20)	(1,587,453.20)	(1,587,453.20)
502,361.85	502,361.85	502,361.85	502,361.85	502,361.85	502,361.85	502,361.85	502,361.85	502,361.85
(1,085,091.35)	(1,085,091.35)	(1,085,091.35)	(1,085,091.35)	(1,085,091.35)	(1,085,091.35)	(1,085,091.35)	(1,085,091.35)	(1,085,091.35)
-	-	-	-	-	-	-	-	1,085,091.35
6,269,362.83	**6,118,712.60**	**5,968,062.37**	**5,817,412.14**	**5,666,761.91**	**5,516,111.68**	**5,365,461.45**	**5,365,461.45**	**6,450,552.80**

The capital expenses estimated includes the power generation plant and the landfill gas extraction system. As presented above, the Project IRR is 4.29%. Consequently, this scenario is not deemed attractive by the project participants.

The second alternative (LFG2) is the continuation of the current practice, which is in compliance with all applicable regulations and policies, and was deemed the most plausible alternative to the project activity.

Sub-step 2d. Sensitivity analysis

The sensitivity analysis was performed varying the electricity tariff (income), the capital expenses and operational expenses. All parameters ranging from -10% to +10%, as the result presented below:

Table 5 - Sensitivity analysis

	Variation	IRR
CapEx	-10%	5.27%
	10%	3.38%
O&M	-10%	5.17%
	10%	3.36%
Revenues	-10%	2.28%
	10%	6.00%
Base Case	0%	4.29%

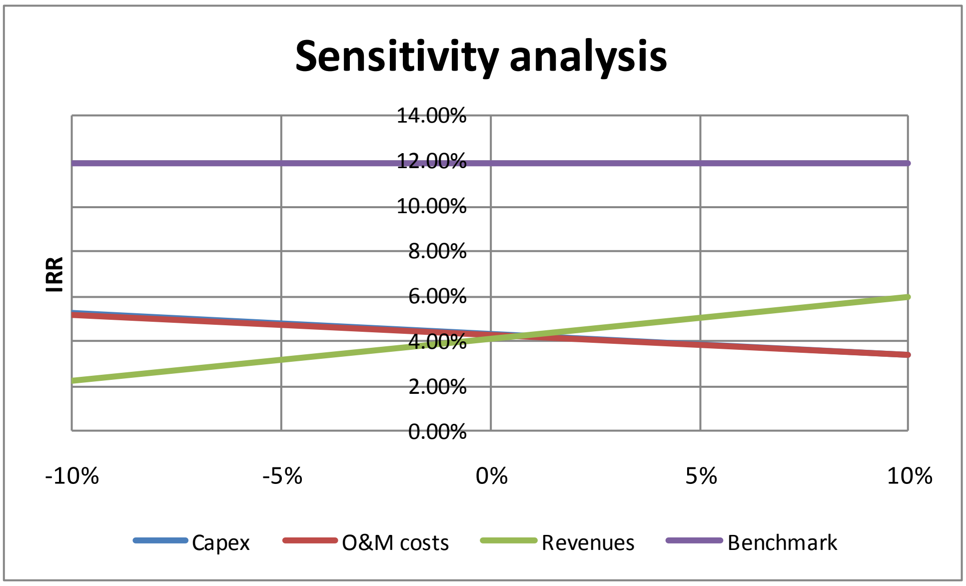

Figure 10 - Sensitivity analysis

As presented above, even if the best scenario is applied, the project IRR is lower than the chosen benchmark.

To ensure the additionality of this project, the project proponents varied the three identified parameters (CapEx, O&M and Revenues) until each of them reached the benchmark. The results are presented below and the spreadsheet was provided to the audit team:

Capital Expenditures (CapEx) – To reach the benchmark, the Capital Expenditures should be reduced in 56%. This result is extremely unlikely to happen in the future, as this reduction is too large for any kind of project which has a reliable investment estimate (such as Manaus Landfill Gas Project) and as usually the CapEx increases during the project implementation.

O&M – Also, to reach the benchmark, the O&M shall be reduced in 99%. This means that PPs should receive and not pay to operate the project. Consequently, this scenario is unreal.

Revenues – this value should be increased in 55% to reach the benchmark. This means that the electricity tariff should reach BRL 243.37, deemed unrealistic as this value is far superior to the average values from the latest electricity sale auction in this subsystem.[8] Also, the second way to increase the revenue is by increasing the electricity generation. The system, as well as the number of gensets to be installed is deemed accurate by the project developers. Some adjustments might occur, but is really not expected to have a variation of 55% in the number of gensets or in the LFG generation. Thus, the PP deemed this situation to be unlikely to happen in the future.

As could be noted, this project lacks of financial attractiveness by giving an IRR without the CER revenue below the selected benchmark.

Thus, it seems reasonable to conclude that the project activity is unlikely to be the most financially attractive scenario.

[8] Source: Eletrobras Amazonas Energia (http://www.amazonasenergia.gov.br), accessed on 14 May 2010

Step 4. Common practice analysis

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

Based on the documents below:

- SNIS (2007) - Secretaria Nacional de Informações sobre Saneamento Sistema Nacional de Informações sobre Saneamento: diagnóstico do manejo de resíduos sólidos urbanos [9];
- Brazilian Greenhouse Gases Emissions Inventory Report for Waste Sector[10] and ;
- Brazilian Country Profile for waste sector by Methane to Markets[11].
- Understanding methane emissions from passive systems in landfills in Brazil[12].

There are no similar activities[13] like the proposed project activity in Brazil, because all of the landfills that are developing capture and destruction of the LFG, are being developed as CDM project activities. The table below shows the landfill projects implemented or underway in Brazil.

Project Title	Status	Source
NovaGerar Landfill Gas to Energy Project	Registered on 18/11/2004	http://cdm.unfccc.int/Projects/DB/DNV-CUK1095236970.6/view
Salvador da Bahia Landfill Gas Management Project	Registered on 15/08/2005	http://cdm.unfccc.int/Projects/DB/DNV-CUK1117823353.4/view
Onyx Landfill Gas Recovery Project – Trémembé, Brazil	Registered on 24/11/2005	http://cdm.unfccc.int/Projects/DB/DNV-CUK1126082019.35/view
Brazil MARCA Landfill Gas to Energy Project	Registered on 23/01/2006	http://cdm.unfccc.int/Projects/DB/DNV-CUK1132565688.17/view

[9] Source: Ministry of the Cities (http://www.pmss.gov.br/snis/PaginaCarrega.php?EWRErterterTERTer=80)

[10] Source: Ministry of Science and Technology (http://www.mct.gov.br/index.php/content/view/21465.html), page 45.

[11] Source: Methane to Markets (http://www.methanetomarkets.org/documents/landfills_cap_brazil.pdf), page 2.

[12] Source: MAGALHÃES, G.HC.; ALVES, J.W.S.; SANTO FILHO. F.; COSTA, R.M.; KELSON. M. Understanding methane emissions from passive systems in landfills in Brazil. São Paulo, Brasil, 2010. Page 2. (http://homologa.ambiente.sp.gov.br/biogas/docs/artigos_dissertacoes/magalhaes_alves_santofilho_costa_kelson.pdf)

[13] The “Tool for the demonstration and assessment of additionality” – version 5.2, states: “Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Other CDM project activities (registered project activities and project activities which have been published on the UNFCCC website for global stakeholder consultation as part of the validation process) are not to be included in this analysis”

Bandeirantes Landfill Gas to Energy Project (BLFGE)	Registered on 20/02/2006	http://cdm.unfccc.int/Projects/DB/DNV-CUK1134130255.56/view
ESTRE's Paulínia Landfill Gas Project (EPLGP)	Registered on 03/03/2006	http://cdm.unfccc.int/Projects/DB/DNV-CUK1134989999.25/view
Caieiras landfill gas emission reduction	Registered on 09/03/2006	http://cdm.unfccc.int/Projects/DB/DNV-CUK1134509951.62/view
Landfill Gas to Energy Project at Lara Landfill, Mauá, Brazil	Registered on 15/05/2006	http://cdm.unfccc.int/Projects/DB/DNV-CUK1138957573.9/view
São João Landfill Gas to Energy Project (SJ)	Registered on 02/07/2006	http://cdm.unfccc.int/Projects/DB/DNV-CUK1145141778.29/view
Project Anaconda	Registered on 15/12/2006	http://cdm.unfccc.int/Projects/DB/DNV-CUK1155134946.56/view
Central de Resíduos do Recreio Landfill Gas Project	Registered on 31/12/2006	http://cdm.unfccc.int/Projects/DB/DNV-CUK1158844635.31/view
Canabrava Landfill Gas Project	Registered on 08/04/2007	http://cdm.unfccc.int/Projects/DB/SGS-UKL1169669649.47/view
Aurá Landfill Gas Project	Registered on 30/04/2007	http://cdm.unfccc.int/Projects/DB/SGS-UKL1169639070.69/view
Quitaúna Landfill Gas Project (QLGP)	Registered on 27/05/2007	http://cdm.unfccc.int/Projects/DB/DNV-CUK1169931302.54/view
ESTRE Itapevi Landfill Gas Project (EILGP)	Registered on 17/09/2007	http://cdm.unfccc.int/Projects/DB/DNV-CUK1169886803.63/view
URBAM/ARAUNA - Landfill Gas Project (UALGP)	Registered on 14/10/2007	http://cdm.unfccc.int/Projects/DB/DNV-CUK1185017358.24/view
Embralixo/Araúna - Bragança Landfill Gas Project (EABLGP)	Registered on 15/10/2007	http://cdm.unfccc.int/Projects/DB/DNV-CUK1182151832.44/view
Alto-Tiete landfill gas capture project	Registered on 29/05/2008	http://cdm.unfccc.int/Projects/DB/RWTUV1204280292.23/view
Probiogas - JP-João Pessoa Landfill Gas Project	Registered on 30/01/2008	http://cdm.unfccc.int/Projects/DB/SGS-UKL1181685608.94/view
ESTRE Pedreira Landfill Gás Project (EPLGP)	Registered on 12/02/2008	http://cdm.unfccc.int/Projects/DB/DNV-CUK1179394615.79/view
SANTECH – Saneamento & Tecnologia Ambiental Ltda. – SANTEC Resíduos landfill gas emission reduction Project Activity	Registered on 19/02/2009	http://cdm.unfccc.int/Projects/DB/TUEV-SUED1214902532.06/view
Terrestre Ambiental Landfill Gás Project	Registered on 06/05/2008	http://cdm.unfccc.int/Projects/DB/DNV-CUK1179391286.32/view
CTRVV Landfill emission reduction project	Registered on 28/05/2008	http://cdm.unfccc.int/Projects/DB/SGS-UKL1198775230.25/view
Feira de Santana Landfill Gas Project	Registered on 12/08/2008	http://cdm.unfccc.int/Projects/DB/DNV-CUK1203743009.45/view
Proactiva Tijuquinhas Landfill Gas Capture and Flaring project	Registered on 13/08/2008	http://cdm.unfccc.int/Projects/DB/DNV-CUK1200058130.23/view

Natal Landfill Gas Recovery Project	Validation	http://cdm.unfccc.int/Projects/Validation/DB/K82DG9XUKVQ8IGUYJZMLMYLPQRAL1S/view.html
Projeto de Gas de Aterro TECIPAR – PROGAT	Validation	http://cdm.unfccc.int/Projects/Validation/DB/O7LXRYICDY6UWTAIEGYKIZXMEM2SMO/view.html
Marilia/Arauna Landfill Gas Project	Validation	http://cdm.unfccc.int/Projects/Validation/DB/FQBM6GP50MLPJPM39192IFGG9T783R/view.html
Laguna Landfill Methane Flaring	Validation	http://cdm.unfccc.int/Projects/Validation/DB/ZYNYNR7MAYN1HUBX6W98E7BWLMWOI4/view.html
Gramacho Landfill Gas Project	Validation	http://cdm.unfccc.int/Projects/Validation/DB/IOJKHC9RUXNKFXMF0GW8V7YS4BV4UU/view.html
Exploitation of the biogas from Controlled Landfill in Solid Waste Management Central-CTRS/BR.040	Validation	http://cdm.unfccc.int/Projects/Validation/DB/MOYBL8JBAF6YGLLMXD0Q4EWLGPF9M7/view.html
Embralixo/Araúna - Bragança Landfill Gas Project (EABLGP)	Validation	http://cdm.unfccc.int/Projects/Validation/DB/BLH87CY04LN8PYLXEF6VS7X0PX8O60/view.html
Corpus/Araúna – Landfill Biogas Project.	Validation	http://cdm.unfccc.int/Projects/Validation/DB/XRCDRQ6VTVP6B8NFCCTH92OZI9D6B7/view.html
CGR Guatapará landfill Project	Validation	http://cdm.unfccc.int/Projects/Validation/DB/0RXYM30S4G1B0J9KBZ81WGM9CWL93L/view.html
CTR Candeias Sanitary Landfill	Validation	http://cdm.unfccc.int/Projects/Validation/DB/N6QEYV2VTTLSA6IHMB5246UONLXAA3/view.html

Summarizing, there are no landfill projects in Brazil burning LFG without CDM revenues.

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

Not applicable. There are no similar options to the proposed project activity not being developed as a CDM project activity.

Conclusion:

Since all the criteria of the *"Tool for the demonstration and assessment of additionality" 5.2* are satisfied, the proposed project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The baseline emissions were calculated according to the following formula:

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

Where:

BE_y	=	Baseline emissions in year *y* (tCO_2e);
$MD_{project,y}$	=	The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH_4) in project scenario;
$MD_{BL,y}$	=	The amount of methane that would have been destroyed/combusted during the year in the absence of the project due to regulatory and/or contractual requirement, in tonnes of methane (tCH_4);
GWP_{CH4}	=	Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4;
EL_{LFG}	=	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, in tCO_2e/MWh;
$ET_{LFG,y}$	=	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, in tCO_2/TJ.

As the project aims to flare and generate electricity, $ET_{LFG,y} = 0$, and the equation is changed as following:

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

As there are no regulatory or contractual requirements specifying MD_{BL}, no historic data for LFG capture and destruction is available. Therefore, an "Adjustment Factor" (AF) is used taking into account the project context by using the following formula:

$$MD_{BL} = MD_{project,y} \times AF$$

Before the project implementation, the Manaus landfill did not have any wells burning LFG, according to "Sistema Nacional de Informações sobre Saneamento: diagnóstico do manejo de resíduos sólidos urbanos – 2007" – Table Up03, page II.281.

Thus, the AF = 0.

According to the methodology ACM0001 version 11, the methane destroyed by the project activity ($MD_{project,y}$) during a year is determined by monitoring the quantity of methane actually flared and gas used to generate electricity and/or produce thermal energy and/or supply to end users via natural gas distribution pipeline. The Manaus Landfill Gas Project aims to capture and flare LFG and in a second phase to generate electricity with LFG.

The sum of the quantities fed to the flare(s) and to the power plant(s)

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y};$$

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);

$MD_{flared,y}$ is calculated as following:

$$MD_{flared,y} = (LFG_{flared,y} \times w_{CH4} \times D_{CH4}) - \frac{PE_{flare,y}}{GWP_{CH4}}$$

Where:
$LFG_{flare,y}$ = Quantity of landfill gas fed to the flare(s) during the year measured in (m^3);
w_{CH4} = Average methane fraction of the landfill gas as measured during the given time period t in time intervals of not greater than one hour (typically every 2-3 minutes) and expressed as a fraction of CH_4 volume per LFG volume (in m^3CH_4/m^3LFG);
D_{CH4} Methane density, expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4), and measured at STP[14] (0 degree Celsius and 1.01325 bar), which is 0.0007168 tCH_4/m^3CH_4 (as per consolidated methodology ACM0001 ver.11);
$PE_{flare,y}$ = Project emissions from flaring of the residual gas stream in year y (tCO_2e);

And $MD_{electricity,y}$ is calculated as follows:

$$MD_{electricity,y} = LFG_{electricity,y} \times w_{CH4} \times D_{CH4}$$

Where:
$LFG_{electricity,y}$ = Quantity of landfill gas fed into electricity generator (m^3).

The ex-ante emissions were calculated as described in item B.6.3.

Project emissions:

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

[14] STP: Standard condition for temperature and pressure

Where:
$PE_{EC,y}$ = Emissions from consumption of electricity in the project case (tCO_2).
$PE_{FC,j,y}$ = Emission from consumption of heat in the project case (tCO_2).

There will not have any consumption of heat by this project activity ($PE_{FC,j,y}$=0), thus the formula becomes:

$$PE_y = PE_{EC}$$

As electricity will be consumed from the grid, it follows in scenario A: *Electricity consumption from the grid* of the *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"*, version 1.

In this scenario, the project participants must choose between the following options:

Option A1: Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest approved version of the "Tool to calculate the emission factor for an electricity system" ($EF_{EL,j/k/l,y} = EF_{grid,CM,y}$).

Option A2: Use the following conservative default values:

- A value of 1.3 tCO_2/MWh if
  - Scenario A applies only to project and/or electricity consumption sources but not to baseline electricity consumption sources; or
  - Scenario A applies to: both baseline and project (and/or leakage) electricity consumption sources; and the electricity consumption of the project and leakage sources are greater than the electricity consumption of the baseline sources.

- A value of 0.4 tCO_2/MWh for electricity grids where hydro power plants constitute less than 50% of total grid generation in 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production, and a value of 0.25 tCO_2/MWh for other electricity grids. These values can be used if:
  - Scenario A applies only to baseline electricity consumption sources but not to project or leakage electricity consumption sources; or
  - Scenario A applies to: both baseline and project (and/or leakage) electricity consumption sources; and the electricity consumption of the baseline sources are greater than the electricity consumption of the project and leakage sources.

For this project activity, option A1 was chosen.

Thus, the emission is calculated as following:

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

Where:

$EC_{PJ,y}$ = quantity of electricity consumed by the project activity during the year y (MWh);
$EF_{grid,CM,y}$ = the emission factor for the grid in year y (tCO_2/MWh);

TDL_y = average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

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

Where:

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

The value for $COEF_{i,y}$ will be calculated according to Option A of the "Tool to calculate project of leakage CO_2 emissions from fossil fuel combustion" version 2 using the following equation on a mass basis:

$$COEF_{i,y} = w_{C,i,y} \times 44/12$$

Where:

- $W_{C,i,y}$ is the weighted average mass fraction of fuel type I (tCO_2/mass or volume unit).

In the event that this information is not obtainable, the alternative solution, Option B of the "Tool to calculate project of leakage CO_2 emissions from fossil fuel combustion" version 2, will be used as follows:

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

Where:

- $NCV_{i,y}$ is the weighted average net caloric value of fuel type i in year y (GJ/mass or volume unit); and
- $EF_{CO2,I,y}$ is the weighted average emission factor of fuel type i in year y (tCO_2/GJ).

All values associated with Option B of the "Tool to calculate project of leakage CO_2 emissions from fossil fuel combustion" version 2 will be assessed on a yearly basis as per the IPCC Guidelines. For the purposes of estimation in this document, Option B will be used.

Leakage:

In accordance with the ACM0001 version 11, no leakage effects need to be accounted.

Emission Reduction

Emission reductions are calculated as follows:

$$ER_y = BE_y – PE_y,$$

Where:
ER_y = Emission reductions in year y (tCO_2e/yr);

BE_y = Baseline emissions in year y (tCO_2e/yr);
PE_y = Project emissions in year y (tCO_2e/yr);

Enclosed flare(s) will be installed in Manaus Landfill Gas Project to increase the destruction efficiency. Those flares could reach a minimum of 98% of methane destruction efficiency.

To determine the project emissions from flaring gases were used the "Tool to determine project emissions from flaring gases containing methane". According to this tool, the project emissions should be calculated in 7 steps.

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

The density of the residual gas is determined based on the volumetric fraction of all components in the gas:

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

$FM_{RG,h}$ = Mass flow rate of the residual gas in hour h (kg/h);
$\rho_{RG,n,h}$ = Density of the residual gas at normal conditions in hour h (kg/m^3);
$FV_{RG,h}$ = Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h;

And

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

P_n = Atmospheric pressure at normal conditions (101,325Pa);
R_u = Universal ideal gas constant (8.314 $Pa.m^3/kmol.K$);
$MM_{RG,h}$ = Molecular mass of the residual gas in hour *h* (kg/kmol);
T_n = Temperature at normal conditions (273.15K);

And,

$$MM_{RG,h} = \sum_i (fv_{i,h} \cdot MM_i)$$

$fv_{i,h}$ = Volumetric fraction of component *i* in the residual gas in the hour *h*;
MM_i = Molecular mass of residual gas component *i* (kg/kmol/);
i = Gas components;

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

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

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

$fm_{j,h}$ = Mass fraction of element *j* in the residual gas in hour *h*;
AM_j = Atomic mass of element *j* (kg/kmol);
$NA_{j,i}$ = Number of atoms of element *j* in component *i*;
$MM_{RG,h}$ = Molecular mass of the residual gas in hour *h*;
j = The elements carbon, hydrogen, oxygen and nitrogen;
i = The components CH_4 and N_2 (according to the simplification used);

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

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

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* (kg residual gas/h);

$$V_{n,FG,h} = V_{n,CO2,h} + V_{n,O2,h} + V_{n,N2,h}$$

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);
$V_{n,O2,h}$ = 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);
$V_{n,CO2,h}$ = 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);

$$V_{n,O2,h} = n_{O2,h} \times MV_n$$

$n_{O2,h}$ = Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in 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) (in m^3/kmol);

$$V_{n,CO2,h} = \frac{fm_{C,h}}{AM_C} \times MV_n$$

$fm_{C,h}$ = Mass fraction of carbon in the residual gas in the hour h (m^3/ kg residual gas);
AM_C = Atomic mass of carbon (kg/kmol);
MV_n = Volume of one mole of any ideal gas at normal temperature and pressure (22.4 L/mol) (in m^3/kmol);

And

$$V_{n,N2,h} = MV_n \cdot \left\{ \frac{fm_{N,h}}{200AM_n} + \left(\frac{1-MF_{o_2}}{MF_{O_2}} \right) \cdot \left(F_h + n_{O_2,h} \right) \right\}$$

Where:

$fm_{N,h}$ = Mass fraction of nitrogen in the residual gas in the hour h
AM_n = Atomic mass of nitrogen (kg/kmol);
MF_{O2} = O_2 volumetric fraction of air;
F_h = Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas flared in hour h (kmol/kg residual gas);
$n_{O2,h}$ = Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour h (kmol/kg residual gas);

$$n_{O_2,h} = \frac{t_{O_2,h}}{(1-(\frac{t_{O_2,h}}{MF_{O_2}}))} \times \left[\frac{fm_{C,h}}{AM_C} + \frac{fm_{N,h}}{2AM_N} + \left(\frac{1-MF_{O2}}{MF_{O2}} \right) \times F_h \right]$$

$t_{O2,h}$ = Volumetric fraction of O_2 in the exhaust gas in the hour *h*;
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);
AM_j = Atomic mass of element *j* (kg/kmol);
j = The elements carbon, hydrogen, oxygen and nitrogen;

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

Where:

$fm_{j,h}$ = Mass fraction of element *j* in the residual gas in hour *h*;

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

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

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

Where:

$TV_{n,FG,h}$ = 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

The quantity of methane in the residual gas flowing into the flare is the product of the volumetric flow rate of the residual gas ($FV_{RG,h}$), the volumetric fraction of methane in the residual gas ($fv_{CH4,RG,h}$) and the density of methane ($\rho_{CH4,n,h}$) in the same reference conditions (normal conditions and dry or wet basis).

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

$FV_{RG,h}$ = Volume flow rate of the residual gas in dry basis at normal conditions in hour h (m^3/h);
$fv_{CH4,RG,h}$ = Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in hour *h* .
$\rho_{CH4,n}$ = Density of methane at normal conditions (0.716 kg/m^3);

STEP 6. Determination of the hourly flare efficiency

The determination of the hourly flare efficiency depends on the operation of flare (through temperature), the type of flare used (enclosed) and the approach selected (continuous).

For the project activity, the case of enclosed flares and continuous monitoring of the flare efficiency, the flare efficiency in the hour 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*;

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

Where:

$TM_{FG,h}$ = Methane mass flow rate in exhaust gas averaged in a period of time *t* (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:

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

$TM_{RG,h}$ = Mass flow rate of methane in the residual gas in the hour *h* (kg/h);
$\eta_{flare,h}$ = Flare efficiency in hour *h*;

Emission Reductions Associated with Electricity Displacement from Other Sources:

The emission reductions derived from the displacement of fossil fuels used for electricity generation from other sources are estimated for the Manaus Electricity Grid and strictly guided by ACM0001 ver. 11 which includes the "Tool to Calculate the Emission Factor for an Electricity System" ver. 2, as follows.

Step 1. Identify the Relevant Electricity Systems

The Manaus Electricity Grid is an isolated and independent system with no connection to the Brazilian national grid (ELETRONORTE, http://www.eln.gov.br/). The generating sources of the Manaus grid are comprised of a hydroelectric power plant and a number of thermoelectric plants as shown in the inventory of power plants provided by the Brazilian Electricity Regulatory Agency (ANEEL, http://www.aneel.gov.br/). The increasing demand for electricity in Manaus is currently being addressed by the construction of new thermoelectric plants. Amazonas Energia (the local power utility company) has consistently issued calls for proposals to independent power producers for the supply of electricity generated by thermoelectric plants (Amazonas Energia, http://www.amazonasenergia.gov.br).

Step 2. Choose whether to Include Off-Grid Power Plants in the Project Electricity System (Optional)

Option 1: Only grid power plants are included in the calculation, will be the option used to determine the emission factor for an electricity system at the project site. The Project Activity will only be receiving electricity from grid connected sources throughout the project activity duration.

Step 3. Select a Method to Determine the Operating Margin (OM)

The $EF_{OM,\,y}$ can be calculated by the simple OM methodology ("Tool to Calculate the Emission Factor for an Electricity System" version 2) when low-cost/must run resources constitute less than 50% of total grid generation. Since the Balbina Hydroelectric Power Plant is the only low-cost/must run power plant of the Manaus Electricity Grid, with 250 MW of installed capacity (out of 1,862.0 MW), representing 13.4% of this grid (Eletrobras, accessed on 20/05/2010), the simple OM methodology should be applied to calculate the $EF_{OM,\,y}$.

The operating margin is defined ex-ante.

Step 4. Calculate the Operating Margin emission factor(s)($EF_{grid,OMsimple,y}$)

As the necessary data for Option A (the net electricity generation and a CO_2 emission factor of each power unit) is not available, the option B was chosen to Operating Margin emission factor calculation, according to the "Tool to Calculate the Emission Factor for an Electricity System" version 2.

The simple $EF_{grid,OMsimple,\,y}$ is ex-ante and was calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i \left(FC_{i,y} \times NCVi,y \times EF_{CO2,i,y}\right)}{EG_y}$$

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,y}$	Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
EG_y	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year y (MWh)
i	All fossil fuel types combusted in power sources in the project electricity system in year y
y	The relevant year as per the data vintage chosen in Step 3

The Balbina hydroelectric plant is not considered for the $EF_{grid,OMsimple,\ y}$ calculations because it is a low-cost/must run plant.

Step 5. Identify the Group of Power Units to be Included in the Build Margin

The sample group of power units *m* used to calculate the build margin consists of either:

a) The set of five power units that have been built most recently; or
b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

The project participants used the set of power units that comprises the larger annual generation.

For this set, registered as CDM project activity should be excluded from the sample group m. However, if the group of power units, not registered as CDM project activity, identified for estimating the build margin emission factor includes power unit(s) that is (are) built more than 10 years ago then:

i. Exclude power unit(s) that is (are) built more than 10 years ago from the group; and
ii. Include grid connected power projects registered as CDM project activities, which are dispatched by dispatching authority to the electricity system.

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: For the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor should be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin factor shall be calculated ex-ante, as described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

The *Option 1* was chosen for the proposed project.

Step 6. Calculate the Build Margin Emission Factor ($EF_{grid,BM,y}$)

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

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

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh);
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (tCO_2/MWh)

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) should be determined as per the guidance in Step 4 (a) for the simple OM, using options A1 for the y the most recent historical year for which power generation data is available, and using for m the power units included in the build margin.

Step 7. Calculate the Combined Margin Emissions Factor

The baseline emission factor is defined by the "Tool to Calculate the Emission Factor for an Electricity System" version 2, as the weighted average of the Operating Margin emission factor and the Build Margin emission factor, as follows:

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

Where:

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

The weights w_{OM} and w_{BM}, by default, are 0.5 will be used for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 shall be used for the second and third period, unless otherwise specified.

The Combined Margin Emissions Factor is defined ex-ante.

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

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	Combined margin CO_2 emission factor for the project electricity system
Source of data used:	Isolated System spreadsheet
Value applied:	0.7160
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per the “Tool to calculate the emission factor for an electricity system” – version 2.
Any comment:	The emission factor is defined ex-ante.

Data / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2/MWh
Description:	Build margin CO_2 emission factor for the project electricity system
Source of data used:	Isolated System spreadsheet
Value applied:	0.6992
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per the “Tool to calculate the emission factor for an electricity system” – version 2.
Any comment:	The emission factor is defined ex-ante.

Data / Parameter:	$EF_{grid,OM,y}$
Data unit:	tCO_2/MWh
Description:	Operating margin CO_2 emission factor for the project electricity system
Source of data used:	Isolated System spreadsheet
Value applied:	0.7329
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per the “Tool to calculate the emission factor for an electricity system” – version 2.
Any comment:	The emission factor is defined ex-ante.

Data / Parameter:	Regulatory requirements relating to landfill gas
Data unit:	Text
Description:	Regulatory requirements relating to landfill gas
Source of data used:	SNIS (2007) - Secretaria Nacional de Informações sobre Saneamento Sistema Nacional de Informações sobre Saneamento: diagnóstico do manejo de resíduos sólidos urbanos, page II.281[15]. This document was made by Brazilian Ministry of the Cities.
Value applied:	-
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	The information though recorded annually, is used for changes to the adjustment factor (AF) or directly $MD_{BL,y}$ at renewal of the credit period. Relevant regulations for LFG project activities shall be updated at renewal of each credit period. Changes to regulation should be converted to the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{BL,y}$). Project participants should explain how regulations are translated into that amount of gas

Data / Parameter:	φ
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	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.
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value used
Any comment:	Used for projection of methane avoidance

[15] SNIS http://www.pmss.gov.br/snis/PaginaCarrega.php?EWRErterterTERTer=80

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:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value used for managed solid waste disposal sites
Any comment:	Used for projection of methane avoidance

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 applied :	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC.
Any comment:	Used for projection of methane avoidance

Data / Parameter:	DOC_f
Data unit:	-
Description:	Fraction of degradable organic carbon 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 :	
Any comment:	Used for projection of methane avoidance

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 :	IPPC default value for anaerobic managed solid waste disposal site is applied. The landfill site has a controlled placement
Any comment:	Used for projection of methane avoidance

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 description of measurement methods and procedures actually applied :	IPCC default value for anaerobic managed solid waste disposal site is applied.
Any comment:	Used for projection of methane avoidance

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

<table>
<tr><td>Data / Parameter:</td><td>k_j</td></tr>
<tr><td>Data unit:</td><td>-</td></tr>
<tr><td>Description:</td><td>Decay rate for waste type j</td></tr>
<tr><td>Source of data used:</td><td>2006 IPCC Guidelines for National Greenhouse Gas Inventories</td></tr>
<tr><td>Value applied:</td><td>
<table>
<tr><td colspan="2" rowspan="2">Waste type j</td><td>Tropical (MAT > 20 °C)</td></tr>
<tr><td>Wet (MAP > 1,000mm)</td></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.07</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.035</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.17</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.4</td></tr>
</table>
</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>IPCC default value for anaerobic managed solid waste disposal site is applied.</td></tr>
<tr><td>Any comment:</td><td>Used for projection of methane avoidance. The climate data about Manaus city was provided from Instituto Nacional de Meterologia (INMET) (http://www.bdclima.cnpm.embrapa.br/resultados/balanco.php?UF=&COD=7)</td></tr>
</table>

Data / Parameter:	Waste composition
Data unit:	%
Description:	Waste composition
Source of data used:	Landfill waste characterization report
Value applied:	**Composition of the waste** A) Wood and wood products: 1.92% B) Pulp, paper and cardboard (other than sludge): 21.18% C) Food, food waste, beverages and tobacco (other than sludge): 35.84% D) Textiles: 1.39% E) Garden, yard and park waste: 2.99% F) Glass, plastic, metal, other inert waste: 36.68% **TOTAL**: 100.0%
Justification of the choice of data or description of measurement methods and procedures actually applied :	The values are based on the site waste composition report.
Any comment:	Used for projection of methane avoidance

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Global warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data used:	Decisions under UNFCCC and the Kyoto Protocol
Value applied:	21
Description of measurement methods and procedures to be applied:	21 for the first commitment period. Shall be updated according to any future COP/MOP decisions.
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” ver. 5
Any comment:	

Data / Parameter:	D_{CH4}
Data unit:	tCH_4/m^3CH_4
Description:	Methane density
Source of data used:	ACM0001 – version 11
Value applied:	0.0007168
Description of measurement methods and procedures to be applied:	At standard temperature and pressure (0 degrees Celsius and 1.01325 bar) the density of methane is 0.0007168 tCH_4/m^3CH_4
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per guidance in ACM0001 ver. 11
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:	Emission reduction (ER) spreadsheet
Value applied:	see table below
Description of measurement methods and procedures to be applied:	As per the "Tool to determine methane emissions avoided from disposal of waste at a waste disposal site" ver. 5.
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	Used for ex-ante estimation of the amount of methane that would have been destroyed/combusted during the year

YEAR	**$BE_{CH4,SWDS,y}$ (tCO_2)**
01/03/2011	823,291
2012	1,070,217
2013	1,147,729
2014	1,222,382
2015	1,295,500
2016	1,365,707
2017	1,434,119
28/02/2018	250,254

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

There is a total of over 11,000,000 tonnes of Municipal Solid Waste (MSW) disposed at the Manaus Landfill between 1986 to the end of 2005. The site continues to receive waste and it is expected to receive MSW until 2021, at least. The total methane generation at the site has been estimated based on the waste tonnage of the landfill using the first order decay model presented in the *"Tool to determine methane emissions from disposal of waste at a solid waste disposal site"* and considering the following equation as mentioned previously.

The methane generation from the landfill in the absence of the project activity (ex-ante emissions) may be calculated as per the following equation in the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" as stated in Section B.6.1:

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

Where:

- $BE_{CH4,SWDS,y}$ is the methane generation from the landfill in the absence of the project activity, measured in tCO_2e.
- φ is the model correction factor to account for model uncertainties (0.9);
- GWP_{CH4} is the global warming potential of methane (21 tCO_2e/tCH_4);
- OX is the oxidation factor (0.1);
- F is the fraction of methane in the SWDS gas (0.5);
- DOC_f is the fraction of degradable organic carbon that can decompose (0.5);
- MCF is the methane correction factor (1.0);
- $W_{j,x}$ is the amount of organic waste type j prevented from disposal in the SWDS , measured in tonnes;
- DOC_j is the fraction of degradable organic carbon (by weight) in the waste type j; and
- k_j is the decay rate constant for waste type j;

The assumptions used to calculate methane emissions are presented as follows:

Methane content in LFG = 50%;
LFG collection efficiency = 80%[16]; and
Density of methane = 0.0007168 tonnes/m^3 (as per consolidated methodology ACM0001 ver. 11).

The landfill gas collection and utilization system will capture only a portion of the generated landfill gas. Thus, an estimate of 80% LFG collection was applied to the estimate of LFG produced. Under assumption that generated LFG is composed of 50% methane, table below illustrates the quantities of methane collected by the project activity during the crediting period.

Table 6 - Estimated amount of methane captured by the project activity

Year	$MD_{project}$ (tCH_4)
01/03/2011	31,363
2012	40,770
2013	43,723
2014	46,567
2015	49,352

[16] The document proving 80 % of the collection efficiency was given to DOE in validation visit.

2016	52,027
2017	54,633
28/02/2018	9,533

1. Estimated Leakage:

No leakage effects need to be accounted under methodology ACM0001 ver. 11.

However, methodology ACM0001 ver. 11 clearly states that the CO_2 emission intensity of the electricity consumed by the project activity must be taken into account using the following equation as stated in Section B.6.1:

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

In the project activity, electrical consumption ($EC_{PJ,j,y}$) is associated with the equipment required to draw and process landfill gas, and the total electrical requirement is estimated as 120 kW. This corresponds to electrical consumption from the grid of 830 MWh/year. Electrical requirements of the power plant can be satisfied by the generated electricity.

Option A1 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" ver. 1, states that a value of the combined margin emission factor ($EF_{grid,CM,y}$) may be used as the emission factor ($EF_{ELj/k/l,y}$) Therefore a value of 0.7160 tCO_2/MWh will be used.

Finally the technical transmission and distribution losses ($TDL_{j,y}$) value has been assumed to be 6%, according to BEN - 2006.[17] The table below summarizes the project emissions resulting from electrical consumption on Site.

Table 7 - Electricity consumption from the grid resulting due to project activity

Year	**Electricity Consumed from the grid (MWh/year)**	**$Pe_{el,grid}$ (tCO_2/year)**
01/03/2011	692	525
2012	830	630
2013	830	630
2014	830	630
2015	830	630
2016	830	630
2017	830	630
28/02/2018	138	105

It is noted that in 2011, the first year of electrical generation utilizing LFG as a fuel, the power plant will be able to supply both the requirements of the power plant and of the blowers required to collect the LFG. As a result, the data contained in Table above will be an overestimation of the actual emissions resulting from electrical consumption and should be seen as conservative estimate for the period prior to implementation of the power plant.

[17] National Energy Balance 2006 (base year 2005), page 21.

Additionally project emissions will be generated from the occasional use of a standby generator located on site. These project emissions will be accounted for using the following equation as stated in Section B.6.1:

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

The option B) was chosen of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" – version 2 because there is no chemical composition of the fossil fuel type i as requested in option A).

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

Where:

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

The generator will run on petroleum Diesel fuel and will be rated for 120 kW. Based on the specifications of a general 120kW generator, the diesel generator consumption will be around 220 MWh/year. Option B of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" version 2 will be used to determine the CO_2 emissions coefficient for the Diesel fuel as stated above. Tables 1.2 and 1.4 of the Energy Section of the IPCC 2006 Guidelines were used to determine the net caloric value and emissions factor for the diesel fuel respectively. The following table represents the project emissions from the use of the standby generator over the crediting period. The table below presents the project emissions associated with fossil fuel combustion at the project site.

Table 8 - Project emissions from diesel generator

Year	Electricity consumption in the diesel generator (MWh/year)	$Pe_{el,diesel}$ (tCO_2/year)
01/03/2011	183	147
2012	220	176
2013	220	176
2014	220	176
2015	220	176
2016	220	176
2017	220	176
28/02/2018	37	29

<u>2. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:</u>

2.1. Emission Reductions Associated with Methane Destruction:

Year	$MD_{project}$ (tCH4)
01/03/2011	31,363
2012	40,770
2013	43,723
2014	46,567
2015	49,352
2016	52,027
2017	54,633
28/02/2018	9,533

$ER_y = EG_y \times EF_{grid,CM,y} – PE_y – L_y$

Where:

- ER_y are the emission reductions associated with the project activity (tonnes of CO_2e);
- PE_y are the project activity emissions (tonnes of CO_2e); and
- L_y are the emissions due to leakage (tonnes of CO_2e).

Since emissions due to leakage are not considered for landfill gas projects (ACM0001 ver. 11), the emission reductions for the electricity displacement are then simplified as:

$ER_y = EG_y \times EF_{grid,CM,y} – PE_y$

Considering 8,760 hours/year from 01/03/2011 to 28/02/2018, a CO_2 emission intensity of 0.7160 tonnes CO_2/MWh and 99.06% as a load factor[18] for the installed capacity of 19.6 MW, the baseline emissions can be estimated and summarized as per table below**Error! Reference source not found.**.

Table 9 - Baseline emission

Year	$MD_{project}$ (tCH4)	MD_{BL} (tCH4)	BEy (tCO2)	PEy (tCO2)	Leakage (tCO2)	ERy (tCO2)
1/3/2011	31,363	0	658,633	672	0	657,961
2,012	40,770	0	885,402	806	0	884,596
2,013	43,723	0	957,352	806	0	956,546
2,014	46,567	0	1,027,017	806	0	1,026,211
2,015	49,352	0	1,095,452	806	0	1,094,646
2,016	52,027	0	1,161,558	806	0	1,160,752
2,017	54,633	0	1,226,229	806	0	1,225,423
28/02/2018	9,533	0	215,016	134	0	214,882

[18] According to "Guidelines for the reporting and validation of plant load factors" –version 1 (EB 48, Annex 11), the option chosen for plant load factor was option b) which states: "*The plant load factor determined by a third party contracted by the project participants (e.g. an engineering company);*"

2.2. Emission Reductions Associated with Electricity Displacement from Other Sources:

The $EF_{OM,\ y}$ can be calculated by the simple OM methodology ("Tool to Calculate the Emission Factor for an Electricity System" version 2) when low-cost/must run resources constitute less than 50% of total grid generation. Since the Balbina Hydroelectric Power Plant is the only low-cost/must run power plant of the Manaus Electricity Grid, with 250 MW of installed capacity (out of 1,862.0 MW), representing 13.4% of this grid (Eletrobras, accessed on 20/05/2010), the simple OM methodology should be applied to calculate the $EF_{OM,\ y}$.

The operating margin is defined ex-ante based on the most recent data available for the last 3 years.

The Balbina hydroelectric plant is not considered for the $EF_{grid,OMsimple,\ y}$ calculations because it is a low-cost/must run plant. The tables below summarize the data plants that are accounted for in the operating margin emission factor for the proposed project:

2007								
Power unit m	Installed capacity (MW)	Fuel type	Net quantity of electricity generated (MWh)	Amount of fossil fuel consumed (ton)	Net calorific value of fossil fuel (GJ/ton) [1,2]	CO2 emission factor of fossil fuel (tCO2/GJ) [3,4]	CO2 emission factor of the power unit (tCO2/MWh)	CO2 emission of the power unit (tCO2)
UTE MATTOS (EX-TAMBAQUI)	161.4	Oil (OC-A1)	481,791.4	106,820.4	40.1	0.0755	0.671	323,404.22
UTE FRAN (EX-JARAQUI)	137.2	Oil (OC-A1)	518,470.3	112,259.6	40.1	0.0755	0.656	339,871.51
UTE CRISTIANO ROCHA	121.2	Oil (OC-A1)	573,397.4	117,788.6	40.1	0.0755	0.622	356,610.90
UTE MANAUARA	44.0	Oil (OC-A1)	534,961.7	111,179.9	40.1	0.0755	0.629	336,602.74
UTE PONTA NEGRA	120.0	Oil (OC-A1)	529,739.8	106,468.5	40.1	0.0755	0.608	322,338.63
UTE Mauá Bloco I (UTE MAUÁ)	166.0	Oil (OC-A1)	460,508.2	149,264.6	40.1	0.0755	0.981	451,906.17
UTE Mauá Bloco II (ex UTE A)	85.4	Oil (OCTE)	13,178.9	5,330.8	40.1	0.0755	1.225	16,139.16
UTE Mauá Bloco III (ex UTE B)	85.4	Oil (OCTE)	359,580.0	134,528.1	40.1	0.0755	1.133	407,290.51
UTE Mauá Bloco IV (ex UTE W)	157.5	Oil (PGE)	1,010,566.1	199,762.2	40.1	0.0755	0.598	604,790.17
UTE Aparecida Bloco I (UTE Aparecida)	92.0	Oil (OCTE)	110,587.9	33,200.4	40.1	0.0755	0.909	100,515.90
UTE Aparecida Bloco II (ex UTE D)	80.0	Oil (OCTE)	348,594.5	101,005.5	40.1	0.0755	0.877	305,799.16
UTE ELECTRON	120.0	Oil (OCTE)	276.0	227.1	40.1	0.0755	2.492	687.70
Operating Margin$_{2007}$ (tCO_2/MWh)								0.722

2008								
Power unit m	Installed capacity (MW)	Fuel type	Net quantity of electricity generated (MWh)	Amount of fossil fuel consumed (ton)	Net calorific value of fossil fuel (GJ/ton)	CO2 emission factor of fossil fuel (tCO2/GJ)	CO2 emission factor of the power unit (tCO2/MWh)	CO2 emission of the power unit (tCO2)
UTE MATTOS (EX-TAMBAQUI)	161.4	Oil (OC-A1)	511,083.4	116,902.2	40.1	0.0755	0.693	353,927.14
UTE FRAN (EX-JARAQUI)	137.2	Oil (OC-A1)	492,825.6	107,363.1	40.1	0.0755	0.660	325,047.06
UTE CRISTIANO ROCHA	121.2	Oil (OC-A1)	557,352.7	113,045.4	40.1	0.0755	0.614	342,250.71
UTE MANAUARA	44.0	Oil (OC-A1)	519,847.7	107,517.7	40.1	0.0755	0.626	325,515.22
UTE PONTA NEGRA	120.0	Oil (OC-A1)	520,747.9	104,104.2	40.1	0.0755	0.605	315,180.67
UTE Mauá Bloco I (UTE MAUÁ)	166.0	Oil (OC-A1)	505,399.2	164,366.6	40.1	0.0755	0.985	497,628.21
UTE Mauá Bloco II (ex UTE A)	85.4	Oil (OCTE)	22,245.6	8,961.4	40.1	0.0755	1.220	27,131.10
UTE Mauá Bloco III (ex UTE B)	85.4	Oil (OCTE)	252,721.9	94,721.6	40.1	0.0755	1.135	286,774.43
UTE Mauá Bloco IV (ex UTE W)	157.5	Oil (PGE)	755,174.9	150,020.9	40.1	0.0755	0.601	454,195.74
UTE Aparecida Bloco I (UTE Aparecida)	92.0	Oil (OCTE)	168,538.3	49,418.0	40.1	0.0755	0.888	149,615.41
UTE Aparecida Bloco II (ex UTE D)	80.0	Oil (OCTE)	243,593.0	70,817.5	40.1	0.0755	0.880	214,403.52
UTE FLORES	83.3	DIESEL	37,944.0	10,320.8	42.2	0.0726	0.833	31,619.94
UTE SÃO JOSÉ	83.3	DIESEL	18,376.8	5,384.4	42.2	0.0726	0.898	16,496.30
UTE CIDADE NOVA	15.4	DIESEL	6,324.0	1,745.4	42.2	0.0726	0.846	5,347.49
Operating Margin$_{2008}$ (tCO_2/MWh)								0.725

2009								
Power unit m	Installed capacity (MW)	Fuel type	Net quantity of electricity generated (MWh)	Amount of fossil fuel consumed (ton)	Net calorific value of fossil fuel (GJ/ton)	CO2 emission factor of fossil fuel (tCO2/GJ)	CO2 emission factor of the power unit (tCO2/MWh)	CO2 emission of the power unit (tCO2)
UTE MATTOS (EX-TAMBAQUI)	161.4	Oil (OC-A1)	418,276.8	95,785.4	40.1	0.0755	0.693	289,995.05
UTE FRAN (EX-JARAQUI)	137.2	Oil (OC-A1)	503,167.2	109,690.4	40.1	0.0755	0.660	332,093.32
UTE CRISTIANO ROCHA	121.2	Oil (OC-A1)	521,469.6	105,858.3	40.1	0.0755	0.615	320,491.38
UTE MANAUARA	44.0	Oil (OC-A1)	509,119.2	105,387.7	40.1	0.0755	0.627	319,066.45
UTE PONTA NEGRA	120.0	Oil (OC-A1)	510,830.4	102,166.1	40.1	0.0755	0.606	309,312.92
UTE Mauá Bloco I (UTE MAUÁ)	166.0	Oil (OC-A1)	522,883.2	169,937.0	40.1	0.0755	0.984	514,492.89
UTE Mauá Bloco II (ex UTE A)	85.4	Oil (OCTE)	24,849.6	10,014.4	40.1	0.0755	1.220	30,319.06
UTE Mauá Bloco III (ex UTE B)	85.4	Oil (OCTE)	424,303.2	159,113.7	40.1	0.0755	1.135	481,724.68
UTE Mauá Bloco IV (ex UTE W)	157.5	Oil (PGE)	740,280.0	147,315.7	40.1	0.0755	0.602	446,005.71
UTE Mauá Bloco V	60.0	DIESEL	76,111.2	22,072.2	42.2	0.0726	0.888	67,623.19
UTE Aparecida Bloco I (UTE Aparecida)	92.0	Oil (OCTE)	168,962.4	49,674.9	40.1	0.0755	0.890	150,393.38
UTE Aparecida Bloco II (ex UTE D)	80.0	Oil (OCTE)	157,876.8	45,942.1	40.1	0.0755	0.881	139,092.15
UTE FLORES	83.3	DIESEL	324,681.6	88,313.4	42.2	0.0726	0.833	270,567.52
UTE SÃO JOSÉ	83.3	DIESEL	63,909.6	18,725.5	42.2	0.0726	0.898	57,369.73
UTE CIDADE NOVA	15.4	DIESEL	22,766.4	6,283.5	42.2	0.0726	0.846	19,250.97
Operating Margin$_{2009}$ (tCO_2/MWh)								0.751

MWh	Net generation	Low-cost/must-run	%
2007	4,941,652	1,014,300	21%
2008	4,537,521	1,576,420	35%
2009	4,900,006	1,593,965	33%

The operating margin emission factor for the power plants in the above table was calculated as $EF_{grid,OMsimple,\ y}$ = 0.7329 tCO_2/MWh, according to Tool to calculate the emission factor for an electricity system – version 2 and IPCC guidelines.

Step 5. Identify the Group of Power Units to be Included in the Build Margin

According to ACM0001 ver. 11, the build margin emission factor is the generation-weighted average emission factor of all power units during the most recent year for which power generation data is available. For the case of Manaus system generation, the most current plant generation data that is available is that which was used from table below:

2009								
Power unit Unit m	Installed capacity (MW)	Fuel	Net quantity of electricity generated (MWh)	Amount of fossil fuel consumed (ton)	Net calorific value of fossil fuel (GJ/ton)	CO2 emission factor of fossil fuel (tCO2/GJ)	CO2 emission factor of the power unit (tCO2/MWh)	CO2 emission of the power unit (tCO2)
UTE Mauá Bloco V	60.0	DIESEL	74,779.2	21,686.0	42.2	0.0726	0.8885	66,439.7
UTE FLORES	83.3	DIESEL	318,741.6	86,697.7	42.2	0.0726	0.8333	265,617.5
UTE SÃO JOSÉ	83.3	DIESEL	62,791.2	18,397.8	42.2	0.0726	0.8977	56,365.8
UTE CIDADE NOVA	15.4	DIESEL	22,432.8	6,191.5	42.2	0.0726	0.8456	18,968.9
UTE Mauá Bloco IV (ex UTE W)	157.5	Oil (PGE)	742,742.9	147,546.9	40.1	0.0755	0.6014	446,705.7
Build Margin$_{2009}$ (tCO_2/MWh)								0.6992

20% total net generation	980,001	MWh
group m of build margin	1,221,488	MWh

Step 6. Calculate the Build Margin Emission Factor ($EF_{grid,BM,y}$)

The build margin emission factor for the five plants in the above table was calculated as $EF_{grid,BM,y}$ = 0.6992 tCO_2/MWh, according to Tool to calculate the emission factor for an electricity system – version 2 and IPCC guidelines.

Step 7. Calculate the Combined Margin Emissions Factor

The baseline emission factor is defined by the "Tool to Calculate the Emission Factor for an Electricity System" version 2, as the weighted average of the Operating Margin emission factor and the Build Margin emission factor, as follows:

$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y}$

The weights w_{OM} and w_{BM}, by default, are 0.5 and alternative weights can be used, as long as $w_{OM} + w_{BM} = 1.0$ ("Tool to Calculate the Emission Factor for an Electricity System" version 2).

The combined margin emission factor ($EF_{grid,CM,y}$) is then calculated as:

$EF_{grid,CM,y} = 0.5 * 0.7329\ tCO_2/MWh + 0.5 * 0.6992\ tCO_2/MWh$

$EF_{grid,CM,,y} = 0.7160\ tCO_2/MWh$.

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

Year	Estimation of project activity emission (tCO_2e)	Estimation of the baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of emission reductions (tCO_2e)
01/03/2011	672	658,633	0	657,961
2012	806	885,402	0	884,596
2013	806	957,352	0	956,546
2014	806	1,027,017	0	1,026,211
2015	806	1,095,452	0	1,094,646
2016	806	1,161,558	0	1,160,752
2017	806	1,226,229	0	1,225,423
28/02/2018	134	215,016	0	214,882
Total (tonnes of CO_2e)	**5,642**	**7,226,658**	**0**	**7,221,016**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$LFG_{total,y}$
Data unit:	Nm^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	152,436,102 (estimated to 2017)
Description of measurement methods and procedures to be applied:	The data will be collected continuously using a flow meter. The data will be aggregated on a monthly and yearly basis using continuous monitoring average values in time intervals of not greater than one hour (every 2-3 minutes). The data will be archived throughout the crediting period and two years thereafter.
QA/QC procedures to be applied:	Calibration of equipment as per manufacturer specifications to ensure validity of data measured. Periodical calibration.
Any comment:	-

Data / Parameter:	$LFG_{flare,y}$
Data unit:	Nm^3
Description:	Amount of landfill gas flared 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	100% for the first phase and around of 10% for the subsequent phase. However this value may vary according to the gensets availability.
Description of measurement methods and procedures to be applied:	During Phase 1 (flaring) the data will be collected continuously (average values in time intervals of not greater than one hour (every 2-3 minutes)) using 1 on-line mass-compensated flow meter located in the piping leading to the flares. Upon completion of Phase 2 (electricity generation) an additional 2 mass-compensated flow meters will be installed with one being in the piping leading to the engine and the other in the piping right after the blowers measuring the total collected landfill gas. The data will be aggregated monthly and yearly for the flares. The data will be archived throughout the crediting period and two years thereafter.
QA/QC procedures to be applied:	Calibration of equipment as per manufacturer specifications to ensure validity of data measured. Periodical calibration.
Any comment:	-

Data / Parameter:	$LFG_{electricity,y}$
Data unit:	Nm^3
Description:	Amount of LFG combusted in power plant 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	0% of the LFG_{total} for the first year and 90% for the subsequent years. However this value will vary according to the gensets availability and operational schedule.
Description of measurement methods and procedures to be applied:	The data will be collected continuously (average values in time intervals of not greater than one hour (every 2-3 minutes)) using a flow meter. The data will be aggregated monthly and yearly for the power plant. The data will be archived throughout the crediting period and two years thereafter.
QA/QC procedures to be applied:	Calibration of equipment as per manufacturer specifications to ensure validity of data measured. Periodical calibration.
Any comment:	-

Data / Parameter:	$\mathbf{w_{CH4}}$
Data unit:	m^3CH_4/m^3LFG
Description:	Methane fraction in the landfill gas
Source of data to be used:	To be measured continuously by the project participants using certified equipment.
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:	Continuous measurements from gas quality analyzer. Data will be aggregated monthly and yearly, using an average value in a time interval not greater than an hour.
QA/QC procedures to be applied:	The gas analyzer should be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	Monitoring under responsibility of the Project's operators (the team, the organizational structure and the management structure will be defined after the project's implementation). The data will be archived throughout the crediting period and two years thereafter.

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	2% of the total baseline emissions
Description of measurement methods and procedures to be applied:	Annual data will be recorded as per the most current version of the *“Tool to determine project emissions from flaring gases containing methane”.* The data will be archived throughout the crediting period and two years thereafter.
QA/QC procedures to be applied:	The parameters used for determining the project emissions from flaring of the residual gas stream in year y will use the QA/QC procedures as per the “*Tool to determine project emissions from flaring gases containing methane”*.
Any comment:	The value of 98% was based on the manufacturer specification

Data / Parameter:	EL_{LFG} .
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	<table><tr><td>Year</td><td>Net electricity generated in the plant (MWh)</td></tr><tr><td>01/03/2011</td><td>0</td></tr><tr><td>2012</td><td>40,823</td></tr><tr><td>2013</td><td>54,707</td></tr><tr><td>2014</td><td>68,592</td></tr><tr><td>2015</td><td>82,476</td></tr><tr><td>2016</td><td>96,360</td></tr><tr><td>2017</td><td>110,244</td></tr><tr><td>28/02/2018</td><td>20,688</td></tr></table>
Description of measurement methods and procedures to be applied:	The data will be collected continuously using an electricity meter. The net amount of electricity will be directly measured. The data will be archived throughout the crediting period and two years thereafter.
QA/QC procedures to be applied:	Calibration of equipment as per manufacturer specifications to ensure validity of data measured. Periodical calibration.
Any comment:	-

Data / Parameter:	Operational of the energy plant
Data unit:	Hours
Description:	Operation of the energy plant
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	8,742 hours/year
Description of measurement methods and procedures to be applied:	Information will be monitored and reviewed on an annual basis. The information will be archived during the crediting period and for two years thereafter.
QA/QC procedures to be applied:	Reliable sources will be used. The information acquired will be peer reviewed.
Any comment:	This value was based on in another plant from CRA. The data will be archived throughout the crediting period and two years thereafter.

Data / Parameter:	$NCV_{diesel,y}$
Data unit:	GJ per mass (GJ/ton)
Description:	Weighted average net calorific value of diesel in year y
Source of data to be used:	Brazilian Energy Balance (BEN) and where such data is not available, reliable sources will be used from IPCC.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	42.2
Description of measurement methods and procedures to be applied:	Measurements should be undertaken in line with national or international fuel standards.
QA/QC procedures to be applied:	-
Any comment:	The NCV_{diesel} was based on Brazilian Energy Balance -BEN (2009). The data will be archived throughout the crediting period and two years thereafter.

Data / Parameter:	$EF_{CO2,i,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor of diesel in year y
Source of data to be used:	Regional or national default values
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0726
Description of measurement methods and procedures to be applied:	Measurements should be undertaken in line with national or international fuel standards.
QA/QC procedures to be applied:	For a) and b): The CO_2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually. For d): Any future revision of the IPCC Guidelines should be taken into account.
Any comment:	For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.

Data / Parameter:	$PE_{EC,y}$
Data unit:	tCO_2
Description:	Project emissions from electricity consumption by the project activity during the year y
Source of data to be used:	Calculated as per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” ver. 1
Value of data applied for the purpose of calculating expected emission reductions in section B.5	(see table below)
Description of measurement methods and procedures to be applied:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” version 1.
QA/QC procedures to be applied:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” version 1
Any comment:	The data will be archived throughout the crediting period and two years thereafter.

Year	PE_{TOTAL} (tCO_2/year)
01/03/2011	525
2012	630
2013	630
2014	630
2015	630
2016	630
2017	630
28/02/2018	105

Data / Parameter:	$PE_{FCj,y}$
Data unit:	tCO_e
Description:	Project emissions from diesel combustion in process j during the year y.
Source of data to be used:	Quantities of diesel used for the standby generator will be recorded via receipts and additional information will be delivered from the fuel company. In the event they cannot produce this information IPCC guidelines will be used.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	<table><tr><td>Year</td><td>$PE_{el,diesel}$ (tCO_2/year)</td></tr><tr><td>01/03/2011</td><td>147</td></tr><tr><td>2012</td><td>176</td></tr><tr><td>2013</td><td>176</td></tr><tr><td>2014</td><td>176</td></tr><tr><td>2015</td><td>176</td></tr><tr><td>2016</td><td>176</td></tr><tr><td>2017</td><td>176</td></tr><tr><td>28/02/2018</td><td>29</td></tr></table>
Description of measurement methods and procedures to be applied:	Recorded via purchase receipts from the product distributor in accordance with the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” version 2.
QA/QC procedures to be applied:	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” version 2.
Any comment:	The data will be archived throughout the crediting period and two years thereafter.

Data / Parameter:	f
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner.
Source of data to be used:	Project participants.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0%
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	More details please see Section B.5 - Sub-step 1b. Consistency with mandatory laws and regulations.

<table>
<tr><td>Data / Parameter:</td><td>W_x</td></tr>
<tr><td>Data unit:</td><td>tons</td></tr>
<tr><td>Description:</td><td>Total amount of organic waste prevented from disposal in year x</td></tr>
<tr><td>Source of data to be used:</td><td>Landfill operator (measured at weigh scale on site)</td></tr>
<tr><td>Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td>
<table>
<tr><th>Year</th><th>Waste disposal (t/yr)</th></tr>
<tr><td>1986</td><td>392,548</td></tr>
<tr><td>1987</td><td>407,190</td></tr>
<tr><td>1988</td><td>422,378</td></tr>
<tr><td>1989</td><td>438,132</td></tr>
<tr><td>1990</td><td>454,475</td></tr>
<tr><td>1991</td><td>471,427</td></tr>
<tr><td>1992</td><td>489,011</td></tr>
<tr><td>1993</td><td>507,251</td></tr>
<tr><td>1994</td><td>526,171</td></tr>
<tr><td>1995</td><td>545,798</td></tr>
<tr><td>1996</td><td>566,156</td></tr>
<tr><td>1997</td><td>587,273</td></tr>
<tr><td>1998</td><td>609,179</td></tr>
<tr><td>1999</td><td>631,901</td></tr>
<tr><td>2000</td><td>655,471</td></tr>
<tr><td>2001</td><td>679,920</td></tr>
<tr><td>2002</td><td>705,281</td></tr>
<tr><td>2003</td><td>731,588</td></tr>
<tr><td>2004</td><td>758,876</td></tr>
<tr><td>2005</td><td>787,182</td></tr>
<tr><td>2006</td><td>807,024</td></tr>
<tr><td>2007</td><td>837,126</td></tr>
<tr><td>2008</td><td>1,736,701</td></tr>
<tr><td>2009</td><td>1,801,480</td></tr>
<tr><td>2010</td><td>1,868,675</td></tr>
<tr><td>2011</td><td>1,938,377</td></tr>
<tr><td>2012</td><td>2,010,678</td></tr>
<tr><td>2013</td><td>2,085,676</td></tr>
<tr><td>2014</td><td>2,163,472</td></tr>
<tr><td>2015</td><td>2,244,170</td></tr>
<tr><td>2016</td><td>2,311,495</td></tr>
<tr><td>2017</td><td>2,380,840</td></tr>
<tr><td>2018</td><td>2,452,265</td></tr>
<tr><td>2019</td><td>2,525,833</td></tr>
<tr><td>2020</td><td>2,601,608</td></tr>
<tr><td>2021</td><td>2,679,656</td></tr>
</table>
</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>Weigh scale logs are stored at site and summarized on a yearly basis.</td></tr>
</table>

QA/QC procedures to be applied:	As per "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" ver. 5
Any comment:	-

Regarding Flare efficiency, according to "Tool to determine project emissions from flaring gases containing methane"

Data / Parameter:	$t_{O2,h}$
Data unit:	-
Description:	Volumetric fraction of O_2 in the exhaust gas of the flares in the hour h
Source of data to be used:	Measurements by project participants using a continuous gas analyzer
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:	Extractive sampling analyzers with water and particulates removal devices or *in situ* analyzers for wet basis determination. The point of measurement (sampling point) shall be in the upper section of the flares (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperature level.
QA/QC procedures to be applied:	Analyzers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas. Periodical calibration.
Any comment:	-

Data / Parameter:	$fv_{CH4,FG,h}$
Data unit:	mg/m^3
Description:	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour h
Source of data to be used:	Measurements by project participants using a continuous gas analyzer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	n/a
Description of measurement methods and procedures to be applied:	Extractive sampling analyzers with water and particulates removal devices or *in situ* analyzers for wet basis determination. The point of measurement (sampling point) shall be in the upper section of the flares (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperature level. Data will be recorded continuously and values will be averaged hourly or at a shorter time interval
QA/QC procedures to be applied:	Analyzers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas. Periodical calibration.
Any comment:	Measurement instruments will be read ppmv values.

Data / Parameter:	T_{flare}
Data unit:	º C
Description:	Temperature on the exhaust gas of the flare
Source of data to be used:	Measurements by project participants
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:	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 500 ^{o}C indicates that a significant amount of gases are still being burnt and that the flare is operating. Data will be recorded continuously and values will be averaged hourly or at a shorter time interval
QA/QC procedures to be applied:	Thermocouples will be replaced or calibrated every year
Any comment:	-

Data / Parameter:	$FV_{RG,h}$
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	n/a
Description of measurement methods and procedures to be applied:	Ensure that the same basis (wet or dry) is considered for this measurement and the measurement of volumetric fraction of all components in the residual gas when the residual gas temperature exceeds 60 ^{0}C. Data will be monitored continuously and values will be averaged hourly or a shorter time interval.
QA/QC procedures to be applied:	Flow meters must be periodically calibrated according to the manufacturer's recommendation. Periodical calibration.
Any comment:	-

Data / Parameter:	$fv_{i,,h}$
Data unit:	
Description:	Volumetric fraction component i of the residual gas in dry basis at normal conditions in the hour h, where i = CH_4 and N_2
Source of data to be used:	Measurements by project participants using a continuous gas analyzer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50% of methane
Description of measurement methods and procedures to be applied:	Ensure that the same basis (wet or dry) is considered for this measurement and the measurement of volumetric fraction of all components in the residual gas when the residual gas temperature exceeds 60 ^{0}C. Data will be monitored continuously and values will be averaged hourly or a shorter time interval.
QA/QC procedures to be applied:	Flow meters must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas. Periodical calibration.
Any comment:	-

Data / Parameter:	**TDL_y**
Data unit:	-
Description:	Average technical transmission and distribution losses in the grid in year *y* for the voltage level at which electricity is obtained from the grid at the project site.
Source of data to be used:	Brazilian Energy Balance (BEN) and where such data is not available, reliable national sources will be used.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	6%
Description of measurement methods and procedures to be applied:	The technical distribution losses do not contain grid losses other than technical transmission and distribution.
QA/QC procedures to be applied:	-
Any comment:	The value was based on Brazilian Energy Balance 2006 (base year 2005), page 21.

Data / Parameter:	**$FC_{i,j,y}$**
Data unit:	Mass or volume unit per year
Description:	Quantity of fuel type i combusted in process j during 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	-

Description of measurement methods and procedures to be applied:	• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
QA/QC procedures to be applied:	The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Any comment:	-

Data / Parameter:	$Mass_{LPG}$
Data unit:	kg
Description:	Consumption of LPG by the project activity
Source of data to be used:	Invoices of LPG suppliers.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	n/a
Description of measurement methods and procedures to be applied:	The mass of LPG purchased by the project developer will be stated in the invoices issued by the LPG supplier. Hard copies of the invoices will be kept in files during the crediting period and two years after.
QA/QC procedures to be applied:	Scope of the LPG supplier.
Any comment:	The mass of LPG used by the project activity will be used to calculate the corresponding emissions: ET_y * $CEF_{thermal,y}$, , where ETy = $Mass_{LPG}$ * LHV_{LPG} ($Mass_{LPG}$ = consumption of LPG in kilograms; LHV_{LPG} = lower heating value of LPG) and $CEF_{thermal,y}$. The LHV_{LPG} will be based on reliable local or national (such as Brazilian Energy Balance) data. Where such data is not available, IPCC data will be used should in a conservative manner.

B.7.2. Description of the monitoring plan:

All continuously measured parameters (LFG flow, CH_4 concentration, flare temperature, flare operating hours, engine operating hours, and engine electrical output) will be recorded electronically via a datalogger, located within the Site boundary which will have the capability to aggregate and print the collected data at the frequencies as specified above. It will be the responsibility of the Site Operator to provide all requested data logs which will be stored ov.er the duration of the reporting period at the Site office. The data logs will be summarized into emission reduction calculation summaries prior to each verification. This task will be completed by CRA and reported directly to the DOE. These logs will be available at the request of the DOE in order to prove the operational integrity of the Project.

1. Introduction and Objectives

The two primary purposes of the monitoring plan are:

- To collect the necessary system data required for the determination the emissions reductions; and
- To demonstrate successful compliance with established operating and performance criteria to verify the emission reductions and generate the respective CERs.

The operational data that is collected will be used to support the periodic verification report that will be required CER auditing. The monitoring plan discussed herein is designed to meet or exceed the UNFCCC requirements (approved monitoring methodology ACM0001 ver. 11).

The routine system monitoring program required for the determination of the emission reductions is discussed in section 2 below, while the additional system data that is collected to ensure the safe, correct, and efficient operation of the LFG management system is discussed in section 3.

2. Training of monitoring personnel

Before commencement of the O&M phase, Conestoga-Rovers & Associates Capital Limited (CRA) will conduct a training and quality control program to ensure that good management practices are carried out and implemented by all project operating personnel in terms of record-keeping, equipment calibration, overall maintenance, and procedures for corrective action. An operations manual will be developed for the operating personnel. The procedures for filing data and calculations to be performed by the LFG utilization operator will be included in a daily log to be placed in the main control room.

3. Monitoring Work Program

The LFG monitoring program is a relatively simple, straight forward program designed to collect system operating data required to safely operate the system and for the verification of CERs. This data is collected in real time, and will provide a continuous record that is easy to monitor, review, and validate.

The following sections will outline and discuss the following key elements of the monitoring program:

- Flow measurement;
- Gas quality measurements;
- Uncombusted methane;
- Electrical Consumption;
- Project electricity output;
- Regulatory requirements;
- Data records; and
- Data assessment and reporting.

3.1. Flow Measurement

According to ACM0001 ver. 11, one flow meter will be installed during Phase 1 (flaring) on the piping, straight before the flares.

During phase 2 (electricity generation) implementation, in order to follow ACM0001 version 11, two other flow meters will also be installed: one flow meter will be installed in the main piping straight after the blowers to measure the total LFG flow extracted from the landfill; and another flow meter will be installed in the piping before the power plant to measure the LFG flow utilized for electricity generation.

The flow of LFG collected by the system and subsequently utilized or flared are measured via individual flow measuring devices suitable for measuring the velocity and volumetric flow of a gas. One common example is an annubar. The flow measurements are taken within the piping itself, and the flow sensors are connected to transmitters that are capable of collecting and sending continuous data to a recording device such as a datalogger.

The flow sensors are calibrated according to a specified temperature and composition of the gas, thus the flow actually measured must be corrected to according to actual temperature, pressure, and composition, thus density, of the gas measured. The equipment selected will allow dynamic compensation for these parameters, normalized to a standard temperature, pressure, and gas composition. For reporting purposes, the flows are generally required to be normalized to 0°C and 1.01325 bar at standard gas composition of 50% methane and carbon dioxide each by volume.

The accuracy of a flow meter is dependent on the design of the equipment, and the specific type of sensor used, however equipment is available that will provide a minimum accuracy of +/- 2% by volume. The equipment selected for the site utilizes a continuous monitoring system as defined in ACM0001 ver. 11, which measures and aggregates flow data approximately once every two minutes.

3.2. Gas Quality

The two parameters that are most pertinent to the validation of CERs, as well as the safe and efficient operation of the system are the concentration of methane and oxygen in the gas stream delivered for utilization or diverted to flaring. These two parameters are measured via a common sample line that is run to the main collection system piping, and measured in real time by two separate sensors, one each for methane and oxygen, installed as per ACM0001 ver.11.

Regular calibration of the equipment is especially important, as the accuracy of the methane and oxygen sensors is greatest within the expected range of the gas stream to be measured. Equipment is readily available that will provide an accuracy of at least +/- 1% by volume. The equipment selected for the site aggregates gas compositions approximately once every 2 minutes as per the definition of a continuous monitoring system in ACM0001 ver. 11.

3.3. Uncombusted Methane

The efficiency of the enclosed flares will be measured per the methodological “Tool to determine project emissions from flaring gases containing methane”.

3.4. Electrical Consumption

Monthly electrical bills charged to the project will be monitored and considered as the actual energy consumption for the project.

3.5. Project Electricity Output

The generated electricity supplied to the grid by the project activity will be continuously measured by an electricity meter and respective data will be electronically recorded.

3.6. LPG purchased

The mass of LPG purchased by the project developer will be stated in the invoices issued by the LPG supplier.

3.7. Diesel purchased

Quantities of diesel used for the standby generator will be recorded via receipts and additional information will be delivered from the fuel company. In the event they cannot produce this information IPCC guidelines will be used.

3.8. Regulatory Requirements

Regulatory requirements relating to LFG projects will be evaluated annually by investigating municipal, state and national regulations pertaining to LFG. This will be done through consultation with the appropriate regulatory bodies, ongoing discussion with regulators, and monitoring of publications delineating upcoming legislative changes governing landfills and LFG.

4. Data records and storage

Data collected from each of the parameter sensors is transmitted directly to an electronic database from which the CER volume calculations may be carried out, as described in section 2.1 above. A hard copy backup or reports of the data may be printed as required or recorded in Portable Document Format (PDF). Backup of the electronic data is conducted on a 2-3 minute intervals, as described above.

4.1. Data Assessment and Reporting

Assessment of the flow and composition data described above coupled with the operating hours of the engines/flare and engines/flare destruction efficiencies are used to determine the quantity of CERs to be generated. For electricity generation offsets, the appropriate emission factors will be applied.

The destruction efficiency of the flare is a function of the internal combustion temperature and resident holding time, which are generally measured by the flare system controller and recorded for auditing purposes. Extensive technical documentation is available that documents the destructive efficiency of the enclosed drum flares that will be used, subject to the flow rate and combustion temperature verification. Destruction efficiency will also be assessed periodically through measurement of uncombusted methane emissions.

As discussed in Section 2.1, flow data is normalized to standard temperature, pressure, and composition for reporting purposes. The data will be compiled and assessed to produce the required quantification and validation. The periodic monitoring report will contain the data required for the verification of the CERs, and additionally may contain operational data from the collection system and flaring system described below to illustrate that the system is well maintained and operating at peak efficiency. Records of regular maintenance performed will also be a component of the annual report.

5. Related monitoring and project performance review

CRA will conduct an additional operational monitoring of the LFG collection system to check the project performance and ensure that the system is being operated both correctly and efficiently. Periodic adjustments to the extraction wells will be required to optimize the collection system effectiveness. LFG collection field adjustments will be made based upon a review of the well performance history considered within the context of the overall LFG collection field operation in order to maximize the collection of methane balanced against minimization of any oxygen in the system that could introduce unsafe operating conditions. Monitoring at each extraction well/trench will consist of the following parameters: valve position, individual well/trench flow, individual well/trench vacuum, and composition of the gas collected, i.e., methane, carbon dioxide, and oxygen, using a portable measuring device.

6. Emergency procedures

As a precautionary measure, the Landtec® system is plugged to a battery-based uninterruptible power supply (UPS) to avoid data loss due to power failures. As a backup is produced and stored off-site from the main recording system, no more than 2 to 3 minutes of data at a time would ever be lost due to a system malfunction.

All data will be collected through a Landtec® Field Analytical Unit (FAU) and will be transmitted to a Landtec® Field Server Unit (FSU), which records the data on-site and automatically sends it via a "always-on" Internet connection to an off-site server for storage and off-site back-up. All collected data is available for viewing, report generation, and retrieval through a Web interface, the EnviroComp™ Reporting System (ECRS), which can be accessed from anywhere an Internet connection is available. The plant Manager will check daily the records. In addition, it was developed an Emergency Plan including others types of emergencies such as fire and work accidents.

7. Calibration

All the measurement instruments will be subject to regular calibration as per manufacturer's specifications. The regular check and calibration will be made to the operators. The plant Manager will be responsible for checking the equipment's proper working order, as well as checking and storing up the calibration certificates and records. Calibration certificates will be kept for all the equipments until two years after the end of the crediting period.

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 date of completion the application of the methodology to the project activity study is 12/05/2010.

The person/entity determining the baseline is as follows:
Econergy Brasil Ltda, São Paulo, Brazil
Telephone: +55 (11) 3555-5700
Contact person: Mr. Francisco do Espirito Santo Filho
E-mail: francisco.santo@econergy.com.br

Econergy Brasil Ltda is not a Project Participant.

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:

The starting date of the project activity is 25/07/2008 based on the contract (includes CDM consideration) signed between CRA, Tumpex (landfill operator), Manaus City Hall and Enterpa to develop the proposed project.

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

25y-0m

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

C.2.1. Renewable crediting period:

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

The date which occurs later between 01/03/2011 and the date of Registration on CDM Executive Board.

C.2.1.2. Length of the first crediting period:

7y-0m

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Left blank on purpose.

C.2.2.2. Length:

Left blank on purpose.

SECTION D. Environmental impacts

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

There are expected to be no significant environmental impacts due to the project activity. All condensate generated by the project activity will be collected and sanitary water will be properly collected and treated to comply with local environmental regulations. Emissions from the gas engines and flares include the carbon dioxide component of LFG, but this carbon dioxide is considered to be a natural product of the carbon cycle. In the combustion of LFG, carbon dioxide is additionally produced, but this is also considered to be part of the natural carbon cycle and not of anthropogenic origin. There is minimal visual impact from the utilization and flare facilities, and noise and vibration from the blower, gas engines and flares will be limited to the site.

There is a positive environmental impact on the environment due to the project activity. LFG emissions are decreased, reducing greenhouse gas emissions and impacts to local air pollution. Odour will be diminished. Operationally, proper management of the LFG will reduce the potential for landfill fires and the associated release of incomplete combustion products. Generation of electricity through utilization of LFG further provides offset of fossil fuel generation sources common in the area, leading to lower total emissions and local impacts.

The Manaus landfill received, from SEMULSP (Municipal Environmental Agency), the Operation License n° 109/2010, process number n° 2010/4933/6187/00135 issued on 11/08/2010 and valid until 11/08/2011.

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:

There are no significant environmental impacts resulting from the project activity.

SECTION E. Stakeholders' comments

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

A public meeting with local stakeholders was held in Manaus on January 26th, 2006 to present the project to the public as well as to official authorities.

Invitations were published in two different local newspapers of broad circulation announcing the project's public meeting as follows:

- January 23, 2006, "A Crítica", page 05;

- January 23, 2006, "Diário do Amazonas", section Classifácil, page 10.

Additionally, two interviews were given to the local press and are documented as follows:

- "Amazonas em Tempo" newspaper, section Cidades (Cities), on January 27, 2006;

- "A Crítica" newspaper, section Cidades (Cities), on January 27, 2006;

Invitations were sent to the following stakeholders in accordance with Resolution No. 1 September 11th 2003 from the Ministry of Science and Technology of Brazil:

- City Hall;
- City Council;
- State Environmental Agency;
- Municipal Environmental Agency;
- Brazilian Forum of NGOs and Social Movements;
- Community Associations; and

- Public Ministry.

Some of the above-mentioned stakeholders did not attend the public meeting, and these include:

- Mrs. Maura Rejane Moraes – Regional Director of the Brazilian Forum of NGOs and Social Movements;
- Mr. Virgílio Viana – State Secretary of the Environment;
- Mr. Serafim Corrêa – Mayor of Manaus; and
- Mr. Chico Preto – President of the City Council of Manaus.

The public meeting with the local stakeholders was held on January 26, 2006 at the Auditorium João Mendonça Furtado, at the City Hall building downtown Manaus, and was taped and photographed from beginning to finish. The following are selected photographs from the public meeting.

Figure 11 - From left to right: Dr. Luciana Montenegro Valente, Secretary of Development and the Environment of Manaus; Mr. Paulo Ricardo Rocha Farias, Secretary of Public Services of Manaus and Carlson Cabral, of CRA, before the project presentation.

Figure 12 - Carlson Cabral of CRA presenting the CDM project to the public in Manaus

Figure 13 - Carlson Cabral of CRA answering questions after the project presentation

Figure 14 - Audience at the public meeting in Manaus

The following tables illustrate the list of participants in the meeting.

Conestoga-Rovers & Associates	
Carlson Cabral	Project Manager – CRA Ltd. (Canada)
Juliane Tamura	Geologist - CRA Brasil /São Paulo

LOCAL PRESS	
Júlio Pedrosa	A Crítica Newspaper
Ruth Jucá	Amazonas em Tempo Newspaper

NGOs	
Maria Nunes de Souza – Director	Fundação Dr. Thomas (*Dr. Thomas Foundation*)
Márcia F. H. R. Murad - Representative	Fundação Dr. Thomas
Joelson Bacry – Director	Fundação Manaus de Turismo (*Manaus Tourism Foundation)*

CITY AND STATE OFFICIALS	
Paulo Ricardo Rocha Farias – Secretary	Secretariat of Public Works and Waste Management of the City of Manaus – SEMULSP
Dra. Suely D'Araújo – Sub-secretary	SEMULSP
Paula Ângela Valério de Oliveira – Secretary	Secretaria Municipal de Ação Social e Cidadania – SEMASC (*Municipal Secretariat of Social Works and Citizenship*)
Kátia de Araújo lima Vallina – Sub-secretary	SEMASC
Laerte Mendes – Employee	SEMASC
José Valério Neto – Employee	SEMASC
Luciana Valente – Secretary	Secretaria Municipal de Defesa do Meio Ambiente – SEDEMA (*Municipal Secretariat of the Environment*)
Eduardo Gogo – Sub-secretary	SEDEMA
José Barbosa Rbouças – Engineer	SEMULSP
Ronys Rebouças – Urban planner	SEMULSP
Francisco Fernando Silva - Engineer	SEMULSP
Tatiana Almeida – Environmental Attorney General	Procuradoria do Meio ambiente - Procuradoria Geral do Município (*Environmental Attorney General's Office*)
José Maurício Silva Rodrigues - Secretary	Secretaria de Planejamento do Estado do Amazonas – SEPLAN (*Secretariat of Planning of the State of Amazonas*)
Tahisa Neitzel Kuck – Administrative Assistant	SEMULSP
Jaime Kuck – Secretary	Secretaria Municipal de Administração e Finanças – SEMAD (*Municipal Secretariat of Administration and Finance*)
CITY AND STATE OFFICIALS	
Alcemir Filho - Employee	SEMULSP
Mariano C. Cenamo – Representative	Instituto de Desenvolvimento Sustentável

	do Amazonas – Secretaria de Desenvolvimento Sustentável do Estado do Amazonas – IDESAM/SDS (*Amazonas Institute of Sustainable Development – Secretariat of Sustainable Development of the State of Amazonas*)
Rui de Oliveira Gomes – Representative	Secretaria Municipal do Trabalho – SEMTRA (*Municipal Secretariat of Labour*)
Lislair Leão Marques - Employee	SEMULSP
Leidimar Fátima Brigatto - Employee	SEMULSP
Eliomar Mota da Costa – Representative	Secretaria Municipal de Esportes – SEMESP (*Municipal Secretariat of Sports*)
Cláudia Machado	SEMESP
Maria José Nazareth – Chief Attorney	Ministério Público do Estado do Amazonas (*Public Ministry of the State of Amazonas*)
André da Silva e Silva – Employee	SEMULSP
Thaia Cacciamali – Employee	SEMULSP
Solemar T. ª dos Reis – Employee	SEMULSP
Terezinha Souza – Employee	SEMULSP
Maria Venina Savedra Rodrigues – Employee	SEMULSP
William Cavalcante Andrade – Employee	SEMULSP
Jorgete Silva da Costa – Employee	SEMULSP
José Olavo Nogueira Braga – Employee	SEMULSP
Jônatas D'Araújo Corrêa – Employee	SEMULSP
Renan Rodrigo Araújo de Brito – Employee	SEMULSP
Fabrício de Almeida – Employee	SEMULSP

PRIVATE SECTOR	
Giovanni Teixeira Guedes – Engineer	TUMPEX
Lucas Valentim Mansur – Engineer	TUMPEX
Mauro Lúcio Mansur da Silva – President	TUMPEX
Cezar S. Sotero Lopes – On-site Engineer	TUMPEX
Michele Vazzolini – Director	Fogás
Tereza Ribeiro – Engineer	Fogás
Bonatto – Engineer	ENTERPA

COMMUNITY ASSOCIATIONS	
Raimundo Santos – President	Central Única Comunitária (*Community Center)*

According to the Resolutions Number 1[19], 4[20] and 7[21] of the Brazilian Designed National Authority (CIMGC – Comissão Interministerial de Mudança Global do Clima / *Interministerial Commission on Global Climate Change*), project participants shall send letters to local stakeholders 15 days before the start of the validation period, in order to receive comments. It includes:

- Name and type of the activity project;

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[19] http://www.mct.gov.br/upd_blob/0002/2736.pdf (Art. 3º, II)
[20] http://www.mct.gov.br/upd_blob/0011/11780.pdf (Artº 5°, unique paragraph)
[21] http://www.mct.gov.br/upd_blob/0023/23744.pdf, accessed on July 21st, 2008.

- PDD (translated to Portuguese), made available through a website;
- Description of the project's contribution to the sustainable development; also made available through a website.

Letters were sent to the following stakeholders involved and affected by the project activity and the PDD was made public through a website since this date:

- Prefeitura Municipal de Manaus (Municipal administration of Manaus).
- Câmara Municipal de Manaus (Municipal Chamber of Manaus)
- SEMMAS - Secretaria Municipal de Meio Ambiente e Sustentabilidade de Manaus (Municipal Administration of Environment and Sustainability of Manuaus)
- IPAAM - Instituto de Proteção Ambiental do Amazonas (Environmental Protection Institute of Amazonas)
- FBOMS-Forum Brasileiro de ONG's e Movimentos Sociais para o Meio Ambiente e o Desenvolvimento (Brazilian Forum of Non-Governmental Organizations and Social Movements for Environment and Development);
- Ministério Público do Estado do Amazonas (Amazonas Prosecutor´s office)
- Ministério Público Federal (Federal Prosecutor´s office)
- ARPA - Associação de Reciclagem e Preservação Ambiental (Recycling and Environmental Preservation Association)
- ACR -Associação de Catadores de Resíduos (Residues Collectors Association)
- Associação Manauense de Recicláveis (Recycling Association of Manaus)

E.2. Summary of the comments received:

A questionnaire was distributed to the public meeting participants for feedback, with questions relating to how the project activity would relate to sustainable development in Brazil, technology transfer, and improvement in the socio-economic situation of the local region. The comments received concerning the project activity, as indicated on the questionnaires, were overwhelmingly positive and supportive. During the question and answer component of the public meeting, comments were also strongly positive and supportive of the project.

One participant asked that additional general information about the project be made available to local residents and suggested that wider distribution of information regarding the project would be helpful. A second participant asked that more technical information regarding the project activity be disseminated. These issues are addressed in the subsequent section.

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

The comment received relating to further general information and wider distribution of information regarding the project technology will be addressed and the following options will be contemplated:

- A leaflet describing the project technology will be produced and distributed to interested stakeholders; and
- Further advertising of the project activity will be undertaken utilizing local media in order to disseminate information to a wider range of interested parties.

The comment received relating to additional technical information regarding the project activity will be addressed according to the following options:

- An information package containing drawings and specifications detailing the project technology will be produced and kept at the site and be available for public information; and
- After the commissioning of the system, a program will be developed to provide tours of the flaring and electrical generation system and to provide further explanation of the technology.

Regarding the letters sent, no comments have been received so far.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Tumpex – Empresa Amazonense de Coleta de Lixo Ltda.
Street/P.O.Box:	Est. Torquato Tapajós, no. 1292, Bairro da Paz
Building:	
City:	Manaus
State/Region:	Amazonas
Postfix/ZIP:	69048-660
Country:	Brazil
Telephone:	+55 (92) 4009-0400
FAX:	+55 (92) 4009-0401
E-Mail:	tumpex@tumpex.com.br
URL:	
Represented by:	Mauro Lúcio Mansur da Silva
Title:	
Salutation:	Mr.
Last Name:	Mansur
Middle Name:	Lúcio
First Name:	Mauro
Department:	
Mobile:	
Direct FAX:	+55 (92) 4009-0412
Direct tel:	+55 (92) 4009-0420
Personal E-Mail:	mauromansur@uol.com.br

Organization:	Conestoga-Rovers & Associates Capital Limited
Street/P.O.Box:	651 Colby Drive
Building:	
City:	Waterloo
State/Region:	Ontario
Postfix/ZIP:	N2V 1C2
Country:	Canada
Telephone:	(519) 884-0510
FAX:	(519) 725-1158
E-Mail:	
URL:	http://www.CRAworld.com
Represented by:	Frank Anthony Rovers
Title:	Principal and Senior Engineer
Salutation:	Mr.
Last Name:	Rovers
Middle Name:	Anthony
First Name:	Frank
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	frovers@craworld.com

Organization:	Enterpa Engenharia Ltda.
Street/P.O.Box:	Praca General Gentil Falcao, 108-14º andar
Building:	
City:	Sao Paulo
State/Region:	Sao Paulo
Postfix/ZIP:	04571-150
Country:	Brasil
Telephone:	+55 11 5502 8079
FAX:	+55 11 5502 8002
E-Mail:	
URL:	
Represented by:	Claudia de Carvalho Alves
Title:	
Salutation:	Mrs.
Last Name:	Alves
Middle Name:	
First Name:	Claudia
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	claudia@enterpa.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no Annex I public funding involved in Manaus Landfill Gas Project.

Annex 3

BASELINE INFORMATION

The baseline scenario for the project activity is the uncontrolled release of landfill gas to the atmosphere and also the generation of electricity from other sources. There are presently no measures in place to reduce methane emissions and there are no current or pending regulations that would require the Site to reduce emissions. The local practice to expand the electricity grid is the implementation of new thermoelectric plants.

The table below shows the key elements used for estimate the emissions of the baseline scenario.

1. Key Parameters

Year landfilling operations started operator/historical logs	1986
Projected year for landfill closure estimated based on current filling rate	2021
GWP for methane (UNFCCC and Kyoto Protocol decisions)	21
Methane concentration in LFG (% by volume) typical assumption for baseline scenario	50
LFG collection efficiency (%) typical assumption for baseline scenario	80
Flare efficiencies (%) operational data from flare manufacturer (John Zinc)	98
Electricity consumption from the grid due to the project activity (MWh/year)	830
Electricity consumption from the diesel generator due to the project activity (MWh/year)	220
Total accumulated waste from 1986 to 2005 (tonnes) operator/historical logs	11,000,000
Unit price of electricity sold to the grid (R$/kWh)	156.78
Combined margin emission factor for electricity displacement (tCO_2/MWh) calculated based on the Tool to calculate the emission factor for an electricity system, Version 2.	0.7160
Average capacity of Power Plant (MW) assumed based on available LFG quantities	19.6

2. Emission factor calculation

2.1. Electricity generation

Effective power capacity (MW) [5]

Units	Installed capacity (MW)	Installed capacity (%)	Fuel	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	nov/07	dez/07
			Days in month	31	28	31	30	31	30	31	31	30	31	30	31
UHE BALBINA	250.0	13.4%	(hydro)	123.7	133.0	76.5	76.5	108.0	117.4	114.2	117.9	124.7	113.2	150.2	136.0
UTE MATTOS (EX-TAMBAQUI)	161.4	8.7%	Oil (OC-A1)	50.8	54.9	58.5	57.0	38.1	46.9	55.1	60.0	55.4	61.6	62.6	59.1
UTE FRAN (EX-JARAQUI)	137.2	7.4%	Oil (OC-A1)	60.3	62.5	61.1	61.0	62.4	61.7	61.5	60.0	57.8	54.8	55.5	51.9
UTE CRISTIANO ROCHA	121.2	6.5%	Oil (OC-A1)	65.6	65.6	65.7	66.2	65.9	66.2	65.0	65.0	65.5	65.3	66.1	63.5
UTE MANAUARA	44.0	2.4%	Oil (OC-A1)	60.0	62.0	62.0	61.0	61.0	61.0	61.0	60.0	62.0	61.0	62.0	60.0
UTE PONTA NEGRA	120.0	6.4%	Oil (OC-A1)	59.0	62.0	62.0	58.0	61.0	61.0	61.0	60.0	61.0	60.8	61.0	59.0
UTE Mauá Bloco I (UTE MAUÁ)	166.0	8.9%	Oil (OC-A1)	29.7	47.1	63.9	53.4	57.5	52.7	67.6	65.0	40.6	43.8	55.4	53.3
UTE Mauá Bloco II (ex UTE A)	85.4	4.6%	Oil (OCTE)	0.8	0.9	0.0	0.0	2.1	0.2	0.5	0.0	6.2	3.6	3.5	0.3
UTE Mauá Bloco III (ex UTE B)	85.4	4.6%	Oil (OCTE)	17.1	18.2	30.5	39.0	39.2	35.2	36.5	80.0	67.1	62.6	39.5	26.0
UTE Mauá Bloco IV (ex UTE W)	157.5	8.5%	Oil (PGE)	121.2	115.0	116.0	115.0	114.0	124.4	113.0	110.0	116.0	115.1	119.0	106.0
UTE Mauá Bloco V	60.0	3.2%	DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE Aparecida Bloco I (UTE Aparecida)	92.0	4.9%	Oil (OCTE)	2.8	1.2	7.0	5.0	9.9	5.2	14.2	15.4	23.1	32.5	21.7	12.5
UTE Aparecida Bloco II (ex UTE D)	80.0	4.3%	Oil (OCTE)	31.7	45.7	43.6	47.9	49.2	40.2	35.7	35.0	31.6	41.5	51.0	25.4
UTE FLORES	83.3	4.5%	DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE SÃO JOSÉ	83.3	4.5%	DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE CIDADE NOVA	15.4	0.8%	DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE ELECTRON	120.0	6.4%	Oil (OCTE)	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**1,862.0**														

Units	jan/08	fev/08	mar/08	abr/08	mai/08	jun/08	jul/08	ago/08	set/08	out/08	nov/08	dez/08
Days in month	31	29	31	30	31	30	31	31	30	31	30	31
UHE BALBINA	133.7	148.2	161.2	200.6	200.2	214.3	209.2	189.6	163.1	162.0	173.6	197.0
UTE MATTOS (EX-TAMBAQUI)	60.9	61.7	52.2	57.8	58.4	59.1	56.8	58.7	55.5	58.4	57.6	49.8
UTE FRAN (EX-JARAQUI)	49.0	54.0	57.1	58.4	53.5	58.8	58.0	55.3	54.3	55.7	57.7	50.6
UTE CRISTIANO ROCHA	65.3	65.6	62.4	63.5	61.4	60.5	62.2	63.5	64.1	63.8	63.5	53.3
UTE MANAUARA	61.0	61.0	58.0	59.0	57.0	56.8	58.2	59.3	60.0	59.3	58.6	50.5
UTE PONTA NEGRA	61.0	61.0	58.0	59.0	57.7	57.4	58.4	58.7	59.0	59.6	58.9	51.2
UTE Mauá Bloco I (UTE MAUÁ)	37.6	56.4	52.9	39.7	68.1	56.4	69.1	70.3	78.2	87.2	57.7	5.7
UTE Mauá Bloco II (ex UTE A)	1.6	0.3	0.6	0.0	0.0	0.0	24.5	0.0	0.2	0.7	2.0	0.0
UTE Mauá Bloco III (ex UTE B)	22.0	12.5	25.0	15.8	1.6	5.7	24.9	59.9	48.9	40.6	43.1	39.7
UTE Mauá Bloco IV (ex UTE W)	116.0	94.0	78.0	82.0	79.6	70.0	85.7	85.9	91.3	89.2	86.7	56.6
UTE Mauá Bloco V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE Aparecida Bloco I (UTE Aparecida)	12.7	14.7	1.9	19.0	8.6	12.3	22.0	28.2	42.3	30.9	20.7	13.2
UTE Aparecida Bloco II (ex UTE D)	30.5	23.4	21.7	29.6	27.0	25.7	24.4	23.0	30.5	39.3	39.8	12.5
UTE FLORES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.6	0.7	5.9	41.6
UTE SÃO JOSÉ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	6.8	5.3	6.5	4.0
UTE CIDADE NOVA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.8	1.7	1.7	1.9
UTE ELECTRON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Units	jan/09	fev/09	mar/09	abr/09	mai/09	jun/09	jul/09	ago/09	set/09	out/09	nov/09	dez/09
Days in month	31	28	31	30	31	30	31	31	30	31	30	31
UHE BALBINA	201.6	210.2	219.8	218.8	216.4	219.4	207.2	174.3	136.1	135.7	133.5	112.6
UTE MATTOS (EX-TAMBAQUI)	47.8	51.2	46.4	43.3	38.2	48.2	51.3	46.4	41.8	52.6	52.1	42.9
UTE FRAN (EX-JARAQUI)	47.7	52.4	53.5	58.8	56.5	55.5	58.2	58.6	59.9	59.4	59.7	56.1
UTE CRISTIANO ROCHA	48.9	53.1	54.5	56.0	56.1	55.1	62.0	62.2	63.8	63.8	62.7	62.7
UTE MANAUARA	47.7	51.6	53.3	57.7	56.4	55.4	59.5	57.6	60.6	62.5	62.4	59.6
UTE PONTA NEGRA	48.3	52.8	53.1	57.2	55.9	55.0	59.8	59.0	62.2	62.2	61.9	59.2
UTE Mauá Bloco I (UTE MAUÁ)	51.0	50.0	71.2	60.4	49.3	63.2	38.0	53.0	80.9	55.8	62.0	68.0
UTE Mauá Bloco II (ex UTE A)	0.0	0.0	0.1	0.6	2.2	0.0	2.9	3.4	4.4	13.9	3.8	2.1
UTE Mauá Bloco III (ex UTE B)	38.4	26.1	36.4	43.4	39.7	21.7	51.7	72.3	79.8	72.2	62.8	25.8
UTE Mauá Bloco IV (ex UTE W)	52.4	52.5	55.7	59.5	64.0	68.8	82.5	100.8	115.3	117.2	113.5	112.8
UTE Mauá Bloco V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.5	46.8
UTE Aparecida Bloco I (UTE Aparecida)	6.0	4.6	7.5	15.5	14.0	14.6	21.7	25.5	51.1	23.1	24.6	18.9
UTE Aparecida Bloco II (ex UTE D)	12.0	12.3	8.3	13.1	13.6	13.8	20.1	30.9	11.9	13.4	31.1	31.7
UTE FLORES	31.5	28.3	15.6	20.2	22.9	25.1	32.9	52.9	56.3	65.7	61.0	24.0
UTE SÃO JOSÉ	4.3	5.3	3.4	4.9	5.9	4.7	7.3	10.7	11.1	11.0	10.0	7.3
UTE CIDADE NOVA	0.9	0.6	0.8	2.2	2.2	2.0	2.9	5.6	4.0	3.4	3.9	2.1
UTE ELECTRON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Electricity Generation (MWh)

Units	Installed capacity (MW)		Fuel	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	nov/07	dez/07
UHE BALBINA	250.0		(hydro)	92,032.8	89,376.0	56,916.0	55,080.0	80,352.0	84,528.0	84,964.8	87,717.6	89,784.0	84,220.8	108,144.0	101,184.0
UTE MATTOS (EX-TAMBAQUI)	161.4		Oil (OC-A1)	37,795.2	36,892.8	43,524.0	41,040.0	28,346.4	33,768.0	40,994.4	44,640.0	39,888.0	45,860.2	45,072.0	43,970.4
UTE FRAN (EX-JARAQUI)	137.2		Oil (OC-A1)	44,863.2	42,000.0	45,458.4	43,920.0	46,425.6	44,424.0	45,756.0	44,640.0	41,616.0	40,793.5	39,960.0	38,613.6
UTE CRISTIANO ROCHA	121.2		Oil (OC-A1)	48,806.4	44,083.2	48,880.8	47,664.0	49,029.6	47,664.0	48,360.0	48,360.0	47,160.0	48,553.4	47,592.0	47,244.0
UTE MANAUARA	44.0		Oil (OC-A1)	44,640.0	41,664.0	46,128.0	43,920.0	45,384.0	43,920.0	45,384.0	44,640.0	44,640.0	45,361.7	44,640.0	44,640.0
UTE PONTA NEGRA	120.0		Oil (OC-A1)	43,896.0	41,664.0	46,128.0	41,760.0	45,384.0	43,920.0	45,384.0	44,640.0	43,920.0	45,227.8	43,920.0	43,896.0
UTE Mauá Bloco I (UTE MAUÁ)	166.0		Oil (OC-A1)	22,096.8	31,651.2	47,541.6	38,448.0	42,780.0	37,944.0	50,294.4	48,360.0	29,232.0	32,617.0	39,888.0	39,655.2
UTE Mauá Bloco II (ex UTE A)	85.4		Oil (OCTE)	595.2	604.8	0.0	0.0	1,562.4	144.0	372.0	0.0	4,464.0	2,693.3	2,520.0	223.2
UTE Mauá Bloco III (ex UTE B)	85.4		Oil (OCTE)	12,722.4	12,230.4	22,692.0	28,080.0	29,164.8	25,344.0	27,156.0	59,520.0	48,312.0	46,574.4	28,440.0	19,344.0
UTE Mauá Bloco IV (ex UTE W)	157.5		Oil (PGE)	90,172.8	77,280.0	86,304.0	82,800.0	84,816.0	89,568.0	84,072.0	81,840.0	83,520.0	85,649.3	85,680.0	78,864.0
UTE Mauá Bloco V	60.0		DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE Aparecida Bloco I (UTE Aparecida)	92.0		Oil (OCTE)	2,083.2	806.4	5,208.0	3,600.0	7,365.6	3,744.0	10,564.8	11,457.6	16,632.0	24,202.3	15,624.0	9,300.0
UTE Aparecida Bloco II (ex UTE D)	80.0		Oil (OCTE)	23,584.8	30,710.4	32,438.4	34,488.0	36,604.8	28,944.0	26,560.8	26,040.0	22,752.0	30,853.7	36,720.0	18,897.6
UTE FLORES	83.3		DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE SÃO JOSÉ	83.3		DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE CIDADE NOVA	15.4		DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE ELECTRON	120.0		Oil (OCTE)	74.4	201.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**1,862.0**														

Units	jan/08	fev/08	mar/08	abr/08	mai/08	jun/08	jul/08	ago/08	set/08	out/08	nov/08	dez/08
UHE BALBINA	99,472.8	103,147.2	119,932.8	144,432.0	148,911.6	154,296.0	155,644.8	141,062.4	117,432.0	120,528.0	124,992.0	146,568.0
UTE MATTOS (EX-TAMBAQUI)	45,309.6	42,943.2	38,836.8	41,616.0	43,479.4	42,552.0	42,259.2	43,672.8	39,960.0	43,449.6	41,472.0	37,051.2
UTE FRAN (EX-JARAQUI)	36,456.0	37,584.0	42,482.4	42,048.0	39,804.0	42,336.0	43,152.0	41,143.2	39,096.0	41,440.8	41,544.0	37,646.4
UTE CRISTIANO ROCHA	48,583.2	45,657.6	46,425.6	45,720.0	45,703.9	43,560.0	46,276.8	47,244.0	46,152.0	47,467.2	45,720.0	39,655.2
UTE MANAUARA	45,384.0	42,456.0	43,152.0	42,480.0	42,422.9	40,896.0	43,300.8	44,119.2	43,200.0	44,119.2	42,192.0	37,572.0
UTE PONTA NEGRA	45,384.0	42,456.0	43,152.0	42,480.0	42,951.1	41,328.0	43,449.6	43,672.8	42,480.0	44,342.4	42,408.0	38,092.8
UTE Mauá Bloco I (UTE MAUÁ)	27,974.4	39,254.4	39,357.6	28,584.0	50,666.4	40,608.0	51,410.4	52,303.2	56,304.0	64,876.8	41,544.0	4,240.8
UTE Mauá Bloco II (ex UTE A)	1,190.4	208.8	446.4	0.0	0.0	0.0	18,228.0	0.0	144.0	520.8	1,440.0	0.0
UTE Mauá Bloco III (ex UTE B)	16,368.0	8,700.0	18,600.0	11,376.0	1,175.5	4,104.0	18,525.6	44,565.6	35,208.0	30,206.4	31,032.0	29,536.8
UTE Mauá Bloco IV (ex UTE W)	86,304.0	65,424.0	58,032.0	59,040.0	59,237.3	50,400.0	63,760.8	63,909.6	65,736.0	66,364.8	62,424.0	42,110.4
UTE Mauá Bloco V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE Aparecida Bloco I (UTE Aparecida)	9,448.8	10,231.2	1,413.6	13,680.0	6,420.7	8,856.0	16,368.0	20,980.8	30,456.0	22,989.6	14,904.0	9,820.8
UTE Aparecida Bloco II (ex UTE D)	22,692.0	16,286.4	16,144.8	21,312.0	20,095.4	18,504.0	18,153.6	17,112.0	21,960.0	29,239.2	28,656.0	9,300.0
UTE FLORES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	892.8	1,152.0	520.8	4,248.0	30,950.4
UTE SÃO JOSÉ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,562.4	4,896.0	3,943.2	4,680.0	2,976.0
UTE CIDADE NOVA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,041.6	1,296.0	1,264.8	1,224.0	1,413.6
UTE ELECTRON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Units	jan/09	fev/09	mar/09	abr/09	mai/09	jun/09	jul/09	ago/09	set/09	out/09	nov/09	dez/09
UHE BALBINA	149,990.4	141,254.4	163,531.2	157,536.0	161,001.6	157,968.0	154,156.8	129,679.2	97,992.0	100,960.8	96,120.0	83,774.4
UTE MATTOS (EX-TAMBAQUI)	35,563.2	34,406.4	34,521.6	31,176.0	28,420.8	34,704.0	38,167.2	34,521.6	30,096.0	39,134.4	37,512.0	31,917.6
UTE FRAN (EX-JARAQUI)	35,488.8	35,212.8	39,804.0	42,336.0	42,036.0	39,960.0	43,300.8	43,598.4	43,128.0	44,193.6	42,984.0	41,738.4
UTE CRISTIANO ROCHA	36,381.6	35,683.2	40,548.0	40,320.0	41,738.4	39,672.0	46,128.0	46,276.8	45,936.0	47,467.2	45,144.0	46,648.8
UTE MANAUARA	35,488.8	34,675.2	39,655.2	41,544.0	41,961.6	39,888.0	44,268.0	42,854.4	43,632.0	46,500.0	44,928.0	44,342.4
UTE PONTA NEGRA	35,935.2	35,481.6	39,506.4	41,184.0	41,589.6	39,600.0	44,491.2	43,896.0	44,784.0	46,276.8	44,568.0	44,044.8
UTE Mauá Bloco I (UTE MAUÁ)	37,944.0	33,600.0	52,972.8	43,488.0	36,679.2	45,504.0	28,272.0	39,432.0	58,248.0	41,515.2	44,640.0	50,592.0
UTE Mauá Bloco II (ex UTE A)	0.0	0.0	74.4	432.0	1,636.8	0.0	2,157.6	2,529.6	3,168.0	10,341.6	2,736.0	1,562.4
UTE Mauá Bloco III (ex UTE B)	28,569.6	17,539.2	27,081.6	31,248.0	29,536.8	15,624.0	38,464.8	53,791.2	57,456.0	53,716.8	45,216.0	19,195.2
UTE Mauá Bloco IV (ex UTE W)	38,985.6	35,280.0	41,440.8	42,840.0	47,616.0	49,536.0	61,380.0	74,995.2	83,016.0	87,196.8	81,720.0	83,923.2
UTE Mauá Bloco V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39,960.0	34,819.2
UTE Aparecida Bloco I (UTE Aparecida)	4,464.0	3,091.2	5,580.0	11,160.0	10,416.0	10,512.0	16,144.8	18,972.0	36,792.0	17,186.4	17,712.0	14,061.6
UTE Aparecida Bloco II (ex UTE D)	8,928.0	8,265.6	6,175.2	9,432.0	10,118.4	9,936.0	14,954.4	22,989.6	8,568.0	9,969.6	22,392.0	23,584.8
UTE FLORES	23,436.0	19,017.6	11,606.4	14,544.0	17,037.6	18,072.0	24,477.6	39,357.6	40,536.0	48,880.8	43,920.0	17,856.0
UTE SÃO JOSÉ	3,199.2	3,561.6	2,529.6	3,528.0	4,389.6	3,384.0	5,431.2	7,960.8	7,992.0	8,184.0	7,200.0	5,431.2
UTE CIDADE NOVA	669.6	403.2	595.2	1,584.0	1,636.8	1,440.0	2,157.6	4,166.4	2,880.0	2,529.6	2,808.0	1,562.4
UTE ELECTRON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

2.2. Fuel consumption

Specific consumption (ton/MWh) [5]

Units	Installed capacity (MW)	Fuel	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	nov/07	dez/07
		Days in month	31	28	31	30	31	30	31	31	30	31	30	31
UTE MATTOS (EX-TAMBAQUI)	161.4	Oil (OC-A1)	0.225	0.219	0.219	0.219	0.219	0.219	0.216	0.214	0.231	0.229	0.225	0.224
UTE FRAN (EX-JARAQUI)	137.2	Oil (OC-A1)	0.219	0.217	0.218	0.217	0.215	0.216	0.213	0.212	0.217	0.217	0.221	0.217
UTE CRISTIANO ROCHA	121.2	Oil (OC-A1)	0.207	0.207	0.208	0.208	0.209	0.207	0.204	0.205	0.204	0.203	0.201	0.202
UTE MANAUARA	44.0	Oil (OC-A1)	0.210	0.209	0.210	0.210	0.209	0.209	0.209	0.208	0.205	0.205	0.205	0.205
UTE PONTA NEGRA	120.0	Oil (OC-A1)	0.205	0.204	0.202	0.202	0.201	0.201	0.199	0.198	0.198	0.203	0.201	0.198
UTE Mauá Bloco I (UTE MAUÁ)	166.0	Oil (OC-A1)	0.323	0.328	0.322	0.322	0.318	0.315	0.315	0.334	0.332	0.332	0.331	0.322
UTE Mauá Bloco II (ex UTE A)	85.4	Oil (OCTE)	0.394	0.460	0.408	0.407	0.399	0.403	0.403	0.403	0.403	0.403	0.402	0.400
UTE Mauá Bloco III (ex UTE B)	85.4	Oil (OCTE)	0.371	0.365	0.370	0.372	0.369	0.375	0.377	0.383	0.377	0.371	0.369	0.373
UTE Mauá Bloco IV (ex UTE W)	157.5	Oil (PGE)	0.197	0.186	0.189	0.197	0.206	0.205	0.196	0.195	0.212	0.192	0.198	0.198
UTE Mauá Bloco V	60.0	DIESEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
UTE Aparecida Bloco I (UTE Aparecida)	92.0	Oil (OCTE)	0.297	0.288	0.292	0.299	0.284	0.296	0.289	0.294	0.297	0.308	0.316	0.301
UTE Aparecida Bloco II (ex UTE D)	80.0	Oil (OCTE)	0.281	0.280	0.290	0.289	0.299	0.300	0.301	0.305	0.289	0.278	0.279	0.288
UTE FLORES	83.3	DIESEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.297	0.293	0.209	0.265	0.293
UTE SÃO JOSÉ	83.3	DIESEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.293	0.293	0.289	0.285	0.294
UTE CIDADE NOVA	15.4	DIESEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.294	0.297	0.285	0.262	0.274
UTE ELECTRON	120.0	Oil (OCTE)	0.823	0.823	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	**1,612.0**													

Units	jan/08	fev/08	mar/08	abr/08	mai/08	jun/08	jul/08	ago/08	set/08	out/08	nov/08	dez/08
Days in month	31	29	31	30	31	30	31	31	30	31	30	31
UTE MATTOS (EX-TAMBAQUI)	0.226	0.229	0.229	0.229	0.229	0.229	0.229	0.229	0.229	0.229	0.229	0.229
UTE FRAN (EX-JARAQUI)	0.216	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218
UTE CRISTIANO ROCHA	0.201	0.203	0.203	0.203	0.203	0.203	0.203	0.203	0.203	0.203	0.203	0.203
UTE MANAUARA	0.205	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207
UTE PONTA NEGRA	0.199	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
UTE Mauá Bloco I (UTE MAUÁ)	0.329	0.325	0.325	0.325	0.325	0.325	0.325	0.325	0.325	0.325	0.325	0.325
UTE Mauá Bloco II (ex UTE A)	0.400	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403
UTE Mauá Bloco III (ex UTE B)	0.372	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375
UTE Mauá Bloco IV (ex UTE W)	0.196	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.199
UTE Mauá Bloco V	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.290	0.290	0.290
UTE Aparecida Bloco I (UTE Aparecida)	0.280	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294
UTE Aparecida Bloco II (ex UTE D)	0.288	0.291	0.291	0.291	0.291	0.291	0.291	0.291	0.291	0.291	0.291	0.291
UTE FLORES	0.234	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272
UTE SÃO JOSÉ	0.275	0.293	0.293	0.293	0.293	0.293	0.293	0.293	0.293	0.293	0.293	0.293
UTE CIDADE NOVA	0.277	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276
UTE ELECTRON	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.380	0.380	0.380

Units	jan/09	fev/09	mar/09	abr/09	mai/09	jun/09	jul/09	ago/09	set/09	out/09	nov/09	dez/09
Days in month	31	28	31	30	31	30	31	31	30	31	30	31
UTE MATTOS (EX-TAMBAQUI)	0.229	0.229	0.229	0.229	0.229	0.229	0.229	0.229	0.229	0.229	0.229	0.229
UTE FRAN (EX-JARAQUI)	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218
UTE CRISTIANO ROCHA	0.203	0.203	0.203	0.203	0.203	0.203	0.203	0.203	0.203	0.203	0.203	0.203
UTE MANAUARA	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207
UTE PONTA NEGRA	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
UTE Mauá Bloco I (UTE MAUÁ)	0.325	0.325	0.325	0.325	0.325	0.325	0.325	0.325	0.325	0.325	0.325	0.325
UTE Mauá Bloco II (ex UTE A)	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403
UTE Mauá Bloco III (ex UTE B)	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375
UTE Mauá Bloco IV (ex UTE W)	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.199
UTE Mauá Bloco V	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290
UTE Aparecida Bloco I (UTE Aparecida)	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294
UTE Aparecida Bloco II (ex UTE D)	0.291	0.291	0.291	0.291	0.291	0.291	0.291	0.291	0.291	0.291	0.291	0.291
UTE FLORES	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272
UTE SÃO JOSÉ	0.293	0.293	0.293	0.293	0.293	0.293	0.293	0.293	0.293	0.293	0.293	0.293
UTE CIDADE NOVA	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276
UTE ELECTRON	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380

Fuel consumption (ton)

Units	Installed capacity (MW)	Fuel	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	nov/07	dez/07
UTE MATTOS (EX-TAMBAQUI)	161.4	Oil (OC-A1)	8,503.9	8,079.5	9,531.8	8,987.8	6,207.9	7,395.2	8,854.8	9,553.0	9,214.1	10,502.0	10,141.2	9,849.4
UTE FRAN (EX-JARAQUI)	137.2	Oil (OC-A1)	9,825.0	9,114.0	9,909.9	9,530.6	9,981.5	9,595.6	9,746.0	9,463.7	9,030.7	8,852.2	8,831.2	8,379.2
UTE CRISTIANO ROCHA	121.2	Oil (OC-A1)	10,102.9	9,125.2	10,167.2	9,914.1	10,247.2	9,866.4	9,865.4	9,913.8	9,620.6	9,856.3	9,566.0	9,543.3
UTE MANAUARA	44.0	Oil (OC-A1)	9,374.4	8,707.8	9,686.9	9,223.2	9,485.3	9,179.3	9,485.3	9,285.1	9,151.2	9,299.1	9,151.2	9,151.2
UTE PONTA NEGRA	120.0	Oil (OC-A1)	8,998.7	8,499.5	9,317.9	8,435.5	9,122.2	8,827.9	9,031.4	8,838.7	8,696.2	9,181.2	8,827.9	8,691.4
UTE Mauá Bloco I (UTE MAUÁ)	166.0	Oil (OC-A1)	7,137.3	10,381.6	15,308.4	12,380.3	13,604.0	11,952.4	15,842.7	16,152.2	9,705.0	10,828.8	13,202.9	12,769.0
UTE Mauá Bloco II (ex UTE A)	85.4	Oil (OCTE)	234.5	278.2	0.0	0.0	623.4	58.0	149.9	0.0	1,799.0	1,085.4	1,013.0	89.3
UTE Mauá Bloco III (ex UTE B)	85.4	Oil (OCTE)	4,720.0	4,464.1	8,396.0	10,445.8	10,761.8	9,504.0	10,237.8	22,796.2	18,213.6	17,279.1	10,494.4	7,215.3
UTE Mauá Bloco IV (ex UTE W)	157.5	Oil (PGE)	17,764.0	14,374.1	16,311.5	16,311.6	17,472.1	18,361.4	16,478.1	15,958.8	17,706.2	16,444.7	16,964.6	15,615.1
UTE Mauá Bloco V	60.0	DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE Aparecida Bloco I (UTE Aparecida)	92.0	Oil (OCTE)	618.7	232.2	1,520.7	1,076.4	2,091.8	1,108.2	3,053.2	3,368.5	4,939.7	7,454.3	4,937.2	2,799.3
UTE Aparecida Bloco II (ex UTE D)	80.0	Oil (OCTE)	6,627.3	8,598.9	9,407.1	9,967.0	10,944.8	8,683.2	7,994.8	7,942.2	6,575.3	8,577.3	10,244.9	5,442.5
UTE FLORES	83.3	DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE SÃO JOSÉ	83.3	DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE CIDADE NOVA	15.4	DIESEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE ELECTRON	120.0	Oil (OCTE)	61.2	165.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Units	jan/08	fev/08	mar/08	abr/08	mai/08	jun/08	jul/08	ago/08	set/08	out/08	nov/08	dez/08
UTE MATTOS (EX-TAMBAQUI)	10,240.0	9,834.0	8,893.6	9,530.1	9,956.8	9,744.4	9,677.4	10,001.1	9,150.8	9,950.0	9,497.1	8,484.7
UTE FRAN (EX-JARAQUI)	7,874.5	8,193.3	9,261.2	9,166.5	8,677.3	9,229.2	9,407.1	8,969.2	8,522.9	9,034.1	9,056.6	8,206.9
UTE CRISTIANO ROCHA	9,765.2	9,268.5	9,424.4	9,281.2	9,277.9	8,842.7	9,394.2	9,590.5	9,368.9	9,635.8	9,281.2	8,050.0
UTE MANAUARA	9,303.7	8,788.4	8,932.5	8,793.4	8,781.5	8,465.5	8,963.3	9,132.7	8,942.4	9,132.7	8,733.7	7,777.4
UTE PONTA NEGRA	9,031.4	8,491.2	8,630.4	8,496.0	8,590.2	8,265.6	8,689.9	8,734.6	8,496.0	8,868.5	8,481.6	7,618.6
UTE Mauá Bloco I (UTE MAUÁ)	9,203.6	12,757.7	12,791.2	9,289.8	16,466.6	13,197.6	16,708.4	16,998.5	18,298.8	21,085.0	13,501.8	1,378.3
UTE Mauá Bloco II (ex UTE A)	476.2	84.1	179.9	0.0	0.0	0.0	7,345.9	0.0	58.0	209.9	580.3	0.0
UTE Mauá Bloco III (ex UTE B)	6,088.9	3,262.5	6,975.0	4,266.0	440.8	1,539.0	6,947.1	16,712.1	13,203.0	11,327.4	11,637.0	11,076.3
UTE Mauá Bloco IV (ex UTE W)	16,915.6	13,019.4	11,548.4	11,749.0	11,788.2	10,029.6	12,688.4	12,718.0	13,081.5	13,206.6	12,422.4	8,380.0
UTE Mauá Bloco V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTE Aparecida Bloco I (UTE Aparecida)	2,645.7	3,008.0	415.6	4,021.9	1,887.7	2,603.7	4,812.2	6,168.4	8,954.1	6,758.9	4,381.8	2,887.3
UTE Aparecida Bloco II (ex UTE D)	6,535.3	4,739.3	4,698.1	6,201.8	5,847.8	5,384.7	5,282.7	4,979.6	6,390.4	8,508.6	8,338.9	2,706.3
UTE FLORES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	242.8	313.3	141.7	1,155.5	8,418.5
UTE SÃO JOSÉ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	457.8	1,434.5	1,155.4	1,371.2	872.0
UTE CIDADE NOVA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	287.5	357.7	349.1	337.8	390.2
UTE ELECTRON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Units	jan/09	fev/09	mar/09	abr/09	mai/09	jun/09	jul/09	ago/09	set/09	out/09	nov/09	dez/09
UTE MATTOS (EX-TAMBAQUI)	8,144.0	7,879.1	7,905.4	7,139.3	6,508.4	7,947.2	8,740.3	7,905.4	6,892.0	8,961.8	8,590.2	7,309.1
UTE FRAN (EX-JARAQUI)	7,736.6	7,676.4	8,677.3	9,229.2	9,163.8	8,711.3	9,439.6	9,504.5	9,401.9	9,634.2	9,370.5	9,099.0
UTE CRISTIANO ROCHA	7,385.5	7,243.7	8,231.2	8,185.0	8,472.9	8,053.4	9,364.0	9,394.2	9,325.0	9,635.8	9,164.2	9,469.7
UTE MANAUARA	7,346.2	7,177.8	8,208.6	8,599.6	8,686.1	8,256.8	9,163.5	8,870.9	9,031.8	9,625.5	9,300.1	9,178.9
UTE PONTA NEGRA	7,187.0	7,096.3	7,901.3	8,236.8	8,317.9	7,920.0	8,898.2	8,779.2	8,956.8	9,255.4	8,913.6	8,809.0
UTE Mauá Bloco I (UTE MAUÁ)	12,331.8	10,920.0	17,216.2	14,133.6	11,920.7	14,788.8	9,188.4	12,815.4	18,930.6	13,492.4	14,508.0	16,442.4
UTE Mauá Bloco II (ex UTE A)	0.0	0.0	30.0	174.1	659.6	0.0	869.5	1,019.4	1,276.7	4,167.7	1,102.6	629.6
UTE Mauá Bloco III (ex UTE B)	10,713.6	6,577.2	10,155.6	11,718.0	11,076.3	5,859.0	14,424.3	20,171.7	21,546.0	20,143.8	16,956.0	7,198.2
UTE Mauá Bloco IV (ex UTE W)	7,758.1	7,020.7	8,246.7	8,525.2	9,475.6	9,857.7	12,214.6	14,924.0	16,520.2	17,352.2	16,262.3	16,700.7
UTE Mauá Bloco V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11,588.4	10,097.6
UTE Aparecida Bloco I (UTE Aparecida)	1,312.4	908.8	1,640.5	3,281.0	3,062.3	3,090.5	4,746.6	5,577.8	10,816.8	5,052.8	5,207.3	4,134.1
UTE Aparecida Bloco II (ex UTE D)	2,598.0	2,405.3	1,797.0	2,744.7	2,944.5	2,891.4	4,351.7	6,690.0	2,493.3	2,901.2	6,516.1	6,863.2
UTE FLORES	6,374.6	5,172.8	3,156.9	3,956.0	4,634.2	4,915.6	6,657.9	10,705.3	11,025.8	13,295.6	11,946.2	4,856.8
UTE SÃO JOSÉ	937.4	1,043.5	741.2	1,033.7	1,286.2	991.5	1,591.3	2,332.5	2,341.7	2,397.9	2,109.6	1,591.3
UTE CIDADE NOVA	184.8	111.3	164.3	437.2	451.8	397.4	595.5	1,149.9	794.9	698.2	775.0	431.2
UTE ELECTRON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

3. Operating Margin

2007								
Power unit m	**Installed capacity (MW)**	**Fuel type**	**Net quantity of electricity generated (MWh)**	**Amount of fossil fuel consumed (ton)**	**Net calorific value of fossil fuel (GJ/ton) [1,2]**	**CO2 emission factor of fossil fuel (tCO2/GJ) [3,4]**	**CO2 emission factor of the power unit (tCO2/MWh)**	**CO2 emission of the power unit (tCO2)**
UTE MATTOS (EX-TAMBAQUI)	161.4	Oil (OC-A1)	481,791.4	106,820.4	40.1	0.0755	0.671	323,404.22
UTE FRAN (EX-JARAQUI)	137.2	Oil (OC-A1)	518,470.3	112,259.6	40.1	0.0755	0.656	339,871.51
UTE CRISTIANO ROCHA	121.2	Oil (OC-A1)	573,397.4	117,788.6	40.1	0.0755	0.622	356,610.90
UTE MANAUARA	44.0	Oil (OC-A1)	534,961.7	111,179.9	40.1	0.0755	0.629	336,602.74
UTE PONTA NEGRA	120.0	Oil (OC-A1)	529,739.8	106,468.5	40.1	0.0755	0.608	322,338.63
UTE Mauá Bloco I (UTE MAUÁ)	166.0	Oil (OC-A1)	460,508.2	149,264.6	40.1	0.0755	0.981	451,906.17
UTE Mauá Bloco II (ex UTE A)	85.4	Oil (OCTE)	13,178.9	5,330.8	40.1	0.0755	1.225	16,139.16
UTE Mauá Bloco III (ex UTE B)	85.4	Oil (OCTE)	359,580.0	134,528.1	40.1	0.0755	1.133	407,290.51
UTE Mauá Bloco IV (ex UTE W)	157.5	Oil (PGE)	1,010,566.1	199,762.2	40.1	0.0755	0.598	604,790.17
UTE Aparecida Bloco I (UTE Aparecida)	92.0	Oil (OCTE)	110,587.9	33,200.4	40.1	0.0755	0.909	100,515.90
UTE Aparecida Bloco II (ex UTE D)	80.0	Oil (OCTE)	348,594.5	101,005.5	40.1	0.0755	0.877	305,799.16
UTE ELECTRON	120.0	Oil (OCTE)	276.0	227.1	40.1	0.0755	2.492	687.70
Operating Margin$_{2007}$ (tCO_2/MWh)								**0.722**

2008								
Power unit m	**Installed capacity (MW)**	**Fuel type**	**Net quantity of electricity generated (MWh)**	**Amount of fossil fuel consumed (ton)**	**Net calorific value of fossil fuel (GJ/ton)**	**CO2 emission factor of fossil fuel (tCO2/GJ)**	**CO2 emission factor of the power unit (tCO2/MWh)**	**CO2 emission of the power unit (tCO2)**
UTE MATTOS (EX-TAMBAQUI)	161.4	Oil (OC-A1)	502,601.8	114,959.9	40.1	0.0755	0.692	348,046.77
UTE FRAN (EX-JARAQUI)	137.2	Oil (OC-A1)	484,732.8	105,598.8	40.1	0.0755	0.660	319,705.76
UTE CRISTIANO ROCHA	121.2	Oil (OC-A1)	548,165.5	111,180.4	40.1	0.0755	0.614	336,604.32
UTE MANAUARA	44.0	Oil (OC-A1)	511,294.1	105,747.1	40.1	0.0755	0.626	320,154.65
UTE PONTA NEGRA	120.0	Oil (OC-A1)	512,196.7	102,394.0	40.1	0.0755	0.605	310,002.83
UTE Mauá Bloco I (UTE MAUÁ)	166.0	Oil (OC-A1)	497,124.0	161,677.2	40.1	0.0755	0.985	489,485.80
UTE Mauá Bloco II (ex UTE A)	85.4	Oil (OCTE)	22,178.4	8,934.3	40.1	0.0755	1.220	27,049.11
UTE Mauá Bloco III (ex UTE B)	85.4	Oil (OCTE)	249,397.9	93,475.1	40.1	0.0755	1.135	283,000.59
UTE Mauá Bloco IV (ex UTE W)	157.5	Oil (PGE)	742,742.9	147,546.9	40.1	0.0755	0.601	446,705.68
UTE Aparecida Bloco I (UTE Aparecida)	92.0	Oil (OCTE)	165,569.5	48,545.2	40.1	0.0755	0.888	146,972.89
UTE Aparecida Bloco II (ex UTE D)	80.0	Oil (OCTE)	239,455.4	69,613.5	40.1	0.0755	0.880	210,758.22
UTE FLORES	83.3	DIESEL	37,764.0	10,271.8	42.2	0.0726	0.833	31,469.94
UTE SÃO JOSÉ	83.3	DIESEL	18,057.6	5,290.9	42.2	0.0726	0.898	16,209.77
UTE CIDADE NOVA	15.4	DIESEL	6,240.0	1,722.2	42.2	0.0726	0.846	5,276.46
Operating Margin$_{2008}$ (tCO_2/MWh)								**0.725**

2009								
Power unit m	Installed capacity (MW)	Fuel type	Net quantity of electricity generated (MWh)	Amount of fossil fuel consumed (ton)	Net calorific value of fossil fuel (GJ/ton)	CO2 emission factor of fossil fuel (tCO2/GJ)	CO2 emission factor of the power unit (tCO2/MWh)	CO2 emission of the power unit (tCO2)
UTE MATTOS (EX-TAMBAQUI)	161.4	Oil (OC-A1)	410,140.8	93,922.2	40.1	0.0755	0.693	284,354.29
UTE FRAN (EX-JARAQUI)	137.2	Oil (OC-A1)	493,780.8	107,644.2	40.1	0.0755	0.660	325,898.24
UTE CRISTIANO ROCHA	121.2	Oil (OC-A1)	511,944.0	103,924.6	40.1	0.0755	0.615	314,637.02
UTE MANAUARA	44.0	Oil (OC-A1)	499,737.6	103,445.7	40.1	0.0755	0.627	313,186.98
UTE PONTA NEGRA	120.0	Oil (OC-A1)	501,357.6	100,271.5	40.1	0.0755	0.606	303,577.04
UTE Mauá Bloco I (UTE MAUÁ)	166.0	Oil (OC-A1)	512,887.2	166,688.3	40.1	0.0755	0.984	504,657.28
UTE Mauá Bloco II (ex UTE A)	85.4	Oil (OCTE)	24,638.4	9,929.3	40.1	0.0755	1.220	30,061.38
UTE Mauá Bloco III (ex UTE B)	85.4	Oil (OCTE)	417,439.2	156,539.7	40.1	0.0755	1.135	473,931.77
UTE Mauá Bloco IV (ex UTE W)	157.5	Oil (PGE)	727,929.6	144,858.0	40.1	0.0755	0.602	438,564.81
UTE Mauá Bloco V	60.0	DIESEL	74,779.2	21,686.0	42.2	0.0726	0.888	66,439.73
UTE Aparecida Bloco I (UTE Aparecida)	92.0	Oil (OCTE)	166,092.0	48,831.0	40.1	0.0755	0.890	147,838.44
UTE Aparecida Bloco II (ex UTE D)	80.0	Oil (OCTE)	155,313.6	45,196.3	40.1	0.0755	0.881	136,833.93
UTE FLORES	83.3	DIESEL	318,741.6	86,697.7	42.2	0.0726	0.833	265,617.52
UTE SÃO JOSÉ	83.3	DIESEL	62,791.2	18,397.8	42.2	0.0726	0.898	56,365.77
UTE CIDADE NOVA	15.4	DIESEL	22,432.8	6,191.5	42.2	0.0726	0.846	18,968.88
Operating Margin$_{2009}$ (tCO_2/MWh)								**0.751**

MWh	Net generation	Low-cost/must-run	%
2007	4,941,652	1,014,300	21%
2008	4,537,521	1,576,420	35%
2009	4,900,006	1,593,965	33%

4. Build Margin

2009								
Power unit Unit m	Installed capacity (MW)	Fuel	Net quantity of electricity generated (MWh)	Amount of fossil fuel consumed (ton)	Net calorific value of fossil fuel (GJ/ton)	CO2 emission factor of fossil fuel (tCO2/GJ)	CO2 emission factor of the power unit (tCO2/MWh)	CO2 emission of the power unit (tCO2)
UTE Mauá Bloco V	60.0	DIESEL	74,779.2	21,686.0	42.2	0.0726	0.8885	66,439.7
UTE FLORES	83.3	DIESEL	318,741.6	86,697.7	42.2	0.0726	0.8333	265,617.5
UTE SÃO JOSÉ	83.3	DIESEL	62,791.2	18,397.8	42.2	0.0726	0.8977	56,365.8
UTE CIDADE NOVA	15.4	DIESEL	22,432.8	6,191.5	42.2	0.0726	0.8456	18,968.9
UTE Mauá Bloco IV (ex UTE W)	157.5	Oil (PGE)	742,742.9	147,546.9	40.1	0.0755	0.6014	446,705.7
Build Margin$_{2009}$ (tCO_2/MWh)								**0.6992**

20% total net generation	980,001	MWh
group m of build margin	1,221,488	MWh

5. Combined margin emission factor

Ex-ante emission factor for the isolated system located in Manaus (Amazonas-Brazil) fo the first crediting period		
Baseline	EF_{OM} [tCO_2/MWh]	Net Generation [MWh]
2009	0.7512	4,900,006
2008	0.7254	4,537,521
2007	0.7216	4,941,652
	$EF_{OM\ simple,\ 2007\text{-}2009}$ 0.7329	$EF_{BM,2009}$ 0.6992
	Weights_wind and solar projects w_{OM} = 0.75 w_{BM} = 0.25	Weights_all other projects w_{OM} = 0.50 w_{BM} = 0.50
	$EF_{2007\text{-}2009}$ [tCO_2/MWh] 0.724	**$EF_{2007\text{-}2009}$ [tCO2/MWh]** **0.7160**

Annex 4

MONITORING INFORMATION

The monitoring will be made as described in item B.7.2.