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:

Lixo Zero Composting Project
PDD Version Number 3
11/09/2008

A.2. Description of the project activity:

The Lixo Zero Composting Project (hereafter, the "Project") developed by Ambiental Lixo Zero Ltda. (hereafter referred to as the "Project Developer") is a composting of organic waste project in Duque de Caxias City, State of Rio de Janeiro, Brazil, hereafter referred to as the "Host Country".

The Project Developer is a Brazilian company that was created to deal with environmental projects, mainly in the waste management area. This company is increasing its operations and will, in the future, be able to manage projects encompassing environmental rehabilitation, conservation and education as well as the various stages of waste management including recycling and final disposal.

This project activity intends to aerobically compost organic waste (fruits and vegetables) supplied by supermarkets, street markets and agro-product retailers in the areas near the Project Developer. This waste will be turned into organic fertilizers to be sold for use in organic agriculture (displacing the use of chemical products).

As with many developing countries, the destination of this waste in the majority of Brazil's cities is its landfills. And as there is no Brazilian regulation obliging landfill gas capture, most of these landfills do not take any methane emissions avoidance measures.

The Project has a forecasted average daily input of 500 tones per day of organic waste, reaching about 150 000 tonnes of organic waste processed per year. This amount is expected to generate about 90 000 tonnes of product per year. As the entire capacity of the project is not fully defined, there could be changes in this number. An increase of capacity after the first months of operation is expected.

The main benefit of this Project, both environmental and social, is to give an alternative treatment to waste that was going to be dumped in landfills. The compost also replaces the fertilized soil which is commonly used instead, making this soil available for other uses.

Moreover, the Project is helping the Host Country fulfill its goals of promoting sustainable development. Specifically, the Project:

- Prevents uncontrolled GHG emissions from waste that would have been disposed of at a landfill;
- Reduces the amount of land used for waste dumping and improves public sanitation by eliminating the problem of disposal of organic wastes in surrounding areas;
- Prevents water and air pollution;
- Provides a product that can be used in organic agriculture (resulting in more healthy agro-products) and can minimize or battle against soil degradation;

- Increases employment opportunities in the area where the Project is located, both temporary (during installation works) and permanent (to operate the composting plant);
- It will strengthen Brazil's economy by contributing with additional employment, a waste disposal alternative and taxes;
- It will demonstrate replicable clean and efficient technology, and conserves natural resources

A.3. Project participants:

Name of Party involved (*)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant
Brazil (host)	Ambiental Lixo Zero Ltda.	No
United Kingdom of Great Britain and Northern Ireland	EcoSecurities Group Plc	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.

EcoSecurities Group Plc. is the official contact for the CDM project activity. Further contact information for the project participants are provided in Annex 1 of this document.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil (host country)

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

Southeast Region, State of Rio de Janeiro

A.4.1.3. City/Town/Community etc:

Duque de Caxias City, Xerém District (4th District), Parque Capivari Neighborhood.

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

The Project is located at the Ambiental Lixo Zero site, located in Parque Capivari Neighborhood, Xerém district, in the municipality of Duque de Caxias, State of Rio de Janeiro (Estrada Velha do Pilar, 2037, CEP: 25231-000). Coordinates are: 22º40'20"S 43º17'58"W. See below for a map of the State of Rio de Janeiro.

Figure: Physical location of Duque de Caxias City (red), in the State of Rio de Janeiro, Southeast Brazil[1].

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

According to Annex A of the Kyoto Protocol, this Project fits in Sectoral Category 13 (Waste Handling and Disposal)[2].

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

According to Monteiro (1999, *apud* Azevedo, 2000), there are two possible ways to perform a composting process: anaerobic and aerobic. Below is described the basic reaction and products of both:

Anaerobic process

Organic Matter + Microorganisms → CO_2 + H_2O + CH_4 + NH_3 + Other Reduced Products + Microorganisms

Aerobic process

Organic Matter + Microorganisms + O_2 → CO_2 + H_2O + Other Oxidized Products + Microorganisms

The composting process used in this project activity is based on the aerobic decomposition of the organic matter. Besides the numerous benefits of composting, the aerobic process produces fewer unpleasant odors and does not generate methane.

The technology applied is based on the use of specific co-factors together with microorganisms (Biocatalyst Agents) that promote the reduction of cellulose and other organic compounds, as well as activating the solubility of minerals.

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[1] http://pt.wikipedia.org/wiki/Duque_de_caxias

[2] http://cdm.unfccc.int/DOE/scopes.html#1

The Biocatalyst Agent is patented in the USA (USPTO) and Brazil (INPI). Its use is recognizably efficient and is a result of Brazilian Research.

It consists in the exploitation of organic residues and minerals, transforming them into a stabilized form of organic matter that make up the compost which is then used as fertilizer in domestic and commercial agriculture. The procedure is in compliance with all applicable legislation. All new staff will be trained in order to ensure an adequate implementation of the technology used.

The technology proposed for the composting plant can be regarded as a new technology to the State of Rio de Janeiro, to the southeast region and to Brazil. Moreover, few other similar technologies that provide a similar product (composting product to be used as fertilizer) are allowed and certified to be used in organic agriculture. The technology uses a different kind of organic matter, different technology and provides a different kind of product.

The company is certified by Ecocert Brasil, a subsidiary of Ecocert S.A. specialized in the certification of organic products, to produce organic compounds to Brazilian and European Union standards. This fact shows the commitment of this company to the chosen technology and demonstrates that the technology can work as expected.

The generation of wastewater is small. It will be directed to a small reservoir and sprayed on the composting piles frequently to adjust the moisture content of the piles, so that this wastewater does not generate methane.

The composting plant is designed for a processing capacity of 1000 tonnes of waste per day, mostly composed of fruit and vegetables. However, an average of 500 tonnes daily is expected. An expansion of the facility is forecasted for the future, but there is no estimation of time to perform this expansion (it would expand the processing capacity to about 1 500 tonnes of waste per day).

The basic procedure for this technology is detailed below:

- Sorting the organic waste that comes to the company manually to avoid inorganic compounds (such as plastic) entering the composting process;
- The waste, after passing through the filter system, is transported to the composting slot. It is in this pathway that the microorganisms and other products are added;
- Type of aeration: the composting pile will be regularly aerated with forced blowing (using a gas compressor) in order to increase oxygen content inside the composting slot where the aerobic process occurs;
- The composting slot will have key parameters monitored as stated in section B.7.1, such as oxygen content (higher than 10%), temperature (50~60ºC), etc;
- One tonne of organic waste net input will result approximately 600 kg of compost;

This technology is differentiated from others technologies used in Brazil because of the following points:

- The extraordinary speed of the transformation of the waste. The product is transformed within 72 hours;
- Other chemicals can be added to the final compost, adapting the product to specific needs;
- It allows the culture of organic food, free of artificial fertilizers, human waste, or sewage sludge;
- Its production chain is certified by international standards;

- The final compost has beneficial complex microorganisms that interact with the soil, promoting an increase of meso and microfauna.

Therefore, it is proven that this technology is safe and sound, with no associated negative impacts.

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

The project activity aims to reduce GHG emissions by avoiding the production of methane in landfills. This goal is achieved by avoiding dumping organic matter at the landfill and, instead, treating this waste aerobically.

Table 2 - estimated emissions reductions from the Project

Years	Annual estimation of emission reductions in tonnes of CO2e
May 2009 - Apr 2010	26710
May 2010 - Apr 2011	47357
May 2011 - Apr 2012	62120
May 2012 - Apr 2013	72835
May 2013 - Apr 2014	80748
May 2014 - Apr 2015	86705
May 2015 - Apr 2016	91285
Total estimated reductions (tonnes of CO2e)	467759
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	66823

A.4.5. Public funding of the project activity:

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

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 Project uses approved methodology AM0025 ("Avoided emissions from organic waste through alternative waste treatment processes"), Version 10.1, Valid from 02 Nov 07 onwards.

For demonstration of additionality, AM0025 refers to the "Tool for the demonstration and assessment of additionality", Version 05.2, EB 39 Meeting Report.

For methane avoidance component, AM0025 refers to the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site", Version 4, EB 41 Meeting Report.

For calculations of Grid Emission Factor, AM0025 refers to the "Tool to calculate the emission factor for an electricity system", Version 01.1, EB 35 Meeting Report.

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

The Project meets all the applicability criteria as set out in the methodology. AM0025 is applicable where:

- The project activity involves a composting process in aerobic condition;
- The produced compost is used as soil conditioner;
- The proportions and characteristics of different types of organic waste processed in the project activity can be determined;
- Waste handling, in the baseline scenario, shows a continuation of current practice of disposing the waste in a landfill (more information in section B.5);
- The project activity does not involve treatment of either industrial or hospital waste.

The project activity meets all the conditions above and is therefore applicable to the methodology.

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

According to AM0025 baseline methodology, the spatial extent of the project boundary is the site of the project activity where the waste is treated. This includes the facilities for processing the waste, on-site electricity consumption, onsite fuel use, waste water treatment plant and the landfill site. The project boundary does not include facilities for waste collection, sorting and transport to the project site.

The following project activities and emission sources are considered within the project boundaries:

For the Baseline, the emission of GHG includes:

- CH_4 emissions from decomposition of waste at the landfill site.

For the Project activity, the emission of GHG includes:

- CO_2 emissions from consumption of fossil fuel on site.

- CO_2 emissions from consumption of electricity from the grid on site.
- CH_4 emissions due to waste processing.
- NO_2 emissions due to waste processing

Table: Sources and gases included in the project boundary

	Source	Gas	Status	Justification / Explanation
Baseline	Emissions from decomposition of waste at the landfill site	CH_4	Included	The major source of emissions in the baseline
		N_2O	Excluded	N2O emissions are small compared to CH4 emissions from landfills. Exclusion of this gas is conservative.
		CO_2	Excluded	CO2 emissions from the decomposition of organic waste are not accounted.
	Emissions from electricity consumption	CO_2	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Emissions from thermal energy generation	CO_2	Excluded	No thermal energy consumption in the baseline.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	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	Included	It includes mainly vehicles used on-site.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from onsite electricity use	CO_2	Included	There is electricity consumption from the grid.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Direct emissions from the waste treatment processes.	N_2O	Included	May be an important emission source for composting activities. N2O is emitted during anaerobic digestion of waste.
		CO_2	Excluded	CO2 emissions from the decomposition or combustion of organic waste are not accounted.
		CH_4	Included	The composting process may not be complete and result in anaerobic decay.
	Emissions from waste water treatment	CO_2	Excluded	CO2 emissions from the decomposition of organic waste are not accounted.
		CH_4	Excluded	The wastewater treatment do not result in CH4 emissions.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.

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

The approved baseline methodology AM0025 will be used to identify the baseline scenario.

Table – Key information and data used to determine the Baseline Scenario

Variable / Information	Unit / Type	Source
Forecasted and Contracted Suppliers of Waste	-	Contracts and Project Developer Information
Main practices of Waste Disposal in Brazil	National Researches	IBGE (2002) – National Research on Basic Sanitation ABRELPE (2006) – Overview of Solid Residues in Brazil
Applicable Laws and Regulations	Text	National and Regional legislation

Step 1: identification of alternative scenarios.

Step 1 of the "Tool for the demonstration and assessment of additionality" is used to identify all realistic and credible alternatives to the project activity. This step is described below.

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

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

Both heat and electricity are the same in all scenarios, as the present project activity does not comprise any changes in these components. In Baseline and Project scenarios, the electricity is bought from the Brazilian Interconnected Grid and there is no need for heat. With the same purpose of waste treatment, the alternatives below are identified as realistic:

Alternative 1: The proposed project activity without CDM. Organic waste composting identical to the proposed Project, but not undertaken as a CDM project activity. Methane production would be avoided by breaking down organic matter through aerobic processes. Composting activities includes processes of waste separation, composting, aeration and monitoring, which requires a good level of technology and, therefore, a high initial capital investment and associated operational and maintenance costs. Moreover, the sales of generated compost face marketing risks.

Alternative 2: Continuation of current practices. Disposal of the waste on a landfill (in this case, Gramacho Landfill) without the capture of landfill gas. As this is the regular practice in Brazil and, more specifically, in the Rio de Janeiro municipality, this alternative does not face problems to its continuation.

Alternative 3: Disposal of waste at a landfill where the landfill gas captured is flared. Methane production would be increased and the gas flared without generating electricity or heat. This alternative requires reliable technology and additional investment without any benefits.

In principle, solid waste could be disposed off in other ways, e.g. incineration, conversion to Refuse-derived fuel (RDF), thermochemical gasification, and biomethanation. None of these are realistic alternatives for the project proponents. These alternatives involve advanced processes for treatment of solid waste; require very large investments and high operating costs compared to the alternatives mentioned above. Finally, there is only limited experience with these alternative processes in Annex 1 countries, and almost none in non-Annex 1 countries, except for a handful of projects being submitted through the CDM.

Sub-step 1b. Consistency with mandatory laws and regulations:
According to the tool, the alternatives shall be in compliance with all mandatory applicable legal and regulatory requirements (excluding national and local policies that do not have legally-binding status). According to the baseline methodology, relevant policies and regulations related to the management of landfill sites should be taken into account.

According to IBGE (2002), from a total estimated volume of garbage collected in Brazil (161,827.1 t/day) 47.1% of the collected garbage was dumped in sanitary landfills, 22.3% was dumped on "controlled" landfills and 30.5% was dumped on "Garbage dumping sites" without any control.

Neither Brazilian State nor County legislation requires landfill gas to be captured, burned or used and there are no signs that plans to change this currently exist. The focus is on improving the adequacy of dumping in order to avoid environmental contamination caused by leakage from waste residues reaching water and soil. The positive impact of this focus has been huge in recent years: in 1989 only 10.7% of the collected garbage was dumped on Sanitary or Controlled landfills compared with 69% in the year 2000.

Within these circumstances, improvements in landfill gas collection and combustion in Brazil entail financial costs that undermine aims to reduce GHG emissions. There is no project activity implemented in Brazil with forced methane extraction and destruction, using blowers, collection system and flaring system, without the CDM incentive. However, there are CDM project activities that do so, including the Bandeirantes, Nova Gerar, Onyx, Marca, Sertãozinho, Salvador da Bahia, Paulínia, Caieiras, Lara, São João, Anaconda, Central de Resíduos do Recreio, Canabrava, Aurá, Quitaúna, Itapevi, Feira de Santana and João Pessoa Landfills, among others.

Step 2: Identify the fuel for the baseline choice of energy source taking into account the national and/or sectoral policies as applicable.
As there is no production of electricity/heat comprehended in the baseline of the project activity, there is no need to identify baseline energy source. There is no fuel used in the Baseline. For this project activity, there is only the consumption of energy/fuel. Therefore, this step is not applicable.

Step 3: Step 2 and/or step 3 of the "Tool for demonstration and assessment of additionality"
In order to assess which of the realistic alternatives should be excluded from further consideration; step 3 of the tool is chosen to demonstrate the baseline scenario. As provided in section B.5 below, alternative 1 (proposed project activity without CDM) has major investment and technological barriers and therefore is not the baseline scenario.

The most plausible baseline scenario for the waste treatment component is identified as the disposal of the waste in a landfill without capture of landfill gas (as per Baseline scenario 1, stated in the methodology AM0025)

The municipality of Rio de Janeiro uses two landfills for waste disposal: Gramacho landfill and Gericinó landfill, both already operating above their full capacity. As the latter is by far the smaller, it receives less then 30% of the waste from Rio de Janeiro and has almost the same conditions of operation as Gramacho. Considering the fact that there is less available information about Gericinó, we considered it a reasonable approach to use Gramacho landfill to represent the situation of waste disposal practices in the proposed baseline scenario. As can be seen in the facts stated in "*Sub-step 1b*" above, in the case of the creation of any other landfill the assumption that this new landfill would destroy or capture LFG without CDM incentives is not plausible, since there are no laws to enforce emission reductions from this source and LFG capture and destruction is not a common practice in the host country. **Therefore, there is no**

reason to believe that Alternative 3 would happen and thus this alternative will be excluded from further analysis.

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 event that marks the starting date of the project activity is the beginning of contractual negotiation with the Carbon Advisory Company (i.e. EcoSecurities). As the decision to go ahead with the project in spite of the risks was made considering carbon credits revenues, EcoSecurities provided the means to fulfill the alternative waste treatment goal. The signature of the contract was 14/09/2006 and this is considered the CDM consideration date. The actual starting date of the project is the issuance date of the Operation Environmental License, i.e. 06/07/2007. Therefore, this project is in compliance with paragraph 13 of Decision 17/CP.7. More details regarding this timeline can be found below.

Event	Approximate Time	Explanation
Requesting Environmental Operational License	End 2004	The plant needed this license to start its operation. However, the installation of equipments was not finished. They needed money to buy lots of equipments and even the equipments bought had problems when the technology was being tested.
End of Financial Resources	End 2005	As the company was not able to request financing, bankruptcy was a reality in this time. The many tests that the company needed to adapt the technology were consuming its already little resources.
Presented CDM possibilities	Mid 2006	Lixo Zero started considering possible CDM revenues as a way to guarantee their investment in the company. Meetings with EcoSecurities staff pointed out a positive sign for this intention.
Contract with EcoSecurities Signed	End 2006	After negotiations, the contract was signed. The installation of equipments, delayed in the past, could start again because now the project developer would have his investments returned.
Delays in Environmental license	Beginning 2007	More delays to get the environmental license led to consequent delays in CDM revenues, culminating in another wave of pessimism in the project developer.
Envirnomental License received	Mid 2007	Only at this time EcoSecurities could assure that the project was really going forward.
PDD development Starts	End 2007	After a thorough evaluation regarding additionality and real potential of emission reductions, EcoSecurities started developing the PDD. At this time financing request was not an option, because the company did not have any guarantees to give to BNDES in order to assure the payment.

The project activity could not be carried out without carbon credit revenue as it involves a technology that is not a common practice in the disposition of waste, state of the art in the host country, and with several associated risks. It is demonstrated in this section that the proposed project activity is additional as per options provided under the "Tool for the demonstration and assessment of additionality", as requested by AM0025.

Three alternatives were evaluated in order to demonstrate the baseline scenario, as shown in section B.4 above. However, Alternative 3 (Disposal of waste at a landfill where the landfill gas captured is flared) is not a viable alternative, because it is not economically practical as a business operation, as it implies higher additional investments with no additional revenues, and would involve much more risk, capital and work than this project activity, what makes this alternative non-realistic. In order to demonstrate that the proposed project activity is additional to the baseline scenario chosen, a Barrier Analysis and a Common Practice Analysis are performed below.

Table: Scenarios considered to Additionality Tool.

Scenarios	Description
Alternative 1	Proposed project activity without CDM
Alternative 2	Continuation of current practice

Step 3. Barrier Analysis

Evidence for why the proposed project is additional is offered under the following categories of barrier: (a) investment/economic barrier and (b) technological barrier. The result is a matrix that summarizes the analyses, providing an indication of the barriers faced by each scenario; the most plausible scenario will be the one with the fewest barriers.

Sub-step 3a: Identify barriers that would prevent the implementation of the proposed CDM project activity:

Establish that there are realistic and credible barriers that would prevent the implementation of the proposed project activity from being carried out if the project activity was not registered as a CDM activity.

Technological barrier– This barrier evaluates whether the technology is currently available, if there are locals skilled in its operation, if the application of the technology is a regional, national or global standard, and generally if there are technological risks associated with the particular project outcome being evaluated.

Alternative 1 – The proposed project uses technology new to the host country, resulting in difficulties associated with dominating the technology and proving that the technology is viable.

The Project Developer’s composting process uses a unique technology to produce their organic compost, as described in section A.4.3. It uses Biocatalysts Agents to increase the speed of the composting, reducing the lag-time for transforming the waste into compost. This technology is patented by USPTO (United States) and INPI (Brazil). The composting technology being new to the region meant that the company owners encountered many problems that hindered the project’s successful implementation.

Several problems arose during the installation of the pilot plant. As the technology is not well known in Brazil, the company had problems obtaining the Environmental Operational License, because the Environmental Authority did not know how to classify the enterprise. The environmental licensing process took more time than other environmental license applications, with consequently delayed the project and prevented the Project Developer from establishing a supply chain of waste in the Project’s initial stages.

Another problem associated with the technology was unforeseen expenses. At the start of the Project, the technology was new to the project developer. It took them several months to become familiar with the technology and to learn how best to operate it. Moreover, the equipments used to process the waste before composting (shredders, mixers and conveyor belts) were developed, built and tested by the project developer using essentially trial-and-error methods. During this learning process, money was being spent, resulting in costs about six times the initial budget. In addition this process led to yet more delays in the installation of the pilot plant. According to IPT (2000), one of the major barriers to operating composting plants in Brazil is the lack of management and/or operational know-how to conduct the activities.

Because of the uncertainty regarding the technology, the Project Developer was not able to acquire financing. Even the CDM process was delayed due to this fact, because the Project Developer did not have an environmental license and the technology was not well proven. Therefore, the doubts over possible financing sources for the Project's technology left the Project Developers no choice but to go forward with their own resources.

Therefore, there was a technological barrier due to the fact that the technology used in this project activity needed to be completely understood by the Project Developer and by the authorities in the host country before installing the pilot plant, which lead to delays and high expenses that had to be paid using their own resources.

Economic barrier – This barrier evaluates the viability, attractiveness and economic risks associated with each scenario, considering the overall economics of the Project and/or economical conditions in the country.

Alternative 1 – The proposed Project had problems in obtaining financing.

As described in the technological barrier below, the technology used by the Project Developer is a new technology for the region where the Project is located. As a new technology, it needed time and money to function the way it was intended to. However, the company was not able to request financing from the main project financer in Brazil (i.e. BNDES - *Banco Nacional de Desenvolvimento Econômico e Social*) because this organization requests the compliance with environmental legislation applicable before providing financing[4] and, as the project developer did not have the environmental operational license, it could not be considered as in compliance with environmental legislation.

The Project Developer requested the license from the relevant environmental authority (i.e. Feema - *Fundação Estadual de Engenharia do Meio Ambiente*) on 04 December 2004. However, the operational license was emitted on 06 July 2007, 31 months after the initial request. This extremely long licensing process is due to the fact that the environmental authority did not know how to deal with the technology used.

Because of this huge delay, the company did not have time to request financing and had to start the construction of the installations without any financing. The carbon credits project itself was delayed because of the operational license, being one more source of financing that could not be acquired.

Another fact that hindered the request for financing was that Ambiental Lixo Zero Ltda. is a very small company and did not have any assets to provide as guarantee for the financing. BNDES needs an equity

[4] Please check http://www.bndes.gov.br/produtos/faq/bloco1.asp#perg16 for prerequisites to request financing.

guarantee in order to accept a request for financing and the company was unable to provide this crucial item. This, together with the lack of an operational license, spoiled all intentions of financing that the company had.

Besides this financing problem, there is the difficulty of selling the compost to a market not used to buying this kind of product. The consumers of fertilizers in Brazil tend to buy fertilized soil (where soil is mixed with animal feces, mainly from chicken and cattle), which is cheaper than fertilizers made by composting companies. Bearing in mind all the economic and social problems in Brazil, convincing the consumer that a new expensive product is better than a cheaper product they are already accustomed to using is a very difficult task. It involves time and money in advertisement, as well as distributing product samples to try to enter the market. Ambiental Lixo Zero Ltda. needs to donate compost (while not receiving an income) to companies and consumers to try and sell it in the future and convince those consumers that the product is as good as the traditional one. As this company is a very small one that has as its only source of income the sale of compost, all these difficulties culminated in lots of expenses and no financing at the start of its installation. According to IPT (2000), the argument for the "profitability" of the composting plant (presented many times to public or private decision makers) is not sound, as the sales of the compost do not cover the operational and financial expenses or investment.

Cultural barrier – This barrier evaluates any other major barrier applicable to the proposed project activity.

Alternative 1 – There is a cultural barrier for not using compost as fertilizer in the host country. Brazil has an extremely developed agricultural sector, with several large companies operating in this sector. However, the majority of the agriculture practiced in Brazil comes from traditional producers, manly big land owners that have been using their land for agriculture for a long time. And they already are used to fertilizers others than compost and traditional farmers are not easily convinced that another "new" kind of fertilizer is better than the one they are accustomed to use.

Moreover, the reputation of compost in Brazil is not good. The quality of fertilizer from composting units in Brazil was, historically, very poor; and the amount of this kind of fertilizer available in the market was extremely low. As shown by the common practice analysis in the PDD, even today in Brazil there are very few composting units.

Following this rationale, a research from EMBRAPA (from Portuguese: Empresa Brasileira de Pesquisa Agropecuária – a respected federal institution) (Pires, 2006) corroborates the argument of low quality compost. It states that the problems with the compost are related mainly to three factors:

1) the poor quality of the residues used to make the compost and to poorly managed composting processes;
2) the presence of heavy metals in the waste used to make the compost and, therefore, in the final compost as well;
3) the presence of pathogens in the compost.

As said in the investment barrier above, according to IPT (2000), the argument for the "profitability" of the composting plant (presented many times to public or private decision makers) is not sound, as the sales of the compost do not cover the operational and financial expenses or investment. One of the reasons for this is cultural. Most of the time the business plan for a composting plant considers the sale of

the entire production of compost. However, this is not an easy task as consumers usually avoid buying compost as fertilizer. It takes time for the composting plant be successful in selling its production.

The proposed project activity intends to change this wrong and outdated culture already established in Brazil that compost is bad as fertilizer. Therefore, all these three aspects were severely evaluated in order to provide excellent quality compost.

Sub-step 3 b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

Economic barrier – This barrier evaluates the viability, attractiveness and financial and economic risks associated with each scenario, considering the overall economics of the Project and/or economical conditions in the country.

Alternative 2 – The continuation of the practice of dumping the waste in landfills would not have any financial barriers, as this is common practice in the host country. There are no problems with technology and licensing, and it is a very cheap practice when compared to composting. Therefore, there would not be any investment constraints in this alternative.

Technological barrier– This barrier evaluates whether the technology is currently available, if there are locals skilled in its operation, if the application of the technology is a regional, national or global standard, and generally if there are technological risks associated with the particular project outcome being evaluated.

Alternative 2 – The continuation of the practice of dumping the waste in landfills would not have any technological issues, as this practice is very well known by the Host Country. Therefore, there would not be any technological constraints in this alternative.

Cultural – This barrier evaluates any other major barrier applicable to the proposed project activity.

Alternative 2 – The continuation of the practice of dumping the waste in landfills would not have any cultural issues, as this practice is very well known by the Host Country. It would not generate any product to be sold, therefore would not have problems regarding not selling their product. Therefore, there would not be any other significant constraints in this alternative.

Table: Summary of barrier analysis.

Barriers	1 – Proposed project activity without CDM	2 – Continuation of previous activities
Technological barrier	**Yes**	No
Economic barrier	**Yes**	No
Cultural barrier	**Yes**	No

Step 4. Common Practice Analysis

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

As seen below, there are several other practices common in Brazil regarding waste disposal. The country has several problems with waste disposal practices like any other developing country and therefore investment in the sector is focused on collecting and disposing the waste in landfills.

In Brazil only about 3% of the waste from the country is treated by composting. In Rio de Janeiro only 2.2% of the waste is treated on composting station (IBGE, 2002), as shown in the figure below.

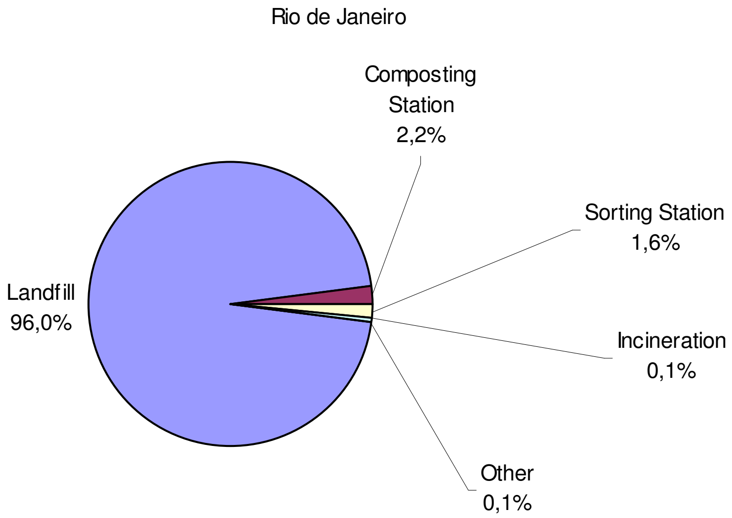

Figure – Waste disposal practices per amount of waste in the State of Rio de Janeiro, Brazil. Source: Modified from IBGE (2002).

Only 4.5% of districts in the State of Rio de Janeiro use Composting as a waste treatment system, as shown by the figure below. And this percentage is even lower when including all districts in Brazil, with only 2.3% of waste having this destination.

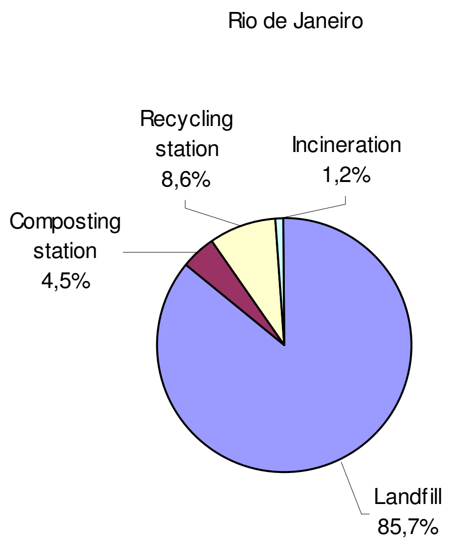

Figure – Percentage of districts that use each type of waste disposal practices in the State of Rio de Janeiro, Brazil. Source: Modified from IBGE (2002).

The plant is certified by EcoCert Brasil S.A., an international company specialized in certifying organic products, for both Brazilian and European markets. There are only four other fertilizer producers certified by EcoCert in Brazil, as listed on their website[5]. The companies and their differences from the present project activity's technology are presented below:

Table – Other Brazilian companies certified by EcoCert to produce Organic Fertilizers.

Company	Location	Product	Technology
Ferticel[6]	Santa Catarina State	Organic Fertilizer	Made from birds excrements
RockAll[7]	Mato Grosso State	Organic Fertilizer	Compound with minerals
Provaso[8]	São Paulo	Organic Fertilizer	Traditional composting (40 to 150 days)
Organoeste[9]	Paraná, Espírito Santo e Mato Grosso do Sul States	Organic Fertilizer	Addition of bacteria to make the composting process last for 12 to 15 days

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

As seen, there is no company certified by EcoCert in the State of Rio de Janeiro. Moreover, none of the companies cited above uses the same technology as the project Developer.

There are very few alternatives to landfilling being put in practice in Brazil. One of them is composting stations. However, the present project activity comprises a totally different technology, as discussed in the technology barrier section above.

This section clearly explains how the approval and registration of the project as a CDM activity, and the attendant benefits and incentives derived from the project activity, will alleviate the barriers illustrated above, and thus enable the Project to be undertaken.

The financial benefit from the revenue obtained by selling the CO_2 emissions reductions has been one of the key issues encouraging investment in the proposed project activity. The CDM has been considered from an early stage and it is an integral part of the financial package of the proposed project activity.

As explained by IPT (2000), many composting plants had their operation interrupted or shut down. Others had never begun operating mainly due to the following reasons (IPT, *op. cit.*):

- Bad planning when starting up composting plants which caused competition for resources between plant owners;
- Absence of institutional and/or management and/or operational know-how to conduct the activities;
- Misunderstanding of the plants' space needs and operational capacity meaning space was lacking for the installation of the landfill necessary to contain the residual compost produced;

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[5] http://www.ecocert.com.br/26701.html (visited in 18 October 2007)

[6] http://www.ferticel.com.br

[7] www.rockall.com.br/

[8] www.provaso.com.br/

[9] www.organoeste.com.br/

- Exploration of the argument regarding employment generation (for example, to the old open landfill waste pickers – *catadores de lixo do lixão*), as a social motivation for the composting plants option;
- Absence of budget, institutional and operational integration of the plants with the local sanitation company/service;
- Inadequate siting of the plants, causing environmental problems and the rejection of its operation by the affected population;
- Local Political and Party dispute issues or prejudice, including the paralyzation of activities of a recently operational plant simply due to the change in local government;
- Mistakes made by municipal managers, forecasting operational "profit" from the plants;
- Inability to obtain products with the quality characteristics necessary to agricultural use, due to bad operation of the plant;
- Bad conception of the project, incomplete or poorly dimensioned installations, inadequate equipment, high maintenance costs, lack of resources and difficulties in selling the compost.

In conclusion the proposed project shall be deemed to be additional according to AM0025.

B.6 Emission reductions

B.6.1. Explanation of methodological choices:

The Methodology AM0025 is applicable to the proposed project activity, as it is applicable to an aerobic composting process where the baseline scenario is the disposal of waste in a landfill.

As mentioned before, the Project is based on three complementary activities, as follows:

- The collection and separation of waste;
- The aerobic composting of this waste;
- The use of the compost product in agriculture.

All the aforementioned activities have as their objective the avoidance of methane generation in the anaerobic degradation of organic waste.

The Project fulfils all applicability conditions of the methodology (as stated in section B.2), and thus AM0025 was considered the most appropriate methodology for the Project.

The weather in the State of Rio de Janeiro (where the project is located) can be classified as Tropical Wet. The average historical temperature is above 21ºC and the average historical precipitation is above 1200 mm/yr, as shown by the figure below.

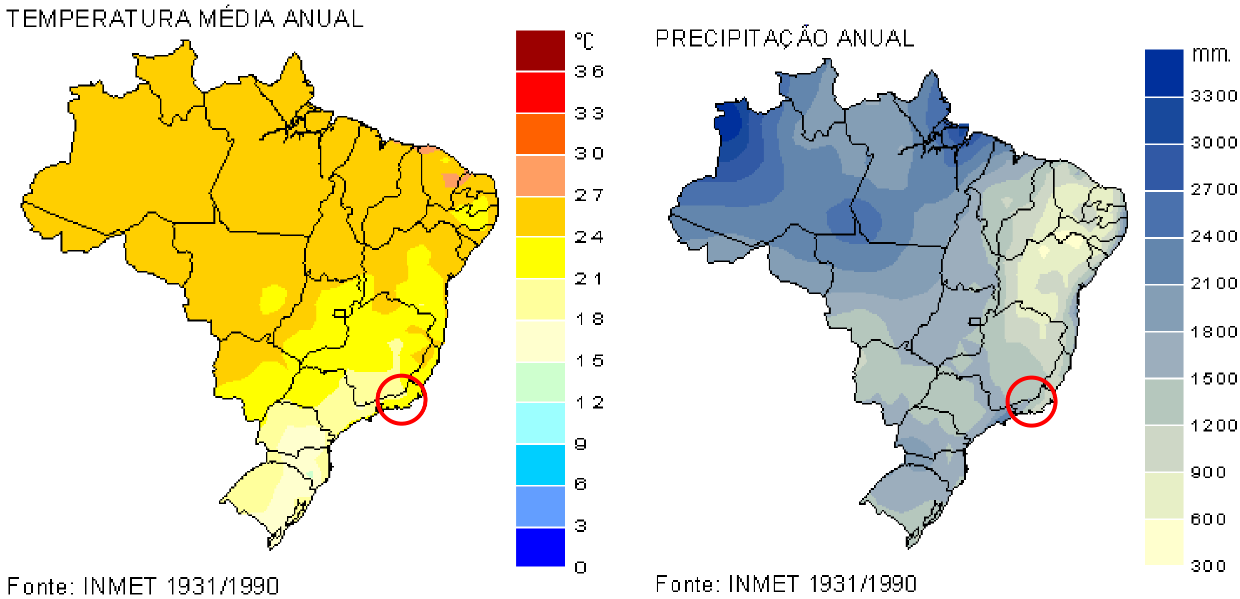

Figure – Mean annual temperature (left) and Mean annual rain (right). The State of Rio de Janeiro is highlighted. Source: National Institute of Meteorology (http://www.inmet.gov.br/html/clima.php?lnk=/html/clima/mapas/)

Project emissions:
According to the methodology, there are four sources of project emissions. Their specific relevance for this project activity is discussed below.

- CO_2 emissions from consumption of fossil fuel on site – This emission source is taken into account, as there are vehicles on-site with the function of turning over the compost, among other things. Emissions are calculated from the quantity of fuel used and the specific CO2-emission factor of the fuel;
- CO_2 emissions from consumption of electricity from the grid on site – The "Tool to calculate the emission factor for an electricity system" is used to calculate this emission source (more info can be found in annex 3);
- CH_4 and N_2O emissions due to waste processing – During the composting process, aerobic conditions may not occur at all times and at all places. This is a potential emission source for methane similar to anaerobic conditions which occur in unmanaged landfills. To determine the oxygen content during the process, the amount of oxygen will be measured and the share of waste that degrades under anaerobic conditions will be defined ex-post on annual basis. Moreover, during the storage of waste in collection containers, as part of the composting process itself, and during the application of compost, N2O emissions might be released. This emission source is proportional to the compost produced, with a default emission factor of 0.043 kg N2O per tonne of compost.

Baseline emissions:
According to the methodology, there are two possible sources of baseline emissions. Their specific relevance for this project activity is discussed below.

- CH_4 produced in the landfill where the waste would be dumped in the absence of the project activity, discounting the CH_4 that would be captured and destroyed – In the absence of the

project activity, the waste would have been landfilled and, consequently, anaerobically degraded with production of methane. In the project activity scenario, this methane will not be produced because the waste is going to be treated aerobically, therefore reducing this source of GHG emissions.

As there is no legal obligation, the destruction of methane according to the legislation is zero. However, the methodology states that, when this situation occurs, an Adjustment Factor must be used. This factor has the following characteristics:

1. In cases where a specific system for collection and destruction of methane is mandated by regulatory or contractual requirements, the ratio between the destruction efficiency of that system and the destruction efficiency of the system used in the project activity shall be used;
2. In cases where a specific percentage of the "generated" amount of methane to be collected and destroyed is specified in the contract or mandated by the regulation, this percentage divided by an assumed efficiency for the collection and destruction system used in the project activity shall be used;
3. The Adjustment Factor shall be revised at the start of each new crediting period taking into account the amount of GHG flaring that occurs as part of common industry practice and/or regulation at that point in the future.

As neither 1 nor 2 are applicable to the present project activity and to the host country thus far, for the first crediting period we will use 5% as Adjustment Factor according to landfill specific data. More information regarding this subject, as well as detailed calculations, are provided in annex 5.

- CO_2 emissions from generation of energy – The proposed project activity will not involve generation of renewable energy. Therefore, this source of baseline emissions will not be considered.

The landfill where the waste would have been deposited in the baseline scenario is the main public landfill in Rio de Janeiro, the Gramacho landfill. This landfill can be described according to its characteristics as **anaerobic managed solid waste disposal site**, having "*controlled access, a recycling facility, well-maintained access roads, waste compaction by bulldozers, and the application of daily and intermediate cover soils*" (SCS Engineers, 2005).

Leakage emissions:

According to the methodology, there are three possible sources of leakage emissions. Their specific relevance for this project activity is discussed below.

- CO_2 emissions from increased transport – in the absence of the project activity, the great majority of waste used in the project would be dumped in the main public landfill of Rio de Janeiro, the Gramacho landfill. This landfill is located in the Jardim Gramacho Neighborhood, Duque de Caxias Municipality, State of Rio de Janeiro. Therefore, the location where the waste was going to be transported to in the absence of the project activity is near (i.e. less than 10Km) the project activity site (location of the project activity can be found at section A.4.1 and the location of the Gramacho Landfill can be found in the figure below). So, for this source of emissions, only the transport of the compost to the final destination will be accounted for, with monitoring of the real distances from the main consumers. These distances will be assessed using the invoices.

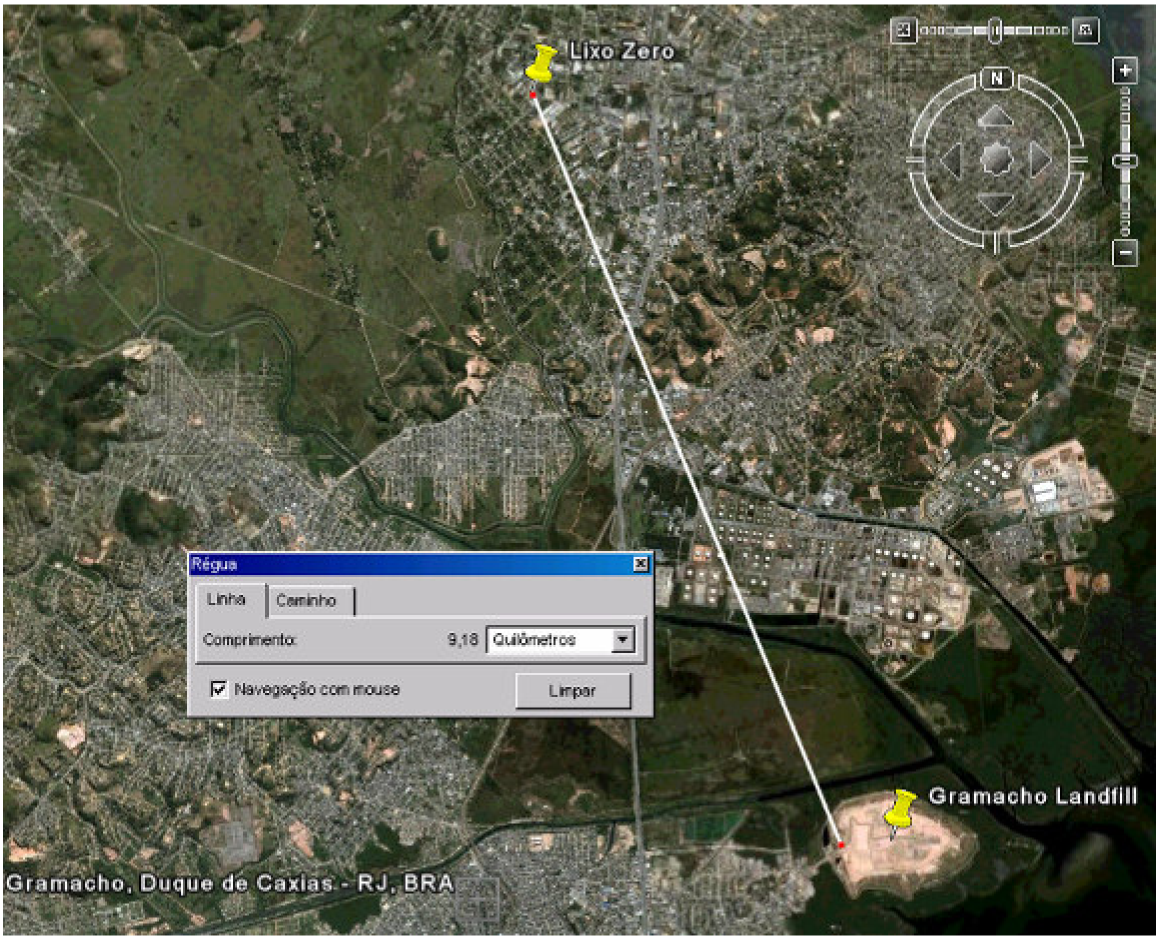

Figure – Location of Ambiental Lixo Zero Ltda. and Gramacho landfill, evidencing the distance between them of less than 10Km.

- CH4 emissions from disposing the compost in landfills – the project developer do not forecast to dispose the compost in landfills. Therefore, this source of emissions is not intended to happen, but as the end-use of the compost will be monitored, this source will be dealt with as recommended by the methodology if needed.

Emission reductions:

According to the methodology, if the sum of Project emissions and Leakage is smaller than 1% of Baseline emissions in the first full operational year of a crediting period, the project participants may assume a fixed percentage of 1% for Project emissions and Leakage combined for the remaining years of the crediting period.

The emission reductions will be calculated as follows:

$$ER_y = BE_y - PE_y - L_y = [MB_y - (MB_y * AF)] - [PE_{elec,y} + PE_{fuel,on-site,y} + PE_{c,y}] - [L_{t,y} + L_{r,y}]$$

Where:

ERy	is the emissions reductions in year y (t CO2e)
BEy	is the emissions in the baseline scenario in year y (t CO2e)
PEy	is the emissions in the project scenario in year y (t CO2e)
MB_y	is the methane produced in the landfill in the absence of the project activity in year y
AF	is the Adjustment Factor for MB_y (%)
$PE_{elec,y}$	is the emissions from electricity consumption on-site due to the project activity in year y (tCO_2e)
$PE_{fuel,\ on\text{-}site,y}$	is the emissions on-site due to fuel consumption on-site in year y (tCO_2e)
$PE_{c,y}$	is the emissions during the composting process in year y (tCO_2e)
Ly	is the leakage in year y (t CO2e)
$L_{t,y}$	is the leakage emissions from increased transport in year y (tCO_2e)
$L_{r,y}$	is the leakage emissions from the residual waste from the anaerobic digester, the gasifier, the processing/combustion of RDF/stabilized biomass, or compost in case it is disposed of in landfills in year y (tCO_2e)

All equations applied to obtain the emission reduction from the project activity are listed in Section B.6.3.

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

Data / Parameter:	$EF_{c,N2O}$
Data unit:	tN2O/tonnes of compost
Description:	Emission factor for N_2O emissions from the composting process.
Source of data used:	Research literature
Value applied:	0.043
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value after Schenk et al, 1997. The value itself is highly variable, but reference data shall be used, as recommended by the methodology.
Any comment:	Defined Ex-ante

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

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:	IPCC 2006
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	The landfill to where the waste would be dumped is a managed solid waste disposal site covered with oxidizing material.
Any comment:	

Data / Parameter:	**F**
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC 2006
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.
Any comment:	

Data / Parameter:	**DOC_f**
Data unit:	-
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	IPCC 2006
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**MCF**
Data unit:	-
Description:	Methane correction factor
Source of data used:	IPCC 2006
Value applied:	1
Justification of the choice of data or description of	The landfill can be described according to its characteristics as **anaerobic managed solid waste disposal site**, having "*controlled access, a recycling facility, well-maintained access roads, waste compaction by bulldozers, and the*

measurement methods and procedures actually applied :	*application of daily and intermediate cover soils*" (SCS Engineers, 2005).
Any comment:	**Anaerobic managed solid waste disposal sites** must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste.

Data / Parameter:	**DOC_j**
Data unit:	-
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value applied:	The following values are applied for the different waste types *j*:
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	If a waste type, prevented from disposal by the proposed CDM project activity, can not clearly be attributed to one of the waste types in the table above, project participants will choose among the waste types that have similar characteristics

DOCj (wet waste)	%
A. Pulp, Paper and Cardboard	40
B. Garden, yard and Park waste	20
C. Food, Food waste, beverages, tobacco and sludge	15
D. Wood and wood products	43
E. Textiles	24
F. Other (inert)	0

Data / Parameter:	**k_j**
Data unit:	-
Description:	Decay rate for the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value applied:	The following values are applied for the different waste types *j*:

Type	Waste type j	Tropical (MAT>20°C)
		Wet (MAP>1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.07
	Wood, Wood	0.035

	<table><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, beverages, tobacco and sewage sludge</td><td>0.4</td></tr></table> MAT – mean annual temperature, MAP – Mean annual precipitation, If a waste type, prevented from disposal by the proposed CDM project activity, can not clearly be attributed to one of the waste types in the table above, project participants will choose among the waste types that have similar characteristics
Justification of the choice of data or description of measurement methods and procedures actually applied :	As can be found in section B.6.1, the weather in the State of Rio de Janeiro is Tropical Wet.
Any comment:	

Data / Parameter:	CEF_{elec}
Data unit:	tCO_2/MWh
Description:	Emission factor for the electricity consumed by the project activity
Source of data used:	Official utility documents.
Value applied:	0.2654
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated according to the “Tool to calculate the emission factor for an electricity system”. Defined Ex-ante.
Any comment:	More information regarding calculation method can be found in annex 3

Data / Parameter:	VF_{cons}
Data unit:	Km/L
Description:	Vehicle fuel consumption in kilometers per litres for vehicle type i
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories 3.21
Value applied:	4
Justification of the choice of data or description of measurement methods and procedures actually applied :	As no official value is available for Brazil, IPCC default data will be used conservatively. IPCC 2006 recommends 5 Km/L for diesel vehicles. We will use 4 Km/L for this project in order to be conservative. Value established ex-ante.
Any comment:	

Data / Parameter:	NCV_{fuel}
Data unit:	TJ/l

Description:	Net calorific value of fuel
Source of data used:	Brazilian energetic balance (BEN), 2005
Value applied:	0.00000004
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default country specific value used. Value established ex-ante.
Any comment:	

Data / Parameter:	EF_{fuel}
Data unit:	tCO_2/TJ
Description:	Emission factor of the fuel.
Source of data used:	Brazilian energetic balance (BEN), 2005
Value applied:	74.066667
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default country specific value used. Value established ex-ante.
Any comment:	

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2e / t CH_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
Justification of the choice of data or description of measurement methods and procedures actually applied :	A value of 21 is to be applied for the first commitment period of the Kyoto Protocol.
Any comment:	

Data / Parameter:	**GWP_{N2O}**
Data unit:	tCO_2e / t N_2O
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:	310
Justification of the choice of data or description of	A value of 310 is to be applied for the first commitment period of the Kyoto Protocol.

measurement methods and procedures actually applied :	
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

All calculations follow guidance provided by the approved methodology AM0025. In order to calculate the Project Emissions, the methodology recommends the following equation:

$$PE_y = PE_{elec,y} + PE_{fuel,\ on\text{-}site,y} + PE_{c,y} + PE_{a,y} + PE_{g,y} + PE_{r,y} + PE_{i,y} + PE_{w,y}$$

Where:

PE_y	is the project emissions during the year y (tCO_2e)
$PE_{elec,y}$	is the emissions from electricity consumption on-site due to the project activity in year y (tCO_2e)
$PE_{fuel,\ on\text{-}site,y}$	is the emissions on-site due to fuel consumption on-site in year y (tCO_2e)
$PE_{c,y}$	is the emissions during the composting process in year y (tCO_2e)
$PE_{a,y}$	is the emissions from the anaerobic digestion process in year y (tCO_2e)
$PE_{g,y}$	is the emissions from the gasification process in year y (tCO_2e)
$PE_{r,y}$	is the emissions from the combustion of RDF/stabilized biomass in year y (tCO_2e)
$PE_{i,y}$	is the emissions from waste incineration in year y (tCO_2e)
$PE_{w,y}$	is the emissions from waste water treatment in year y (tCO_2e)

However, the simplified version of this equation with only the emission sources applicable to this project is:

$$PE_y = PE_{elec,y} + PE_{fuel,on-site,y} + PE_{c,y}$$

Where:

PE_y	is the project emissions during the year y (tCO_2e)
$PE_{elec,y}$	is the emissions from electricity consumption on-site due to the project activity in year y (tCO_2e)
$PE_{fuel,\ on\text{-}site,y}$	is the emissions on-site due to fuel consumption on-site in year y (tCO_2e)
$PE_{c,y}$	is the emissions during the composting process in year y (tCO_2e)

As the use of wastewater will be part of the composting process, no emissions are expected from this source.

The calculation of $PE_{elec,y}$ is:

$$PE_{elec,y} = EG_{PJ,FF,y} * CEF_{elec}$$

Where:

$EG_{PJ,FF,y}$	is the amount of electricity consumed from the grid as a result of the project activity, measured using an electricity meter (MWh)
CEF_{elec}	is the carbon emissions factor for electricity generation in the project activity (tCO_2/MWh)

The calculation of the CEF_{elec} will follow guidance provided by the “Tool to calculate the emission factor for an electricity system” and further information regarding this calculation is presented in annex 3.

The calculation of $PE_{fuel, on\text{-}site,y}$ is:

$$PE_{fuel,\ on\text{-}site,y} = F_{cons,y} * NCV_{fuel} * EF_{fuel}$$

Where:

$PE_{fuel, on\text{-}site,y}$	is the CO_2 emissions due to on-site fuel combustion in year y (tCO_2)
$F_{cons,y}$	is the fuel consumption on site in year y (l)
NCV_{fuel}	is the net caloric value of the fuel (TJ/l)
EF_{fuel}	is the CO_2 emissions factor of the fuel (tCO_2/TJ)

A default value for Brazilian fuel will be used for EF_{fuel} and NCV_{fuel}.

$$PE_{c,y} = PE_{c,N2O,y} + PE_{c,CH4,y}$$

Where

$PE_{c,N2O,y}$	is the N_2O emissions during the composting process in year y (tCO_2e)
$PE_{c,CH4,y}$	is the emissions during the composting process due to methane production through anaerobic conditions in year y (tCO_2e)

To calculate the N2O emissions, the following formula is used:

$$PE_{c,N2O,y} = M_{compost,y} * EF_{c,N2O} * GWP_{N2O}$$

Where:

$PE_{c,N2O,y}$	is the N_2O emissions from composting in year y (tCO_2e)
$M_{compost,y}$	is the total quantity of compost produced in year y (tonnes/a)
$EF_{c,N2O}$	is the emission factor for N_2O emissions from the composting process (tN_2O/t compost)
GWP_{N2O}	is the Global Warming Potential of nitrous oxide, (tCO_2/tN_2O)

As a total loss of 42 mg N_2O-N per kg composted dry matter can be expected (from which 26.9 mg N_2O during the composting process), Assuming 650 kg dry matter per ton of compost and 42 mg N2O-N, and given the molecular relation of 44/28 for N2O-N, an emission factor of 0.043 kg N2O / tonne compost results.

To calculate CH4 emissions, the following formula is used:

$$PE_{c,CH4,y} = MB_{composty} * GWP_{CH4} * S_{a,y}$$

Where:

$PE_{c,CH4,y}$	is the project methane emissions due to anaerobic conditions in the composting process in year y (tCO_2e)
$S_{a,y}$	is the share of the waste that degrades under anaerobic conditions in the composting plant during year y (%)

$MB_{compost,y}$ is the quantity of methane that would be produced in the landfill in the absence of the composting activity in year y (tCH4).

$MB_{compost,y}$ is estimated by multiplying MB_y estimated by the fraction of waste diverted, from the landfill, to the composting activity (f_c) relative to the total waste diverted from the landfill to all project activities (composting, gasification, anaerobic digestion and RDF/stabilized biomass, incineration)

GWP_{CH4} is the Global Warming Potential of methane (tCO2e/tCH4)

$S_{a,y}$ is determined by a combination of measurements and calculations. If oxygen content is below 5% - 7.5%, aerobic composting processes are replaced by anaerobic processes. The calculation of this parameter is done as follows:

$$S_{a,y} = S_{OD,y} / S_{total,y}$$

Where:

$S_{OD,y}$ is the number of samples per year with an oxygen deficiency (i.e. oxygen content below 10%)

$S_{total,y}$ is the total number of samples taken per year, where $S_{total,y}$ should be chosen in a manner that ensures the estimation of $S_{a,y}$ with 20% uncertainty at a 95% confidence level.

In order to estimate $S_{a,y}$, as there are no measurements performed so far, we will assume 2% of anaerobic digestion.

Project emissions calculation summary is presented in the table below:

Table – Project emissions calculation summary by component.

Component	tCO_2e (average)
Electricity ($PE_{elec,y}$)	584
Fossil Fuel ($PE_{fuel, on-site,y}$)	16
Anaerobic Degradation ($PE_{c,y}$)	2 691
Total (PE_y)	3 291

In order to calculate the Baseline Emissions, the methodology recommends the following equation:

$$BE_y = (MB_y - MD_{reg,y}) + BE_{EN,y}$$

Where:

BE_y is the baseline emissions in year y (tCO_2e)

MB_y is the methane produced in the landfill in the absence of the project activity in year y

$MD_{reg,y}$ is methane that would be destroyed in the absence of the project activity in year y

$BE_{EN,y}$ Baseline emissions from generation of energy displaced by the project activity in year y (tCO_2e).

In cases where regulatory or contractual requirements do not specify $MD_{reg,y}$, an Adjustment Factor (AF) shall be used and justified, taking into account the project context. As the Brazilian government does not have any regulation demanding capture and/or burning of methane, $MD_{reg,y}$ is calculated as follows:

$$MD_{reg,y} = MB_y * AF$$

Where:
AF is Adjustment Factor for MB_y (%)

As there is neither regulatory or contractual requirements nor specific percentage of the methane to be destroyed specified in the contract or mandated by the regulation, the AF is defined as 5% for the first crediting period according practices at the landfill (see annex 5).

The amount of methane that is generated each year (*MB_y*) is calculated as per the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"

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

Where:

$BE_{CH4,SWDS,y}$	Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
φ	Model correction factor to account for model uncertainties (0.9)
f	Fraction of methane captured at the SWDS and flared, combusted or used in another manner. As this is already accounted for in the methodology AM0025, "f" shall be assigned a value 0.
GWP_{CH4}	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	Fraction of degradable organic carbon (DOC) that can decompose
MCF	Methane correction factor
$W_{j,x}$	Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons). Represented as $A_{j,x}$ in the AM0025.
DOC_j	Fraction of degradable organic carbon (by weight) in the waste type *j*
k_j	Decay rate for the waste type *j*
j	Waste type category (index)
x	Year during the crediting period: x runs from the first year of the first crediting period (x = 1) to the year y for which avoided emissions are calculated (x = y)
y	Year for which methane emissions are calculated

Table – Baseline emissions calculation summary by component.

Component	tCO_2e (average)
Production of Methane (MB_y)	74 583
Methane Destroyed ($MD_{reg,y}$)	3 729
Energy Displaced ($BE_{EN,y}$)	0
Total (BE_y)	70 854

In order to calculate the Leakage Emissions, the methodology recommends the following equation:

$$L_y = L_{t,y} + L_{r,y} + L_{s,y}$$

Where:

$L_{t,y}$ is the leakage emissions from increased transport in year y (tCO_2e)
$L_{r,y}$ is the leakage emissions from the residual waste from the anaerobic digester, the gasifier, the processing/combustion of RDF/stabilized biomass, or compost in case it is disposed of in landfills in year y (tCO_2e)
$L_{s,y}$ is the leakage emissions from end use of stabilized biomass

As the project does not involve stabilized biomass, $L_{s,y} = 0$.

The only source of leakage identified is described below:

$$L_{t,y} = \sum_{i}^{n} NO_{vehicles,i,y} * DT_{i,y} * VF_{cons,i} * NCV_{fuel} * D_{fuel} * EF_{fuel}$$

Where:
$NO_{vehicles,i,y}$ is the number of vehicles for transport with similar loading capacity
$DT_{i,y}$ is the average additional distance traveled by vehicle type i compared to baseline in year y (km)
VF_{cons} is the vehicle fuel consumption in liters per kilometer for vehicle type i (l/km)
NCV_{fuel} is the Calorific value of the fuel (TJ/l)
D_{fuel} is the fuel density (kg/l), if necessary
EF_{fuel} is the Emission factor of the fuel (tCO_2/TJ)

However, the possibility that the compost is disposed in landfills will be monitored. In this case, the equation to calculate this source of leakage is the equation 18 from AM0025 used in this PDD, as per guidance provided by the methodology.

Therefore,

Table – Leakage emissions calculation summary by component.

Component	tCO_2e
Increased Transportation ($L_{t,y}$)	740
Compost disposed in Landfills ($L_{r,y}$)	0
Total (L_y)	740

In order to calculate the Leakage Emissions, the methodology recommends the following equation:

$$ER_y = BE_y - PE_y - L_y$$

Where:
ER_y is the emissions reductions in year y ($t\ CO_2e$)
BE_y is the emissions in the baseline scenario in year y ($t\ CO_2e$)
PE_y is the emissions in the project scenario in year y ($t\ CO_2e$)
L_y is the leakage in year y ($t\ CO_2e$)

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

Years	Estimation of project activity emissions (tonnes of CO2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO2 e)	Estimation of overall emission reductions (tonnes of CO2 e)
May 2009 - Apr 2010	2429	29878	740	26710
May 2010 - Apr 2011	2873	50970	740	47357
May 2011 - Apr 2012	3190	66050	740	62120
May 2012 - Apr 2013	3421	76995	740	72835
May 2013 - Apr 2014	3591	85078	740	80748
May 2014 - Apr 2015	3719	91164	740	86705
May 2015 - Apr 2016	3818	95842	740	91285
Total estimated reductions (tonnes of CO2e)	**23040**	**495978**	**5180**	**467759**

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

B.7.1. Data and parameters monitored:

Data / Parameter:	$EG_{PJ,FF,y}$
Data unit:	MWh
Description:	Amount of electricity consumed from the grid as a result of the project activity
Source of data to be used:	Electricity meter
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	2201.57
Description of measurement methods and procedures to be applied:	The project developer estimated this value as the total installed capacity (full capacity) of the composting plant. The grid operator electricity meter installed at Ambiental Lixo Zero plant will be used in order to monitor the electricity consumed.
QA/QC procedures to be applied:	The meter is maintained according to national standards. If at any point the meter could not be used, the full capacity of the plant will be used instead.
Any comment:	

Data / Parameter:	$F_{cons,y}$
Data unit:	Liter
Description:	Fuel consumption on-site during year 'y' of the crediting period.
Source of data to be used:	Purchase invoices
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	6000

Description of measurement methods and procedures to be applied:	Data will be monitored annually by the project developer.
QA/QC procedures to be applied:	The amount of fuel will be derived from the paid fuel invoices (administrative obligation).
Any comment:	

Data / Parameter:	$M_{compost,y}$
Data unit:	tones
Description:	Total quantity of compost produced in year ‘y’.
Source of data to be used:	Plant records.
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	90 000
Description of measurement methods and procedures to be applied:	Monitored weekly and reported annually by the project developer. The compost will be weighed on calibrated scale,
QA/QC procedures to be applied:	Sales invoices of the compost will be kept at the project site. They contain customer contact details, physical location of delivery, type, amount (in tons) and the use of compost. The scale will be maintained and calibrated according to manufacturer recommendations.
Any comment:	The produced compost will be trucked off from site. The amount of compost in each truck will be controlled, as the compost is sold in weighted packs.

Data / Parameter:	MB_y
Data unit:	tCH_4
Description:	Methane produced in the landfill in the absence of the project activity in year ‘y’.
Source of data to be used:	Calculated as per the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”.
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	74 583
Description of measurement methods and procedures to be applied:	As per the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”.
QA/QC procedures to be applied:	As per the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”.
Any comment:	Average value provided for estimative

Data / Parameter:	AF
Data unit:	%
Description:	Methane destroyed due to regulatory or other requirements.
Source of data to be used:	Practices from the landfill (see annex 5)
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	5
Description of measurement methods and procedures to be applied:	Adjusted at renewal of crediting period according to new scenario, if applicable. See annex 5 for information.
QA/QC procedures to be applied:	Data are derived from or based upon local or national guidelines, so QA/QCprocedures for these data are not applicable.
Any comment:	Changes in regulatory requirements, relating to the baseline landfill(s) need to be monitored in order to update the adjustment factor (AF), or directly $MD_{reg.}$. This is done at the beginning of each crediting period.

Data / Parameter:	$NO_{vehicles,i,y}$
Data unit:	Number
Description:	Number of vehicles for transport per carrying capacity per year
Source of data to be used:	Counting
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	4 500
Description of measurement methods and procedures to be applied:	Counter accumulates the number of trucks per carrying capacity. It will be monitored annually.
QA/QC procedures to be applied:	Number of vehicles can be cross checked with total amount of sold compost. Checked regularly by DOE.
Any comment:	

Data / Parameter:	$DT_{i,y}$
Data unit:	Km
Description:	Average additional distance traveled by vehicle type 'i' compared to the baseline in year 'y'.
Source of data to be used:	Expert estimate
Value of data applied for the purpose of calculating expected emission reductions in	250

section B.6.3	
Description of measurement methods and procedures to be applied:	The above mentioned value is based on assumptions of distances for estimation purposes only, given that exact distances to compost destiny are not known. The actual average distance will be monitored ex-post annually based on invoices emitted.
QA/QC procedures to be applied:	Approved by DOE.
Any comment:	

Data / Parameter:	$S_{a,y}$
Data unit:	%
Description:	Share of the waste that degrades under anaerobic conditions in the composting plant during year 'y'.
Source of data to be used:	Oxygen measurement device
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	2
Description of measurement methods and procedures to be applied:	Monitored weekly. See $S_{total,y}$.
QA/QC procedures to be applied:	O_2-measurement-instrument will be subject to periodic calibration (in accordance with stipulation of instrument-supplier). Measurement itself to be done by using a standardised mobile gas detection instrument. A statistically significant sampling procedure will be set up that consists of multiple measurements throughout the different stages of the composting process according to a predetermined pattern (depths and scatter) on a weekly basis.
Any comment:	Weekly representative sets of measurements throughout the year, consolidated once per year.

Data / Parameter:	$S_{OD,y}$
Data unit:	Number
Description:	Number of samples with oxygen deficiency (i.e. oxygen content below 10%).
Source of data to be used:	Measurement device
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	0
Description of measurement methods and procedures to be	Monitored weekly. See $S_{total,y}$.

applied:	
QA/QC procedures to be applied:	Instrument will be subject to periodic calibration (in accordance with stipulation of instrument-supplier). Measurement itself to be done by using a standardized mobile gas detection instrument. A statistically significant sampling procedure will be set up that consists of multiple measurements throughout the different stages of the composting process according to a predetermined pattern (to be determined and will be available to the first verification)
Any comment:	

Data / Parameter:	$S_{total,y}$
Data unit:	Number
Description:	Number of samples
Source of data to be used:	Oxygen measurement device
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	0
Description of measurement methods and procedures to be applied:	The data should be statistically significant and measurements are done weekly. Total number of samples taken per year, where $S_{total,y}$ should be chosen in a manner that ensures estimation of $S_{a,y}$ with 20% uncertainty at 95% confidence level. These measurements will be undertaken for each year of the crediting period and recorded each year.
QA/QC procedures to be applied:	Instrument will be subject to periodic calibration (in accordance with stipulation of instrument-supplier). Measurement itself to be done by using a standardized mobile gas detection instrument. A statistically significant sampling procedure will be set up that consists of multiple measurements throughout the different stages of the composting process according to a predetermined pattern (to be determined and will be available to the first verification).
Any comment:	

Data / Parameter:	$A_{j,x}$
Data unit:	tonnes/yr
Description:	Amount of organic waste type j prevented from disposal in the landfill in the year x
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	A. Pulp, Paper and Cardboard (other than sludge): 7500 B. Garden and Park waste (non-food): 22500 C. Food, Food waste, beverages, tobacco and sludge: 97500 D. Wood and straw waste: 7500 E. Textiles: 0 F. Inert: 15000
Description of measurement methods and procedures to be	The amount of organic waste prevented from disposal in landfills will be monitored by weighbridge. The reporting will be made annually.

applied:	
QA/QC procedures to be applied:	Weighbridge will be subject to calibration in accordance with stipulation of the weighbridge supplier.
Any comment:	

Data / Parameter:	f_c
Data unit:	%
Description:	fraction of waste diverted from the landfill to composting
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	100
Description of measurement methods and procedures to be applied:	This fraction has to be updated monthly, in case of new information is available that changes the waste disposal practices in the region.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$\mathbf{W_x}$
Data unit:	tons
Description:	Total amount of organic waste prevented from disposal in year *x* (tons)
Source of data to be used:	Measurement by project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	150 000
Description of measurement methods and procedures to be applied:	Parameter monitored continuously. Reporting will be performed annually.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$\mathbf{p_{n,j,x}}$
Data unit:	-
Description:	Weight fraction of the waste type *j* in the sample *n* collected during the year *x*
Source of data to be used:	Sample measurements by project participants
Value of data applied	

for the purpose of calculating expected emission reductions in section B.6.3	A. Pulp, Paper and Cardboard (other than sludge)	5%
	B. Garden and Park waste (non-food)	15%
	C. Food, Food waste, beverages, tobacco and sludge	65%
	D. Wood and straw waste	5%
	E. Textiles	0%
	F. Inert	10%
Description of measurement methods and procedures to be applied:	Sample the waste prevented from disposal, using the waste categories *j*, as provided in the table for DOC_j and k_j, and weigh each waste fraction. The size and frequency of sampling will be statistically significant with a maximum uncertainty range of 20% at a 95% confidence level. As a minimum, sampling will be undertaken four times per year.	
QA/QC procedures to be applied:		
Any comment:		

Data / Parameter:	**z**
Data unit:	-
Description:	Number of samples collected during the year *x*
Source of data to be used:	project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.6.3	0
Description of measurement methods and procedures to be applied:	Continuously, aggregated annually
QA/QC procedures to be applied:	
Any comment:	This parameter only needs to be monitored if the waste prevented from disposal includes several waste categories *j*, as categorized in the tables for DOC_j and k_j.

B.7.2 Description of the monitoring plan:

The monitoring plan details the actions necessary to record all the variables and factors required by the methodology AM0025 as detailed in section B.7.1 above. All data will be archived electronically, and backed up regularly. Moreover, it will be kept for the full crediting period, plus two years after the end of the crediting period or the last issuance of CERs for this project activity (whichever occurs later).

The monitoring equipment will be chosen carefully to be able to perform good measurements with great quality and lowest possible level of uncertainty. It will be calibrated and maintained according to the manufacturer requirements.

Project staff will be trained regularly in order to satisfactorily fulfill their monitoring obligations. The authority and responsibility for project management, monitoring, measurement and reporting will be agreed between the project participants and formalized. Detailed procedures for calibration of monitoring equipment, maintenance of monitoring equipment and installations, and for records handling will be established.

All data to be monitored will be collected and cross checked by the Project Developer. EcoSecurities will assure the quality of monitoring by adequately training the personnel involved and controlling monthly the data acquired, using its high specialized monitoring staff.

The full capacity of the project waste processing is not defined. Therefore, changes in the numbers provided may occur and will be monitored. However, any increase or decrease from the numbers provided will not impact the capacity of the project to reduce emissions. An increase in the waste processing capacity is forecasted after the first months of operation.

According to the methodology, if the sum of Project emissions and Leakage is smaller than 1% of Baseline emissions in the first full operation year of a crediting period, the project participants may assume a fixed percentage of 1% for Project emissions and Leakage combined for the remaining years 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 baseline study and the monitoring methodology were concluded on 23/10/2007 . The entity determining the baseline study and the monitoring methodology and participating in the project as the Carbon Advisor is EcoSecurities, listed in Annex 1 of this document.

Personnel responsible for the baseline and monitoring of this project:

Mr. Thiago Viana	EcoSecurities Brasil	Project Manager	Thiago.Viana@ecosecurities.com
Mr. Pablo Fernandez	EcoSecurities Brasil	Team Leader	Pablo@ecosecurities.com
Mr. Mauro Fadda	EcoSecurities Chile	Technical Reviewer	Mauro.Fadda@ecosecurities.com

Contact: EcoSecurities Brasil Ltda., Rua Lauro Müller 116, 4303/4304, Botafogo, Rio de Janeiro, Brazil. CEP: 22290-160. Phone: +55 (21) 2546-4150

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:

06/07/2007 (Issuance of the Operation Environmental License)

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

30 years 0 months

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

C.2.1. Renewable crediting period

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

The crediting period will start on 01/05/2009 , or on the date of registration of the CDM project activity, whichever is later.

C.2.1.2. Length of the first crediting period:

7 years 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

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 Project Developer is in compliance with all applicable laws and regulations. All applicable licenses were obtained and all conditions were obeyed. The State Environmental Authority, i.e. Fundação Estadual de Engenharia do Meio Ambiente (FEEMA/RJ), requests an Environmental Impact Assessment (EIA) for all activities with a high potential to harm the environment. However, as this project does not have a high potential to harm the environment, an EIA was not requested for this project activity.

The Secretary of Environment and Special Project from the Municipality of Duque de Caxias (where the project is developed) also authorized the project, stating that the Municipality "does not oppose" the operation of the company. Also, both the company and the product are registered in MAPA (*Ministério da Agricultura, Pecuária e Abastecimento*).

Therefore, given that the project activity will not induce significant impacts, no impact assessment was undertaken.

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:

Not applicable.

SECTION E. Stakeholders' comments

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

According to Resolution #1 dated December 2nd, 2003 from the Brazilian Inter-Ministerial Commission of Climate Change (Comissão Interministerial de Mudança Global do Clima - CIMGC), any CDM project must send a letter with a description of the project and an invitation for comments by local stakeholders. In this case, letters were sent on 11/02/2008 to the following local stakeholders:

- City Hall of Duque de Caxias;
- Chamber of Deputy of Duque de Caxias;
- District Attorney (known in Portuguese as Ministério Público, i.e. the permanent institution essential for legal functions responsible for defending the legal order, democracy and social/individual interests);
- Environment agencies from the State and Local Authority;
- Brazilian Forum of NGOs;
- Local community association(s).

Local stakeholders were invited to raise their concerns and provide comments on the project activity for a period of 30 days after receiving the letter of invitation.

E.2. Summary of the comments received:

To date no negative comments have been received from stakeholders.

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

Not applicable, given that no negative comments were received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project will not receive any public funding.

Annex 3

BASELINE INFORMATION

Please refer to Section B to Baseline analysis.

INFORMATION REGARDING EMISSION FACTOR CALCULATION

For this project, data for combined margin calculation have been based on ONS – *Operador Nacional do Sistema*, the System Operator.

The Brazilian electricity system has been historically divided into two subsystems: the North-Northeast (N-NE) and the South-Southeast-Midwest (S-SE-CO). This is due mainly to the historical evolution of the physical system, which was naturally developed nearby the biggest consuming centers of the country.

The natural evolution of both systems is increasingly showing that integration is to happen in the future. In 1998, the Brazilian government was announcing the first leg of the interconnection line between S-SECO and N-NE. With investments of around US$700 million, the connection had the main purpose, in the government's view, at least, to help solve energy imbalances in the country: the S-SE-CO region could supply the N-NE in case it was necessary and vice-versa.

Nevertheless, even after the interconnection had been established, technical papers still divided the Brazilian system in two (Bosi, 2000)[10]:
"… where the Brazilian Electricity System is divided into three separate subsystems:
(i) The South/Southeast/Midwest Interconnected System;
(ii) The North/Northeast Interconnected System; and
(iii) The Isolated Systems (which represent 300 locations that are electrically isolated from the interconnected systems)"

Moreover, Bosi (2000) gives a strong argumentation in favor of having so-called *multi-project baselines*:

"For large countries with different circumstances within their borders and different power grids based in these different regions, multi-project baselines in the electricity sector may need to be disaggregated below the country-level in order to provide a credible representation of 'what would have happened otherwise'".

Finally, one has to take into account that even though the systems today are connected, the energy flow between N-NE and S-SE-CO is limited by the transmission lines capacity. Therefore, only a fraction of the total energy generated in both subsystems is sent one way or another. It is natural that this fraction may change its direction and magnitude (up to the transmission line's capacity) depending on the hydrological patterns, climate and other uncontrolled factors. But it is not supposed to represent a significant amount of each subsystem's electricity demand. It has also to be considered that only in 2004 the interconnection between SE and NE was concluded, i.e., if project proponents are to be coherent with

[10] Bosi, M. *An Initial View on Methodologies for Emission Baselines: Electricity Generation Case Study*. International Energy Agency. Paris, 2000.

the generation database they have available as of the time of the PDD submission for validation, a situation where the electricity flow between the subsystems was even more restricted is to be considered.

The Brazilian electricity system nowadays comprises of around 100 GW of installed capacity, in a total of 1 690 electricity generation enterprises. From those, nearly 75% are hydropower plants, around 10% are natural gas-fired power plants, 4% are diesel and fuel oil plants, 3.5% are biomass sources (sugarcane bagasse, black liquor, wood, rice straw and biogas), 2% are nuclear plants, 1.3% are coal plants, and there are also 8,1 GW of installed capacity in neighboring countries (Argentina, Uruguay, Venezuela and Paraguay) that may dispatch electricity to the Brazilian grid. (http://www.aneel.gov.br/aplicacoes/capacidadebrasil/OperacaoCapacidadeBrasil.asp). This latter capacity is in fact comprised by mainly 6,3 GW of the Paraguayan part of *Itaipu Binacional*, a hydropower plant operated by both Brazil and Paraguay, but whose energy almost entirely is sent to the Brazilian grid.

Approved methodology ACM0002, and thus the "Tool to calculate the emission factor for an electricity system", asks project proponents to account for "all generating sources serving the system". In that way, project proponents in Brazil should search for, and research, all power plants serving the Brazilian system.

In fact, information on such generating sources is not publicly available in Brazil. The national dispatch center, ONS – *Operador Nacional do Sistema* – argues that dispatching information is strategic to the power agents and therefore cannot be made available. On the other hand, ANEEL, the electricity agency, provides information on power capacity and other legal matters on the electricity sector, but no dispatch information can be got through this entity.

In that regard, project proponents looked for a plausible solution in order to be able to calculate the emission factor in Brazil in the most accurate way. Since real dispatch data is necessary after all, the ONS was contacted, in order to let participants know until which degree of detail information could be provided. After several months of talks, plants' daily dispatch information was made available for years 2003, 2004 and 2005.

Project proponents, discussing the feasibility of using such data, concluded it was the most proper information to be considered when determining the emission factor for the Brazilian grid. According to ANEEL, in fact, ONS centralized dispatched plants accounted for 75,547 MW of installed capacity by 31/12/2004, out of the total 98,848.5 MW installed in Brazil by the same date (http://www.aneel.gov.br/arquivos/PDF/Resumo_Gráficos_mai_2005.pdf), which includes capacity available in neighboring countries to export to Brazil and emergency plants, that are dispatched only during times of electricity constraints in the system. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76.4% of the installed capacity serving Brazil is taken into account, which is a fair amount if one looks at the difficulty in getting dispatch information in Brazil. Moreover, the remaining 23.6% are plants that do not have their dispatch coordinated by ONS, since: either they operate based on power purchase agreements which are not under control of the dispatch authority; or they are located in non-interconnected systems to which ONS has no access. In that way, this portion is not likely to be affected by the CDM projects, and this is another reason for not taking them into account when determining the emission factor.

In an attempt to include all generating sources, project developers considered the option to research for available, but non-official data, to supply the existing gap. The solution found was the International Energy Agency database built when carrying out the study "Road-Testing Baselines For Greenhouse Gas

Mitigation Projects in the Electric Power Sector", published in October 2002. Merging ONS data with the IEA data in a spreadsheet, project proponents have been able to consider all generating sources connected to the relevant grids in order to determine the emission factor. The emission factor calculated was found more conservative when considering ONS data only, as the table below shows the build margin in both cases.

IEA/ONS Merged Data Build Margin (tCO2/MWh)	ONS Data Build Margin (tCO2/MWh)
0.205	0.104

Therefore, considering all the rationale explained, project developers decided for the database considering ONS information only, as it was capable of properly addressing the issue of determining the emission factor and doing it in the most conservative way.

Efficiency data on fossil fuel plants were taken from IEA document. This was made after considering that there was no more detailed information on efficiency, from public, renowned, and reliable sources.

From the reference as mentioned, the efficiency of conversion (%) of fossil fuels to thermo electrical plants fed with fossil fuel was calculated based on the installed capacity of each plant and on the power effectively produced. For most thermo electrical plants under construction, a constant value of 30% was used to estimate its fossil fuel conversion efficiency.

This value was based on data as available in the literature and on observation of real conditions of this kind of plants operating in Brazil. It was assumed that the only 02 natural gas-combined cycle plants (amounting to 648 MW) have higher efficiency rate, i.e. 45%.

Therefore project participants have concluded that the best option available was to use such numbers, although they are not well consolidated.

All this information was directed to the current CDM project validators and thoroughly discussed with them, with the purpose to clarify every item and every possible doubt.

The table below summarizes conclusions of the analysis, with the calculation of the emission factor as presented.

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid

Baseline	EF_{OM}[tCO_2/MWh]	λ_y	Generation [MWh]
2005	0,9653	0,5275	315.511.628
2006	0,8071	0,4185	315.192.117
2007	1,0000	0,5452	345.346.762
	$EF_{OM, simple-adjusted}$	$EF_{BM,2007}$	**EF_y [tCO_2/MWh]**
	0,4599	0,0709	**0,2654**

Annex 4

MONITORING INFORMATION

Further details on the distribution of responsibilities:

(E = responsible for executing data collection, R = responsible for overseeing and assuring quality, I = to be informed)

Task	On-site technician	QC manager	CDM Programme Manager	Management (Project Developer)	EcoSecurities
Collect Data	E	R	I	N/A	N/A
Enter data into Spreadsheet	I	E	R	N/A	N/A
Make monitoring report	N/A	N/A	I	R	E
Archive data & reports	I	E	R	N/A	N/A
Calibration/ Maintenance	E	R	I	N/A	N/A

Annex 5

ADJUSTMENT FACTOR CALCULATION AND LANDFILL INFORMATION

The Gramacho Landfill is the biggest MSW landfill in Latin America, located in Duque de Caxias Municipality, Rio de Janeiro, Brazil. Site operations are managed by COMLURB (from Portuguese *Companhia Municipal de Limpeza Urbana*). According to CIDE (2007) and IBase (2005), it receives approximately 10,000 tonnes of waste per day, meaning that this landfill receives around 80% of the waste produced in the Rio de Janeiro municipality and surrounding municipalities (namely São João de Meriti, Duque de Caxias, Mesquita and Nilópolis). The landfill has an approximate area of 140 ha, with depths greater than 36 m.

The landfill started its operations as an open dump in 1978. In the early 1990s COMLURB began converting the open dump into a sanitary landfill. By 1996, most of the attributes of a modern sanitary landfill were in place, including controlled access, a recycling facility, well-maintained access roads, waste compaction by bulldozers, and the application of daily and intermediate cover soils (SCS Engineers, 2005).

According to SCS Engineers[11] (2005), the landfill currently has elements of LFG (landfill gas) collection and control. These consist of three independent systems: an LFG passive venting system (with no destruction of methane), an LFG collection and flaring system, and an LFGTE (landfill gas-to-energy) system. Because these systems were developed independent of the CDM, a baseline methane reduction would have to be considered and applied to this project evaluation. SCS considered a nominal baseline rate to be appropriate, given the very limited scope and current flow rates of the LFGTE and the LFG flaring control systems.

LFG Venting System

The LFG venting system consists of approximately 263 vents that are unconnected to any system of collection piping. The vents were constructed by digging 3 to 5 m deep holes, installing polyvinyl chloride (PVC) piping in the holes, and backfilling with gravel. The vents are well distributed throughout the site.

LFG Extraction and Flaring System

The LFG extraction and flaring system consists of 16 additional vents which are connected via a PVC piping system to a small blower and flaring station. The vent construction is similar to that described above. The vents and blower and flaring station are located in the central portion of the landfill. The blower has a capacity of 1,880 m^3 per hour. The candlestick flare has a capacity of 2,500 m^3 per hour.

LFGTE System

The LFGTE system consists of a series of 27 vents which are connected high-density polyethylene (HDPE) piping to a small combination LFG/Biodiesel engine powering a 200 kilowatt (kW) generator.

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[11] SCS is an award-winning firm that provides engineering, construction, and long-term operations and maintenance to private and public sector clients, based in Long Beach, California, USA. Since 1970, they have been providing economically and environmentally sound solutions for solid waste management and site remediation projects throughout the world. They had prepared the referred report for The World Bank, relying upon information provided by the City and various assumptions. Judgments and analysis are based upon this information and SCS's experience with LFG collection and utilization systems.

The last two systems do not operate all the time and, during the operational time, do not provide the expected results, mainly because of the very poor proportion of vents per area of landfill. Therefore, the flare of the LFG Extraction and Flaring System operates passively when operational and the LFGTE System, designed to operate with equal amount of LFG and Biodiesel has problems to obtain its share of LFG.

Passive collection system means a gas collection system that solely uses positive pressure within the landfill to move the gas rather than using gas mover equipment. Passive systems are primarily effective in controlling convective flow and have limited success controlling diffusive flow (EPA, 1993).

According to the methodology AM0025:

"In cases where regulatory or contractual requirements do not specify MDreg,y an 'Adjustment Factor' (AF) shall be used and justified, taking into account the project context"

So, the adjustment factor used was estimated taking into account:

1. Destruction of CH_4 in the baseline scenario: The methane is combusted at the top of some of the wells, by means of destruction in a low efficiency manner. The "tool to determine project emissions from flaring gases containing methane", used as a conservative reference, says that for open flares, 50% of destruction efficiency should be used. However, to be even more conservative, we will use the value recommended for enclosed flares, **90%** of efficiency;

2. Percentage of methane vented through the passive system: the site operator has installed a simple passive venting system. It is widely known that passive systems are not as efficient as the active systems, with probable reasons for this being mainly those stated below:

The LFG seeks the equilibrium with the atmospheric pressure. The waste coverage, among other factors, causes some delays in this pressure stabilization, resulting in higher or lower pressure oscillations compared to the atmospheric. This result is that LFG flow through less resistant ways, favoring the leak of LFG through the coverage. According to EPA (2005), using a simple soil cover allied to a passive vent system may result in the majority of the landfill gas being emitted through cracks and gaps in the cover or directly through the soil and not necessarily through the passive vents.

The gas will tend to migrate from the landfill on a path through the refuse and surrounding soils that offers the least resistance (EPA, 1995) and as methane is lighter than air and carbon dioxide is heavier than air, they "*... will not separate by their individual density...*" but rather move "*... as a mass in accordance with the density of the mixture and other gradients such as temperature and partial pressure*" (EPA, 1993). This usually results in landfill gas moving upward through the landfill surface through the surface soils into ambient air.

In this type of situation, the radius of influence of a passive vent is relatively small whereas the transport of landfill gas is multi-dimensional and will take the path of least resistance (EPA, 2005).

The above mentioned characteristics show that the passive systems are less efficient than active systems.

The IPCC guidelines 2006 measured in 11 closed landfill sites (where the collection efficiency is greater than in operational landfill site) an average collection efficiency of 37% for active systems. In general, high recovery efficiencies can be related to closed SWDS (solid waste disposal sites), with reduced gas

fluxes, well-designed and operated recovery and thicker and less permeable covers. The active systems avoid the LFG leakage through the surface by creating a negative pressure gradient (suction) in the landfill cells. In a conservative manner, we will use for calculations the **37%** of collection efficiency recommended for active systems;

3. Wells that actually destroy methane: Because the existing collection system is predominantly a passive venting system, it is estimated to provide extremely poor coverage. The system methane destruction efficiency resulting from the 16 wells delivering LFG to the flare and the 27 wells delivering LFG to the LFGTE facility can be indirectly estimated based on the percentage of wells and the efficiency of collection and destruction. The table below shows the main parameters used in this calculation.

Table – Data used to calculate the Adjustment Factor

Type of vents	#	%	Destruction Efficiency
without flare	263	85.9%	0%
with flare	16	5.2%	33.3%
with electricity production	27	8.8%	33.3%
total	306	100%	-

Efficiency of enclosed flare	90%
Efficiency of active system capture	37%

Destruction efficiency of the entire system – **Adjustment Factor**	**4.7%**

The number (#) of vents from each type is taken from SCS Engineers (2005). The Efficiency of enclosed flare and of active system capture is taken from IPCC guidelines (2006). The destruction efficiency is reached by multiplying the efficiency of the enclosed flare with the efficiency of active system capture.

The Adjustment Factor is calculated by the sum of the percentages from vents that actually destroy methane (5.2% + 8.8%) multiplied with the average efficiency of destruction from these two types of vents (33.3%). This is already very conservative, as we are assuming that the entire LFG production is being collected by the wells. In fact, it does not happen, as explained in “number 2” above.

As the project activity comprises an aerobic composting unit, the efficiency from the project activity can be considered 100% (possible project emission and/or leakage are already accounted for in the calculations requested by the methodology). Therefore, the equation is:

$$AF = (V_{Flaree} + V_{Electricity}) \times E_{System}$$

Where:

AF	Adjustment Factor
V_{Flare}	Percentage of vents leading to a flare (SCS Engineers, 2005);
$V_{Electricity}$	Percentage of vents leading to an engine to produce electricity (SCS Engineers, 2005);
E_{System}	Efficiency of the entire system capture and destruction of LFG (IPCC Guidelines, 2006).

It results in: AF = (0.052 + 0.088) * 0.333 = 0.14 * 0.333 = 0.047

Therefore, to be extra conservative, the AF used is **5%**.

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