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:

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SANTECH – Saneamento & Tecnologia Ambiental Ltda. – SANTEC Resíduos landfill gas emission reduction Project Activity.

Version: 12

Date: (DD/MM/YYYY): 15/12/2006.

A.2. Description of the project activity:

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The primary objective of the SANTEC Resíduos landfill gas emission reduction Project Activity is to avoid greenhouse gases emission by the SANTEC Resíduos landfill through landfill gas capture and flaring, while contributing to the environmental, social and economic sustainability by minimizing global climate changes and local air pollution.

This project is owned by SANTECH – Saneamento & Tecnologia Ambiental Ltda., a waste management company originally founded in 2005, created to develop new technologies in the complete process of waste management, from pick-up to final disposal at sites strategically designed for waste treatment.

Today, SANTEC Residuos landfill has approximately 80 industrial customers, comprising the states of Santa Catarina and the north region of Rio Grande do Sul, and collects the residues of 19 cities–. It was established in this region because of its deficiency in collecting and correctly disposing the industrial an commercial residues.

SANTEC Resíduos landfill (Figure 1) is located in Içara, state of Santa Catarina, south region of Brazil. It has been operating since September, 2005, when the waste started to be deposited, and has 240 tonnes of deposit waste each day (80% of domestic and 20% industrial waste) and prediction date for closing in 2025 with 2 million tones approximately. There is a passive venting system for biogas installed since the day it started to operate. A wake tractor is used to compact the waste.

Figure 1 - Overview from SANTEC Resíduos landfill

The project activity involves the installation of methane collection and destruction equipment with capacity of 416 m³/h in 2006, and 910 m³/h in 2012. This equipment will consist of pipes connected to the drainage wells leading to enclosed flares, which are capable of performing the complete burn and destruction of the methane.

The organic content of the waste land filled, through its decomposition, produce large quantities of biogas whose major contents are methane (CH_4) and carbon dioxide (CO_2). The emission of these gases to the atmosphere, in the absence of the project activity, contributes to raise the greenhouse effect, climate global changes, besides its emissions can do harm to the surroundings by increasing potential explosions and fire risks. Additionally, the biogas causes bad odors and significant health impacts. The Project will have several positive social impacts as well as providing for both short and long-term employment opportunities for local people. Local contractors and laborers will be required for construction, and long-term staff will be used to operate and maintain the system, in addition, by paying the local authority a royalty fee from the sale of the carbon credits, the project will be injecting capital into the local economy, and its use will be entirely decided upon by the local authority.

The revenues obtained from the sale of the CER's will also help SANTECH to continue supporting the community. SANTECH has a strong social responsibility evidenced in numerous initiatives, including: the complete recovery of Içara Waste Disposal; recovery of the area of preservation that leads to the landfill; Environment Educational Center, which promotes activities with the local neighbors and visitors of the landfill; Social Program, promotes incentives and qualification to the collectors of waste from Içara; and, incentives of researches with local schools. This revenue distribution and social efforts most be added to the environmental benefits when evaluating the contribution to sustainable development of this project activity. Total emissions reductions are 205,112 tCO_2e over first 7 years crediting period

A.3. Project participants:

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Name of Party involved	Private and/ or public entity(ies) project participants	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	SANTECH – Saneamento & Tecnologia Ambiental Ltda. (Private entity)	No
Brazil	Ecoinvest Carbon Assessoria Ltda. (Private entity)	

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

The SANTECH received on October from 2006 the prize Fritz Muller, this is granted by FATMA (State of Santa Catarina Environmental Agency) the companies headquartered in the State of Santa Catarina who if had detached in the control of the pollution generated in the process of industrial production.

Figure 2 - Director of the SANTECH, William Wagner de Lima, receiving Trophy FRITZ MÜLLER 2006. (Picture: Felipe Christ)

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

Brazil.

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

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State of Santa Catarina, south of Brazil.

A.4.1.3. City/Town/Community etc:

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Içara.

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

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SANTEC Resíduos landfill is located in the 389 of the BR-101 Road, city of Içara, state of Santa Catarina (Figure 1). Içara is a town of approximately 48,000 inhabitants. It is 182 Km away from the state of Santa Catarina capital, Florianópolis, and is dedicated to the apiculture and the culture of tobacco. Besides, Içara is the largest producer of plastics of all Latin America.

Figure 3 - Location of the project activity in the city of Içara

Point	GPS	
A	49d19'40.6"W	28d47'21.4"S
B	49d19'54.5"W	28d47'29.7"S
C	49d19'47.6"W	28d47'41.0"S
D	49d19'35.9"W	28d47'29.5"S

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

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According to Annex A of the Kyoto Protocol, this project fits in Sectoral Category 13, Waste Handling and Disposal.

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

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The project activity consists in substitute the passive venting system that operates at the present time in SANTEC Resíduos landfill, by a forced exhaustion one. The collection efficiency of the actual method of LFG emission avoidance is not enough to mitigate the impacts of these emissions, and will increase due to this alteration. The landfill has the following structure (Figure 4).

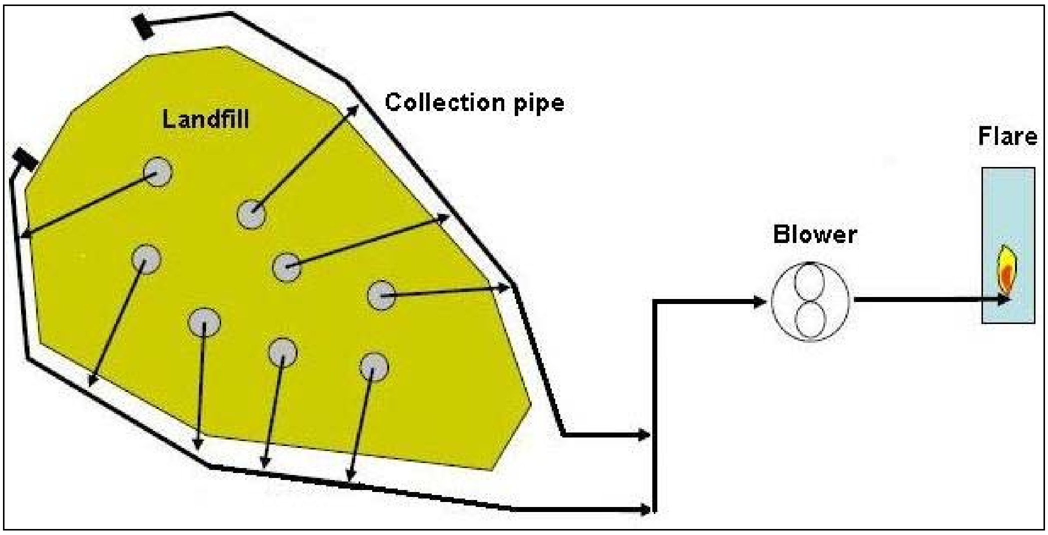

Figure 4 - Technical structure of the project activity

In the passive venting system the biogas is burned directly in the top of the well (well head), with probably less than 90% of combustion efficiency. The biogas that reaches these wells is located around the structure, and is drained naturally. Consequently, the LFG destruction efficiency varies from 5% to 20% of total LFG production, depending on the area type and conditions (in operation or not). This scenario is typically what is practiced in Brazil. In the other hand, in the forced exhaustion system the biogas is collected through forced exhaustion promoted by blowers. The landfill is covered by clay to prevent the biogas to come out through the landfill surface. Consequently, the collection efficiency could reach 70 % in relation to the total LFG produced, depending on the area type and conditions (in operation or not). This efficiency is not monitored, but estimated for evaluating the amount of the landfill gas capturing for blowers. It will not be changed during the credit period . Also, the enclosed flare efficiency is between 95% and 96%.

The project activity involves the installation of state of the art LFG collection technology. This includes:

- Vertical gas wells drilled into waste to extract the LFG. The gas wells cover the area of the landfill available for gas extraction and are spaced on a site-specific grid to maximize LFG collection.
- The gas collection pipe work consists of pipes connecting groups of gas wells to the manifolds. Manifolds connect into a main pipe and then into the main header pipe delivering the gas to the extraction plant and the flare. The system is modular, so it is relatively easy to extend it on parts

of the landfill available for gas extraction in the future.

- The gas collection pipe work allows for effective condensate management by employing dewatering points at strategic low points and returning the condensate back to landfill.
- The system operates at pressure slightly lower than atmospheric. A blower(s) draws the gas from the wells through the collection system and delivers it to the flare. The system is optimized to address issues related to pressure losses.
- For efficient operation of the gas collection system, each landfill cell, where the gas is collected from, is covered by an impermeable material (high density polyethylene membrane or mineral material) to provide sufficient containment and prevent air ingress into landfill body.

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

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The total emission reductions of the project over the first crediting period of seven years are expected to be 205,112 tCO2e.

Table 1 - Estimated emissions reductions from the project.

Year	Annual estimation of emission reductions in tones of CO2e
2007 (from April 1st)	881
2008	9,352
2009	16,884
2010	27,997
2011	38,188
2012	47,786
2013	56,844
2014 (until March 31st)	7,180
Total estimated reductions (tonnes of CO2e)	205,112
Total number of crediting years	7
Annual average over the crediting period of estimated reductions tonnes of CO2e)	29,302

A.4.5. Public funding of the project activity:

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The project will not receive any public funding from Parties included in Annex I of the UNFCCC.

SECTION B. Application of a baseline methodology

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

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For the landfill gas part of the project activity: ACM0001 “Consolidated baseline methodology for landfill gas project activities” (version 4, 28 July 2006).

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

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ACM 0001 is applicable to landfill gas capture project activities, where the baseline scenario is the partial or total atmospheric release of the gas and the project activities include situations such as:

a) The captured gas is flared; or

b) The captured gas is used to produce energy (e.g. electricity/thermal energy), but no emission reductions are claimed for displacing or avoiding energy from other sources1; or

c) The captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reductions are claimed for displacing or avoiding energy generation from other sources. In this case a baseline methodology for electricity and/or thermal energy displaced shall be provided or an approved one used, including the ACM0002 “Consolidated Methodology for Grid-Connected Power Generation from Renewable”. If capacity of electricity generated is less than 15MW, and/or thermal energy displaced is less than 54 TJ (15 GWh), small-scale methodologies can be used.

This baseline methodology shall be used in conjunction with the approved monitoring methodology ACM0001 (“Consolidated monitoring methodology for landfill gas project activities”).

The project activity consists of capturing and flaring the landfill gas emitted in the project site. Therefore, situation A described above is chosen.

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

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	Source	**Spatial boundary**	**Gas**	**Included?**	**Justification**
Baseline	Landfill Gas	Landfill site	CH_4	Yes	CH_4 is produced in landfills
Project Activity	Electricity consumption	Brazilian Interconnected Grid (S-SE-CO)	CO_2	Yes	CO_2 is emitted for the consumption of electricity

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

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There is a passive venting system for biogas installed since the day it started to operate. This corresponds to the baseline scenario. In the absence of the project activity, large quantities of biogas (LFG), whose major contents are methane (CH_4) and carbon dioxide (CO_2), would be emitted to the atmosphere. So far, there is any obligations for an efficient treatment of the LFG in Brazil, neither a national model governing landfill practices. There is only technical norms as provisioned by the Brazilian Association of Technical Norms (ABNT), without any requirement regarding LFG management, besides gas venting.

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

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):

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In order to determine if the project activity is additional, the additionality tool approved by the Executive Board is applied, with the following steps:

Step 0:

Not applicable.

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

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

To define the alternatives to the project activity, there is a two-sided analysis, taking into consideration the perspective of the project owner and the perspective of the country.

From the project owner's perspective, the landfill operator could continue the current business as usual: final disposal of solid waste with the practice of passive venting (i.e., not collecting and flaring) LFG directly to the atmosphere. In Brazil, there is no legislation that obligates the landfill to destroy the methane, according with the baseline scenario.

From the country's perspective, the alternative for producing a similar amount of energy, as the one the landfill is to provide, would be to use current generation system.

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

The alternative, which is to continue with the business as usual situation before the decision of implementing this CDM project activity is consistent with Brazilian laws and regulations.

Step 2. Investment analysis

Following ACM0001 baseline methodology, it must be determined whether the proposed project activity is the economically or financially less attractive than other alternatives without the revenue from the sale of certified emission reductions (CERs). To conduct the investment analysis, the following sub-steps are used:

Sub-step 2a. Determine appropriate analysis method

As the CDM project activity involves only collection and flaring of the LFG and does not generate any financial or economic benefit other than CDM related income, the simple cost analysis scenario is applied.

Sub-step 2b. – Option I. Apply simple cost analysis

The costs of the project activity for the SANTEC Resíduos landfill are documented in the table below. Since there are no revenues other than CDM revenues, the project is demonstrably additional.

Table: Costs related to project activity in the SANTEC Resíduos landfill.

Cost	Amount (US$)	Frequency
Capital costs	727,273	Once
CDM Costs	9,374 (on average)	Annually
Operational costs	20,865 (on average)	Annually

By investing in a landfill gas collection and flaring systems, the Project would not generate any revenues in the absence of the CDM. Therefore, the project activity is not economically attractive and not a realistic baseline scenario.

Step 3. Barrier analysis

Not applicable.

Step 4. Common Practice Analysis

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

According to the latest official statistics on urban solid waste in Brazil – *Pesquisa Nacional de Saneamento Básico 2000* (PNSB 2000) – the country produces 228,413 tons of waste per day, which corresponds to 1.35 kg/inhabitant/day. And though there is a worldwide trend towards reducing, reusing and recycling, therefore decreasing the amount of urban solid waste to be disposed in landfills, the situation in Brazil is peculiar. Most of the waste produced in the country is sent to open dumps which are, in most of the cases, areas without any sort of proper infrastructure to avoid environmental hazards. The Figure below shows the final destination of waste per municipality, according to PNSB 2000.

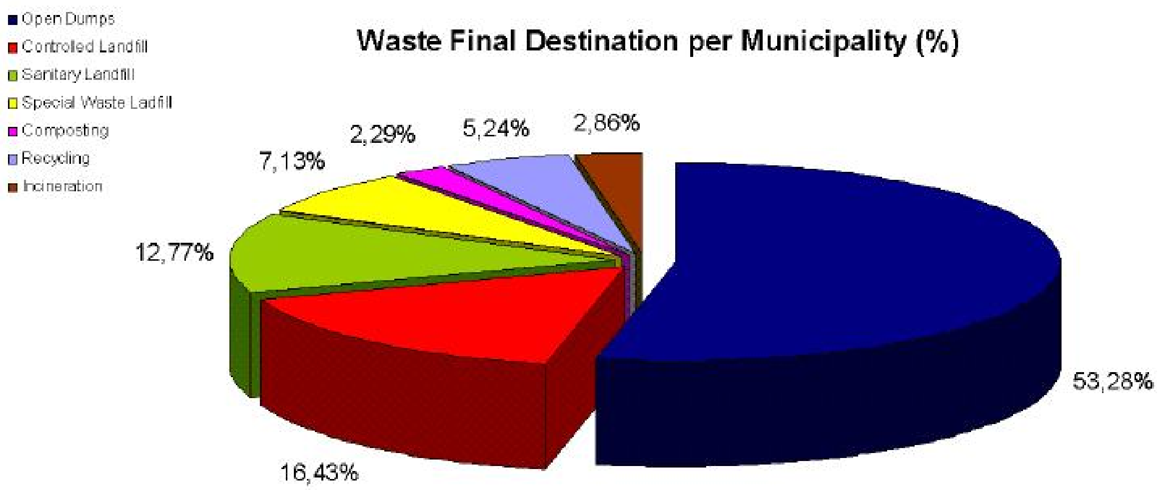

Figure 5 - Waste Final Destination per Municipality in Brazil (Source: PNSB, 2000).

Only few of the existing Brazilian landfills have installed a collecting and flaring methane system. The majority of landfills operate with natural emission of methane to the atmosphere, through concrete wells.

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

Some landfills in Brazil operate with forced methane extraction and destruction, using blowers, collection systems and flaring systems. All of them are registered CDM projects: Bandeirantes Landfill, Nova Gerar Landfill, Onyx Landfill, Marca Landfill, Salvador da Bahia Landfill and ESTRE Paulínia Landfill.

This kind of project activity is not widely spread in the host country and the landfills that operate this way represent only a small portion of the total existing landfills.

The installation of a LFG capture and flaring system, even an undeveloped one, are very costly for the landfill operator and bring no financial compensation.

Therefore, this kind of project is only possible with CDM revenues.

Step 5. Impact of CDM registration

The CDM can make possible for landfills to set up collection and flaring systems (and generate electricity to the grid) by helping to overcome financial barriers through the financial benefits obtained from CDM revenues.

The commercialization of the generated CER's represents the sole benefit of the project. Registration will reduce investment risk and foster the project owners into expanding business activities.

Therefore, the registration of the proposed project activity will have a strong impact in paving the way for similar projects to be implemented in Brazil, which may bring about, among other things, development in technologies. This kind of activity will be encouraged once this project activity gets registered.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The methodology ACM0001 requires that 'Project proponents should provide an ex ante estimate of emissions reductions, by projecting the future GHG emissions of the landfill. In doing so, verifiable methods should be used'.

The quantity of landfill gas flared by the project is estimated ex ante using the US EPA First Order Decay Model[1], using Lo (methane generation potential) and k (methane generation rate constant) values appropriate for Brazil. This ex ante estimate is only for illustrative purposes, as actual emissions reductions will be monitored directly, ex-post, according to the methodology.

The formulae used to calculate emissions reductions are detailed below.
The data used to determine the emission reductions in the project scenario are:

- Total amount of LFG captured
- Amount of LFG flared
- Methane fraction in the LFG
- Flare/combustion efficiency, determined by the operation hours (1) and the methane content in the exhaust gas (2)
- Temperature of the LFG
- Pressure of the LFG

According to ACM0001, version 4, 28 July, 2006, The emission reductions can be calculated using the following formula:

$$ER_y = \left(MD_{project,y} - MD_{reg,y}\right) \times GWP_{CH4} + EL_y \times CEF_{electricity,y} - ET_y \times CEF_{thermal,y} \qquad \textbf{(1)}$$

Where:

ER_y	: is emissions reduction, in tonnes of CO_2 equivalents (tCO_2e)
$MD_{project,y}$	: the amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH4)
$MD_{reg,y}$	: the amount of methane that would have been destroyed/combusted during the year in the absence of the project, in tonnes of methane (tCH4)
GWP_{CH4}	: Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4
EL_y	: net quantity of electricity exported during year y, in megawatt hours (MWh)
$CEF_{electricity,y}$	: CO_2 emissions intensity of the electricity displaced, in tCO_2e/MWh.
ET_y	: incremental quantity of fossil fuel, defined as difference of fossil fuel used in the baseline and fossil use during project
$CEF_{thermal,y}$	: CO2 emissions intensity of the fuel used to generate thermal/mechanical energy, in tCO_2e/TJ

As the landfill did not consume fossil fuel for energy requirements in the baseline, ET_y.= 0.

Determination of $MD_{project,y}$

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y} \quad (2)$$

Where:

$MD_{project,y}$: the amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH4)

$MD_{flared,y}$: is the quantity of methane destroyed by flaring

$MD_{electricity,y}$: is the quantity of methane destroyed by generation of electricity

$MD_{thermal,y}$: is the quantity of methane destroyed for the generation of thermal energy

Determination of $MD_{flared,y}$

$$MD_{flared,y} = LFG_{flare,y} \times w_{CH4,y} \times D_{CH4} \times FE \quad (3)$$

Where:

$MD_{flared,y}$: is the quantity of methane destroyed by flaring

$LFG_{flare,y}$: is the quantity of landfill gas flared during the year measured in cubic meters (m^3)

$w_{CH4,y}$: is the average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3CH_4/m^3LFG)

D_{CH4} : is the methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4)[1]

FE : is the flare efficiency (the fraction of methane destroyed)

Determination of $MD_{electricity,y}$

$$MD_{electricity,y} = LFG_{electricity,y} \times w_{CH4,y} \times D_{CH4} \quad (4)$$

Where:

$MD_{electricity,y}$: is the quantity of methane destroyed by generation of electricity

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

$w_{CH4,y}$: is the average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3CH_4/m^3LFG)

D_{CH4} : is the methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4)

Determination of $MD_{thermal}$

[1] At standard temperature and pressure (0 degree Celsius and 1,013 bar) the density of methane is 0.0007168 tCH_4/m^3CH_4.

$$MD_{thermal,y} = LFG_{thermal,y} \times w_{CH4,y} \times D_{CH4} \qquad \textbf{(5)}$$

Where:

$MD_{thermal,y}$	: is the quantity of methane destroyed for the generation of thermal energy
$LFG_{thermal,y}$	: is the quantity of methane gas fed into the boiler
$w_{CH4,y}$	: is the average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3CH_4/m^3LFG)
D_{CH4}	: is the methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4)

As the landfill does not generate neither electrical nor thermal energy, $\underline{MD_{electricity,y}}$ =$MD_{thermal,y}$ = 0.

Determination of MD_{reg}

$$MD_{reg,y} = MD_{project,y} * AF \qquad \textbf{(6)}$$

Where:

MD_{reg}	: the amount of methane that would have been destroyed/combusted during the year in the absence of the project, in, tonnes of methane (tCH4)
$MD_{project,y}$	: the amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH4)
AF	: Adjustment factor

Determination of EL_y

$$EL_y = EL_{EX,LFG} - EL_{IMP} \qquad \textbf{(7)}$$

Where:

EL_y	: net quantity of electricity exported during year y, in megawatt hours (MWh)
$EL_{EX,LFG}$	: net quantity of electricity exported during year y, produced using landfill gas, in megawatt hours (MWh)
EL_{IMP}	: net incremental electricity imported, defined as difference of project imports less any imports of electricity in the baseline, to meet the project requirements, in MWh

In this project, ELy = 0

The final formula is:

$$ER_y = \left[MD_{project,y} - \left(MD_{project,y} \times AF\right)\right] \times GWP_{CH4} + \left(EL_{EX,LFG} - EL_{IMP}\right) \times CEF_{electricity,y} - ET_y \times CEF_{thermal,y} \qquad \textbf{(8)}$$

Considerations:

- The landfill does not have any contractual obligations to burn methane; so MD_{reg}, y is calculated based on the “Adjustment Factor”, a value estimated as 20%;
- The GWP_{CH4} is 21 tCO_2/tCH_4;
- The landfill does not generate electricity, *so* $EL_{EX, LFG} = 0$.
- The landfill did not consume fossil fuel for energy requirements in the baseline, $ET_y = 0$.

So the formula is simplified to:

$$ER_y = \left(MD_{project y} - 0{,}2 MD_{project, y}\right) \times 21 + \left(0 - EL_{IMP}\right) \times CEF_{electricity, y} \qquad \textbf{(9)}$$

The estimative of the amount of landfill gas produced during year y is shown in E.4. The data used to determine the baseline scenario is presented in Annex 3.

Finally, we have,

$$ER_y = 0{,}8 MD_{project, y} \times 21 - EL_{IMP} \times CEF_{electricity, y} \qquad \textbf{(10)}$$

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

(Copy this table for each data and parameter)

Data / Parameter:	**Factor Used for Converting Methane to Carbon Dioxide Equivalents**
Data unit:	tCO_{2e}/tCH_4
Description:	Regulatory requirements relating to landfill gas projects.
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	Parameter defined within the methodology ACM0001 / version 4.
Any comment:	

Data / Parameter:	**Methane density**
Data unit:	tCH_4/m^3CH_4
Description:	Conversion factor
Source of data used:	ACM0001 / version 4
Value applied:	0.0007168
Justification of the choice of data or description of measurement methods and procedures actually applied :	Parameter defined within the methodology ACM0001 / version 4. This factor will be adjusted depending the on-site pressure and temperature conditions.

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

Data / Parameter:	11. $CEF_{electricity}$
Data unit:	tCO_2/MWh
Description:	CO_2 emission intensity of the electricity energy carrier.
Source of data to be used:	ONS (*Operador Nacional do Sistema Elétrico* – Operator of the Brazilian Electric System)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.2611 tCO_2/MWh
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	All support documentation, assumptions and/or calculation will be made available for review by a verifier.
Any comment:	For the first crediting period, emission factor will be calculated ex-ante.

B.6.3 Ex-ante calculation of emission reductions:

Considering that there is no leakage under ACM0001, SANTEC Resíduos landfill will generate emissions due to the electricity import for their operation.

$EL_y = EL_{IMP} \times CEF_{electricity,y}$.

EL_y = 631 tCO_2.

The Table 2 below shows the quantity of electricity imported and the project emissions:

Table 2 - Quantity of electricity imported and the project emissions in tCO2

Year	**Quantity of electricity imported (MWh)**	**Emission factor for the Brazilian Interconnected Grid (tCO2/MWh)**	**Estimation of emission reductions due Electricity displacement (tonnes of CO2e)**
2007 (From April 1st on)	1,813	0.2611	473
2008	2,418	0.2611	631
2009	2,418	0.2611	631
2010	2,418	0.2611	631
2011	2,418	0.2611	631
2012	2,418	0.2611	631
2013	2,418	0.2611	631

2014 (until March 31st)	604	0.2611	158
TOTAL	16,924		4,419

The calculation details are in annex 3.

Emissions reduction for the methane destruction component:

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

There is no generation of neither thermal energy nor electrical energy, so $MD_{electrical,y} = MD_{thermal,y} = 0$.

Thus,

$$MD_{project,y} = MD_{flared,y}$$

$$MD_{flared,y} = LFG_{flare,y} \times w_{CH4,y} \times D_{CH4} \times FE$$

Therefore,

$$MD_{project,y} = LFG_{flare,y} \times w_{CH4,y} \times D_{CH4} \times FE$$

Baseline emissions reductions for methane destruction are **209,531 tCO_2e** over first 7 years crediting period. The estimated results are expressed in the following table.

Table 3 - Estimation of total emission reductions

Year	Estimation of emission reductions due to methane destruction (tonnes of CO2e)	Estimation of project emissions due to electricity import (tonnes of CO2e)	Estimation of total emission reductions (tonnes of CO2e)
2007 (from April 1st)	1,354	473	881
2008	9,983	631	9,352
2009	17,515	631	16,884
2010	28,628	631	27,997
2011	38,819	631	38,188
2012	48,417	631	47,786
2013	57,475	631	56,844
2014 (until March 31st)	7,338	158	7,180
TOTAL	209,531	4,419	205,112

Values for this calculation are shown in Annex 3.

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

The estimated results are expressed in the following table.

Table 4 - Summary of the estimation of emission reduction

Year	Estimation of project activity emissions (tonnes of CO2e)	Estimation of baseline emissions (tonnes of CO2e)	Estimation of leakage (tonnes of CO2e)	Estimation of overall emission reductions (tonnes of CO2e)
2007 (from April 1st)	473	1,354	0	881
2008	631	9,983	0	9,352
2009	631	17,515	0	16,884
2010	631	28,628	0	27,997
2011	631	38,819	0	38,188
2012	631	48,417	0	47,786
2013	631	57,475	0	56,844
2014 (until March 31st)	158	7,338	0	7,180
TOTAL	4,419	209,531	0	205,112

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

B.7.1 Data and parameters monitored:

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

(Copy this table for each data and parameter)	
Data / Parameter:	1. LFG_{Total}
Data unit:	m^3
Description:	Total amount of landfill gas captured
Source of data to be used:	Measured by 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	Measured by a flow meter. Data to be aggregated monthly and yearly

applied:	
QA/QC procedures to be applied:	Uncertainty level: Low Flowmeter will be calibrated yearly, according to the brazilian standard *NBR 10396 - Medidores de vazão de fluidos* (Flowmeters). Flowmeters will be subject to a regular maintenance and testing regime in accordance with manufacturer specifications. Flowmeters available in the brazilian market have accuracy of +/- 1%.
Any comment:	

Data / Parameter:	2. LFG_{Flare}
Data unit:	m³
Description:	Amount of landfill gas sent of flares
Source of data to be used:	Measured by 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:	Measured by a flow meter. Data to be aggregated monthly and yearly
QA/QC procedures to be applied:	Uncertainty level: Low Flowmeter will be calibrated yearly, according to the brazilian standard *NBR 10396 - Medidores de vazão de fluidos* (Flowmeters). Flowmeters will be subject to a regular maintenance and testing regime in accordance with manufacturer specifications. Flowmeters available in the brazilian market have accuracy of +/- 1%.
Any comment:	

Data / Parameter:	**5. FE**
Data unit:	%
Description:	Flare/combustion efficiency, determined by the percentage of operation hours during the period for which the credits are required and the methane content in the exhaust gas.
Source of data to be used:	(1) The flare operation shall be continuously monitored by continuous measurement of operation time of flare using a run time meter connected to a flame detector or a flame continuous temperature controller, irrespective of whether the flare efficiency is monitored.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	95%
Description of measurement methods and procedures to be	(1) Continuously

applied:	
QA/QC procedures to be applied:	Uncertainty level: Medium Regular maintenance will ensure optimal operation of flares. Flare efficiency will be checked annually, with monthly checks if the efficiency shows significant deviations from previous values. The enclosed flares shall be operated and maintained as per the specifications prescribed by the manufacturer.
Any comment:	The enclosed flares (as in this Project) shall be operated and maintained as per measurement the specifications prescribed by the manufacturer.

Data / Parameter:	6. W_{CH4}
Data unit:	m³ CH4/m³ LFG
Description:	Methane fraction in the landfill gas
Source of data to be used:	Gas analyzer.
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:	Measured by a flow meter. Data to be aggregated monthly and yearly
QA/QC procedures to be applied:	Uncertainty level: Low The gas analyzer will be subject to a regular maintenance, testing and calibration regime in accordance with manufacturer specifications to ensure accuracy. Calibration will be done either manually or automatically on a weekly basis. Once a year the gas analyser will be calibrated by an independent company.
Any comment:	

Data / Parameter:	7. T
Data unit:	°C
Description:	Temperature of the landfill gas.
Source of data to be used:	Temperature sensor.
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:	Measured to determine the density of methane D_{CH4}.
QA/QC procedures to be applied:	Uncertainty level: Low The temperature gauge will be calibrated as per manufacturer recommendations. It will be subject to a regular maintenance, testing and calibration regime in accordance with manufacturer specifications to ensure accuracy.
Any comment:	

Data / Parameter:	8. P
Data unit:	kPa
Description:	Pressure of the landfill gas.
Source of data to be used:	Pressure sensor.
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:	Measured to determine the density of methane D_{CH4}.
QA/QC procedures to be applied:	Uncertainty level: Low The pressure gauge will be calibrated as per manufacturer recommendations. It will be subject to a regular maintenance, testing and calibration regime in accordance with manufacturer specifications to ensure accuracy.
Any comment:	

Data / Parameter:	10. EL_{IMP}
Data unit:	MWh
Description:	Total amount of electricity imported to meet project requirement
Source of data to be used:	Energy meter and receipt of electricity purchase
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2,418 MWh/year
Description of measurement methods and procedures to be applied:	The information about yearly consumption of electricity will be recorded by the project owner.
QA/QC procedures to be applied:	Uncertainty level: Low The meter will be subject to a regular maintenance, testing and calibration regime in accordance with manufacturer specifications to ensure accuracy.
Any comment:	

Data / Parameter:	11. $CEF_{electricity}$
Data unit:	tCO_2/MWh
Description:	CO_2 emission intensity of the electricity energy carrier.
Source of data to be used:	ONS (*Operador Nacional do Sistema Elétrico* – Operator of the Brazilian Electric System)
Value of data applied for the purpose of calculating expected emission reductions in	0.2611 tCO_2/MWh

section B.5	
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	All support documentation, assumptions and/or calculation will be made available for review by a verifier.
Any comment:	For the first crediting period, emission factor will be calculated ex-ante.

Data / Parameter:	13. Regulatory requirements relating to landfill gas projects
Data unit:	Test
Description:	Regulatory requirements relating to landfill gas projects
Source of data to be used:	n/a
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 information though recorded annually, is used for changes to the adjustment factor (AF) or directly $MD_{reg,y}$ at renewal of the credit period.
QA/QC procedures to be applied:	All support documentation, assumptions and/or calculation will be made available for review by a verifier.
Any comment:	

B.7.2 Description of the monitoring plan:

This section details the steps taken to monitor on a regular basis the GHG emissions reductions from the SANTEC Resíduos landfill gas capture project. The main components covered within the monitoring plan (MP) are:

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

The requirements of this MP correspond to the kind of information routinely collected by companies managing landfill gas collection and destruction systems, so following the calibration procedures shown in Table in section B7.1 should be simple and straightforward. If necessary, the MP can be updated and adjusted to meet operational requirements, provided that a Designated Operational Entity approves such modifications during the process of verification.

Monitoring for SANTEC Residuos landfill gas capture project will begin with the start of operation in April 2007. The monitoring plan details the actions necessary to record all the variables and factors required by the methodology ACM0001, version 4, 28 July 2006. All data will be archived electronically, and data will be kept for the full crediting period, plus two years. Monitoring and calibration procedures are shown in the Tables in section B7.1.

Credit owner and project operator, SANTECH (listed under A.3. Project participants), is author and the responsible for all activities related to the project management, registration, monitoring, measurement and reporting.

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

Date of completion: 15/12/2006
Person/entity determining the baseline:
Ecoinvest Carbon
Rua Padre João Manoel 222
01411-000 São Paulo – SP
Brazil

Francisco do Espírito Santo Filho
francisco@ecoinvestcarbon.com
Phone: +55 (11) 3063-9068
Fax: +55 (11) 3063-9069

Ecoinvest is the Project Advisor and also a Project Participant.

Detailed baseline information is attached in Annex 3.

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:

>>

31/March/2005.

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

>>

20 years

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

C.2.1. Renewable crediting period

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

>>

01/April/2007

C.2.1.2. Length of the first crediting period:

>>

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

Not applicable

C.2.2.2. Length:

>>

Not applicable

SECTION D. Environmental impacts

>>

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

>>

The proponent of any project that involves the construction, installation, expansion, and operation of any polluting or potentially polluting activity or any activity capable of causing environmental degradation is required to secure a series of permits from the respective state environmental agency. In addition, any such activity requires the preparation of an environmental assessment report, prior to obtaining construction and operation permits. Three types of permits are required. The first is the preliminary permit (*Licenca Prévia* or L.P.) issued during the planning phase of the project and which contains basic requirements to be complied with during the construction, and operating stages. The second is the construction permit (*Licença de Instalação* or L.I.) and, the final one is the operating permit (*Licenca de Operação* or L.O.).

The project has the necessary environmental licenses. The operating permit/license was issued by the state of Santa Catarina environmental agency, FATMA (*Fundação do Meio Ambiente*), LO no. 116/2006, issued on August 24th, 2006, valid for 48 months. All documents related to operational and environmental licensing are public and can be obtained at the state environmental agency (FATMA).

The installation of the LFG flaring component of the project activity must be communicated to local environmental authorities, but the project activity does not require a specific environmental assessment report or a new environmental permit.

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:

>>

Collection and flaring of landfill gas results in destruction of other gases besides methane. These emissions include over 150 trace components of volatile organic compounds and sulfur dioxides, among others (not considered in this assessment) that can cause odor nuisances, stratospheric ozone layer depletion, and ground-level ozone creation. Besides, emissions reduction of LFG can also have significant health and safety implications at the local level. For example:

- Although the majority of LFG emissions are quickly diluted in the atmosphere, in confined spaces there is a risk of explosion and/or fire, either within the landfill or outside its boundaries.
- Potential threat of concentrated emissions of LFG is asphyxiation and/or toxic effects in human beings.

The installation of a well-designed landfill gas collection and destruction system, and its proper operation, will therefore reduce the risks faced by the surrounding communities. It is part of a broader effort by the Municipal Government to continue improving its waste management practices. Overall, sustainable management of the landfills will result in accelerating waste stabilization, so that the full decomposition of the waste in the landfills will be complete within 30-50 years.

SECTION E. Stakeholders' comments

>>

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

>>

Public discussion with local stakeholders is compulsory for obtaining the environmental construction and operating licenses, and once the project already received the licenses, the project has consequently gone through a stakeholder comments process. The public audience took place in the community center Rio dos Anjos, on June 15th, 2004 (Figure 6).

Figure 6 - Public audience compulsory for obtaining the environmental permits.

The legislation also requests the announcement of the issuance of the licenses (LP, LI and LO) in the local state official journal (*Diário Oficial*) and in the regional newspaper to make the process public and allow public information and opinion.

Additionally, the Brazilian Designated National Authority for the CDM, *Comissão Interministerial de Mudanças Globais do Clima*, requires the compulsory invitation of selected stakeholders to comment the PDD sent to validation in order to provide the letter of approval.

The organizations and entities invited for comments on the project were:

– Içara City Hall
– Içara City Council.
– State of Santa Catarina Environmental Agency.
– Environmental Department of Içara
– Local community association : Associação de Moradores do Bairro Rio dos Anjos
– Santa Catarina State Public Attorney
– FBOMS – *Fórum Brasileiro de ONGs e Movimentos Sociais*

No concerns were raised in the public calls regarding the project.

Besides, during the called Global Stakeholders Process, the SANTEC Residuos landfill PDD will be kept available for comments in the United Nations Framework Convention on Climate Change website (http://www.unfccc.int/), where anyone will have access to the mentioned document from a legitimate source and will be able to express their opinion regarding the project activity.

E.2. Summary of the comments received:

>>

So far, a letter from FBOMS was received, suggesting the use of Gold Standard or similar tools.

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

>>

The project participants consider that requests made by the Brazilian Government are sufficient to be used as sustainable indicators which are attended by this CDM project activity.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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URL:	http://www.santecresiduos.com.br
Represented by:	
Title:	
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Represented by:	
Title:	
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Department:	
Mobile:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in the present project.

This project is not a diverted ODA from an Annex 1 country.

Annex 3

BASELINE INFORMATION

GHG emissions by sources in the baseline were estimated using the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Table 5 - Landfill calculation parameters

Parameter	Units	Value	Source
Landfill data			
Year landfill started operation	year	2005	**SANTEC Residuos Landfill**
Waste in place at the beginning of project	Tonnes	78,900	
Density of waste	tonne/m³	1,0	
Area of site	Ha	58	
Average daily waste rate	Tonnes/day	300	
Date gas collection project starts		1-Apr-07	
Operational data			
Gas collection efficiency[2]	%	70%	
Flare efficiency (FE)[3]	%	95%	
General data			
Lo	m³ CH_4/tonne	83	**IPCC[4]**
k	1/yr	0.09	
w_{CH4}	%	50	
CH_4 GWP	t CO_2/t CH_4	21	
D_{CH4}	Tonne/m³CH_4	0.0007168	
MCF	%	1.0	
Baseline data			
Proportion of methane flared in Baseline (Adjustment Factor - AF)[a]	%	20%	

a) The adjustment factor is the baseline for Brazilian CDM landfill projects. This factor was used in other registered landfill CDM projects.

2 Handbook for preparing LFG-to-Energy Projects in Latin America and the Caribbean (2003)

3 Options to Reduce Methane Emissions (1998)

4 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 5 - Chapter 3)

The Table 6 below presents the waste tonnage Options to Reduce Methane Emissions accepted at the SANTEC Residuos landfill.

Table 6 - Yearly waste disposal in SANTEC Residuos landfill

Year	Waste deposition[5] (tonnes)
2005	2,795
2006	78,900
2007	109,500
2008	146,000
2009	219,000
2010	219,000
2011	223,380
2012	227,848
2013	232,405
2014	237,053
2015	241,794
2016	246,630
2017	251,562

[5] In 2005, annual waste disposal data provided by SANTECH. Data for 2006 estimated by SANTECH.

Project emissions associated with electricity import:

For the electricity import component, the emissions of the project activity (PE_y, in tCO_2e) during a given year y are the product of the baseline emissions factor (EF_y, in $tCO2e/MWh$) times the electricity imported by the project in the baseline($EL_{IMP,y}$, in MWh), as follows:

$$PE_{y,electricity\_import} = EF_y \cdot EL_{IMP,y}$$

According to approved methodology ACM0002, version 6, May 19,2006:

"The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in $kgCO_2e/kWh$) calculated in a transparent and conservative manner:

(a) The average of the "approximate operating margin" and the "build margin", where:

(i) The "approximate operating margin" is the weighted average emissions (in $kgCO_2e/kWh$) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;

The "build margin" is the weighted average emissions (in $kgCO_2e/kWh$) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants. Project participants should use from these two options that sample group that comprises the larger annual generation. Power plant capacity additions registered as CDM project activities should be excluded from the sample group *m*. If 20% falls on part capacity of a plant, that plant is included in the calculation.

(ii)

or

(b) The weighted average emissions (in $kgCO_2e/kWh$) of the current generation mix.

(c) Approximate Operating Margin emission factor and the weighted average emission factor can be calculated using either of the two following data vintages for years(s) y:

• Option 1:
A 3-year average, based on the most recent statistics available at the time of PDD submission.

• Option 2:
The year in which project generation occurs, if emission factor is updated based on ex post monitoring.

(d) Build margin emission factor can be calculated using either of the following data vintages for years(s) y:

• Option 1
Most recent information available on plants already built at the time of PDD submission.

• Option 2
For the first crediting period, emission factor is updated based on ex-post monitoring. For subsequent crediting periods, Emission factor should be calculated ex-ante, as described in option 1 above.

The option chosen in this project is option (a). This choice is due to the fact that, in Brazil, even though most of the energy produced in the country comes from hydroelectric power, most of these low costs investments in hydro electrics are exhausted. Therefore, the possibility of investments in non-renewable sources arises, such as thermoelectric power plants. As thermal plants use fossil, these companies end up having higher operational costs than hydro plants. As a result, they are likely to be displaced by any hydro added to the grid.

As explained above, the baseline emission factor will be calculated as the average of the “approximate operating” margin and the “build margin”, where:

(i) The “approximate operating margin” emission factor ($EF_{OM,y}$) is the weighted average emissions (in $kgCO_2e/MWh$) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. Using the notation from approved methodology (ACM0002, 2006):

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$ **Equation 1**

Where:

- $\sum_{i,j} F_{i,j,y}$ is the amount of fuel *i* (in mass or volume unit) consumed by relevant power sources *j* in year(s) *y*,
- $COEF_{i,j}$ is the CO_2e coefficient of fuel *i* (tCO_2e/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y* and,
- $\sum_{j} GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*,

The CO_2e coefficient $COEF_i$ is obtained as,

$$COEF_{i,j} = NCV_i \cdot EF_{CO2,i} \cdot OXID_i$$ **Equation 2**

Where:

- NCV_i is the net calorific value (energy content) per mass or volume unit of fuel *i*,
- $OXID_i$ is the oxidation factor of the fuel *i*,
- $EF_{CO2,i}$ is CO_2e emission factor per unit of energy of the fuel *i*,

(ii) The “build margin” emission factor ($EF_{BM,y}$) is the weighted average emissions (in $kgCO_2e/MWh$) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants,

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$ **Equation 3**

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described above for the operating margin for plants *m* (sample group *m* defined in (ii)), based on the most recent information available on plants already built.

The baseline emission factor EF_y is the average of the operating margin factor ($EF_{OM,y}$) and the build margin factor ($EF_{BM,y}$),

$$EF_y = 0.5 \cdot EF_{OM,y} + 0.5 \cdot EF_{BM,y}$$ **Equation 4**

Table 7 - Emission factors for the Brazilian South-Southeast-Midwest interconnected grid (simple adjusted operating margin factor)

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	EF_{OM} [tCO2/MWh]	Load [MWh]	LCMR [MWh]	Imports [MWh]
2003	0.9823	288,933,290	274,670,644	459,586
2004	0.9163	302,906,198	284,748,295	1,468,275
2005	0.8086	314,533,592	296,690,687	3,535,252
	Total (2003-2005) =	906,373,081	856,109,626	5,463,113
	$EF_{OM, simple-adjusted}$ [tCO2/MWh]	$EF_{BM,2005}$	Lambda	
	0.4349	0.0872	λ_{2003}	
	Alternative weights	Default weights	0.5312	
	w_{OM} = 0.75	w_{OM} = 0.5	λ_{2004}	
	w_{BM} = 0.25	w_{BM} = 0.5	0.5055	
	Alternative EF_y [tCO2/MWh]	Default EF_y [tCO2/MWh]	λ_{2005}	
	0.3480	0.2611	0.5130	

Using the numbers in the Table above, *EFy*=0.2611 tCO_2/MWh

EL_{IMP} = 2,418 MWh

EL_y = 631 tCO_2.

Annex 4

MONITORING INFORMATION

From the monitoring methodology, it could be seen that there are five main variables to be measured:

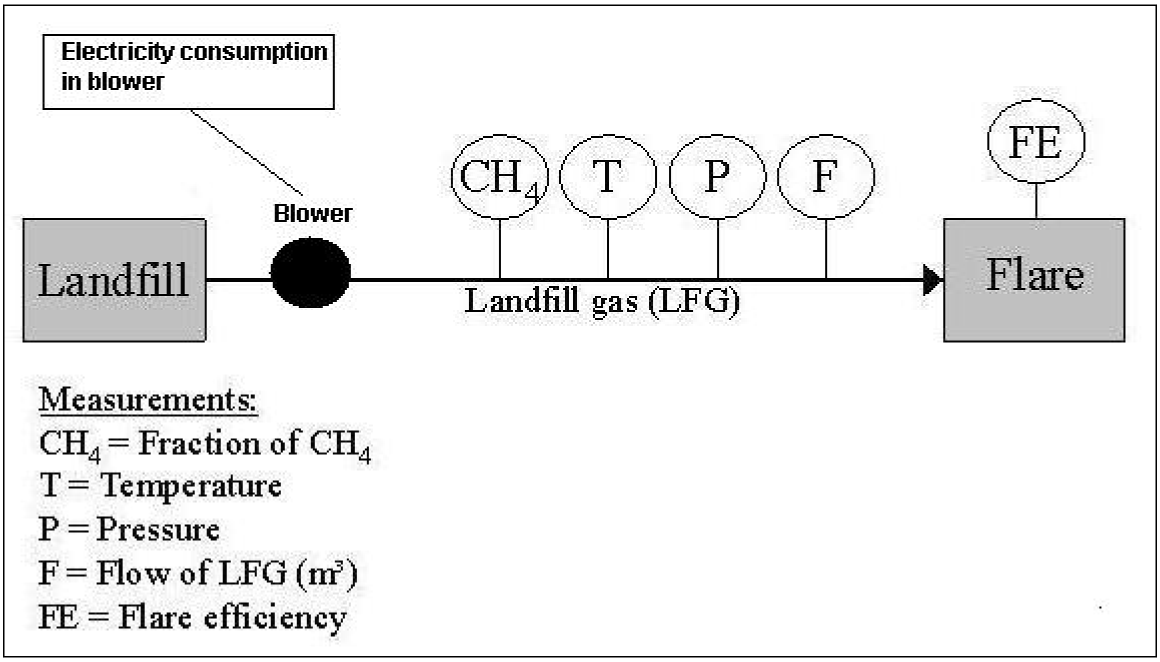

Figure 7 - Monitoring plan – Illustrative Picture

- The amount of landfill gas being sent to flares (F);
- The amount of methane in the landfill gas (CH_4);
- The flares' efficiencies (FE).
- The pressure of the gas (P);
- The temperature of the gas (T);
- Project activity electricity consumption, in MWh (Blower).

The project is installed with most up-to-date equipment to perform measures continually and allow for remote access to equipment and data. The system equipments are connected through a Programmable Logic Control tool that lets operators quickly check the unit's main variables through a user-friendly interface. Through the PLC, users have also access to continuously measured data, such as methane content in the landfill gas and the methane flows.

The amount of landfill gas being sent to flares

The amount of landfill gas generated (in m³, using a continuous flow meter), where the total quantity ($LFG_{total,y}$) is measured continuously. Using data of the temperature and pressure, the flow is converted to Nm³ (methane in the normal conditions – 0°C and 1,013 bar) and multiplied by the methane percentage into the landfill gas (measured for continuous gas analyzer) to result Nm³ methane. Discounting such number by 20% (Effectiveness Adjustment Factor), the emission reductions from the project are determined.

The amount of methane in the landfill gas
The fraction of methane in landfill gas (wCH_4) should be measured with a continuous analyzer or, alternatively, with periodical measurements, at a 95% confidence level, using calibrated portable e gas meters and taking a statistically valid number of samples and accordingly the amount of landfill gas from LFG_{total} shall be monitored in the same frequency. The continuous methane analyzer should be preferred option because the methane content of landfill gas captured can vary by more than 20% during a single day due to gas capture network conditions (dilution with air at wellheads, leakage on pipes, etc.).

The flares' efficiencies:
The flare efficiency will be calculated as product of (i) fraction of time the gas is combusted in the flare; and (ii) the efficiency of the flaring process. Efficiency of the flaring process is defined as fraction of methane completely oxidized by the flaring process, with the first measurement to be made at the time of installation. The measured value of the efficiency of the flare will be applicable for the period up to the next measurement. In case the yearly measurement of efficiency of the flare is not performed, the efficiency of the enclosure flare, as the one used in this Project Activity, will be a default value of 90%. If the last measured value of the efficiency of the flare is lower than 90%, then the last lower measured value will be used.

The pressure and temperature of the gas:
The pressure and temperature will be measured by continuous analyzers to determine the density of the methane.

Project activity electricity consumption, in MWh.
The amount of electricity consumed for the project activity will be monitored by an electricity meter

Annex 5

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