LANDFILL GAS EMISSION REDUCTION – CAIEIRAS, SP BRAZIL

PROJECT DESIGN DOCUMENT (PDD)

Version 4

Essencis Soluções Ambientais SA

Rodovia dos Bandeirantes, km 33

Caieiras, SP - Brazil

Revision #	Description	Date	Modified by:
0	Draft	26/07/2004	JScalon
1	Draft – ACM0001 Additionality tool	08/12/2004	JScalon
2	Complementary info for validation	10/03/2005	JScalon
3	Changing in the starting date of first crediting period, and suppressing of 2005 in the reduction counting years.	12/09/2005	JScalon
4	Inclusion of the following post-registration changes: • Corrections (in information that do not affect the project design): - Revised quantitative information about occured and forecasted disposal of municipal solid waste (MSW) at the CTR Caieiras landfill from the period from year 2007 onwards; - Revised ex-ante estimations of emission reductions (due to revision of the amount of MSW historically disposed in the landfill as well as revised MSW disposal forecasts from year 2007 onwards); - Corrections of minor typo errors/mistakes and general text improvements.	10/01/2013	Fernando Freitas

CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 – in effect as of: 1 July 2004)

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Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Caieiras landfill gas emission reduction

A.2. Description of the project activity:

The organic content of the disposed Municipal Solid Waste (MSW), through its decomposition, produce large quantities of landfill gas (LFG). The major contents of LFG are methane (CH_4) and carbon dioxide (CO_2), powerful greenhouse gases (GHG).

At the time of the project initial design conceptualization, the project activity involved the installation of methane collection and destruction equipment (by promoting combustion of collected LFG in high temperature enclosed flares) with initial flaring capacity of 200 m³/h in 2005, expanding such capacity up to 48.000 m³/h in 2024[1]. This equipment will consist of LFG pipeline network connected to the LFG collecting wells leading to enclosed high temperature flares, which are capable of performing combustion and destruction of the methane (with high methane destruction efficiency).

Besides promoting GHG emission reduction, the project activity will contribute towards Sustainable Development in Brazil. At the time of the project design initial conceptualization[2], the project design was consistent with criteria that were mentioned in a discussion paper dated April 2002 on performance metrics for sustainable development for CDM projects in Brazil which was published by the Ministry of Environment of Brazil (source: Ministerio do Meio Ambiente 2002, "*Criterios de Elegibilidade e Indicadores de Sustentabilidade para Avaliação de Projetos que Contribuam para a Mitigação das Mundancas Climaticas e para a Promoção do Desenvolvimento Sustentavel*.[3]"). For example, utilization of a new technology to capture and destroy LFG in Brazil, switch fossil fuel in the neighboring industry

[1] As per available information dated January 2013, the installed nameplate LFG destruction capacity for the project acitivity (based in the nameplate LFG combustion capacity of the gradually installed high temperature enclosed flares) were as follows:

- in year 2007: 1 high temperature enclosed flare with installed LFG flaring capacity of 7,500 m^3/h was installed.
- in year 2008: 2 high temperature enclosed flares with individual installed LFG flaring capacity of 7,500 m^3/h each were installed. That accounts to a total LFG flaring capacity of 15,500 m^3/h.
- in year 2008: 2 high temperature enclosed flares with individual installed LFG flaring capacity of 7,500 m^3/h each ere installed. That accounts to a total LFG flaring capacity of 15,500 m^3/h.
- in year 2011: 3 high temperature enclosed flares with individual installed LFG flaring capacity of 7,500 m^3/h each were installed. That accounts to a total LFG flaring capacity of 22,500 m^3/h.
- in year 2012: 3 high temperature enclosed flares with individual installed LFG flaring capacity of 7,500 m^3/h each + 1 high temperature enclosed flare with individual installed LFG flaring capacity of 6,000 m^3/h were installed. That accounts to a total LFG flaring capacity of 28,500 m^3/h

By taking into account updated historical data for MSW disposal until 2012 + MSW disposal projections from the period from year 2013 to year 2030 (forecast of 2.0% increment in the annual mass of MSW), it is expected (based on data available in Jan. 2013) that, by year 2024, the project's LFG destruction component will reach a technical nameplate flaring capacity of 166.641 ton CH_4 / year (by considering a LFG collection efficiency of 80%).

[2] The time period encompassing years 2004 and 2005 is when the initial conceptualization of the general design of the project activity was undertaken. All information and details applicable in the context of the initial project design (as earlier indicated in the previous registered version of the PDD) are referred in this revised version of the PDD as "*information available at the time of the project design initial conceptualization*" and refers to information dated/valid at the period encompassing years 2004 and 2005.

[3] Translation into English language: "Ministry of Environment 2002, "*Eligibility criteria and sustainability indicators for evaluation of projects that contribute for climate change mitigation and promotion of Sustainable Development"*

and also possible generation of electricity from a renewable source. Moreover, at the time of the project design initial conceptualization, Essencis Soluções Ambientais S.A. voluntarily proposed to allocate 2% of value from net proceeds from sale of GHG emission reduction to activities that would benefit the local community, environment and economy. Its parent company SUEZ Ambiental[4] has a strong past record of demonstrating corporate social responsibility through initiatives in the communities where it is settled.
At the time of the project design initial conceptualization the landfill operator was also studying the possibility of signing a LFG selling contract with a local industry not in the context of the CDM project activity. The contract, which was not signed, would encompass the supply of a 600Nm³/h continuous flow of LFG in year 2005, expanding the regular supply flow up to 9.800 Nm³/h of LFG in 2006. The client would be an industrial facility located within 3 km from the landfill site. In the absence of the project activity, the rest of the generated and not collected/utilized LFG would be freely emitted into the atmosphere without any control. At the time of the project design initial conceptualization, this quantity of LFG that would be supplied to the industry, as well as direct burning on wellheads, was assumed as sufficiently high to promote LFG draining required to avoide risk of fire and explosions in the CRT Caieiras landfill.

A.3. Project participants:

ESSENCIS SOLUÇÕES AMBIENTAIS S.A. - BRAZIL
ELECTRIC POWER DEVELOPMENT CO. LTD. - JAPAN

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil

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

São Paulo State

A.4.1.3. City/Town/Community etc:

Caieiras

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

The CTR Caieiras landfill is located on the extreme Northeast of Caieiras municipality, on the Metropolitan Area of São Paulo (RMSP). The site has a total area of 3.500.000 m², which 1.620.000 m² will be preserved forming a Transaction Area, in conformity with municipal legislation. Part of the

[4] In January 2013, SUEZ Ambiental was not any longer a shareholder of Essencis Soluções Ambientais S.A. Since year 2006, Solvi Group has assumed all was te management related operations of Suez Ambiental (which was the local subsidiary of the France headquartered Suez Group.

landfill area is located within Franco da Rocha municipality, which will not be used for the waste disposal purposes. This area will be preserved as required by applicable legislation. The site access is by Bandeirantes Highway, km 33.

The project geographical coordinates are as follows:

Latitude:

23° 20' 40" S or -23.3444 S

Longitude:

46° 46' 20" S or -46.7722 W

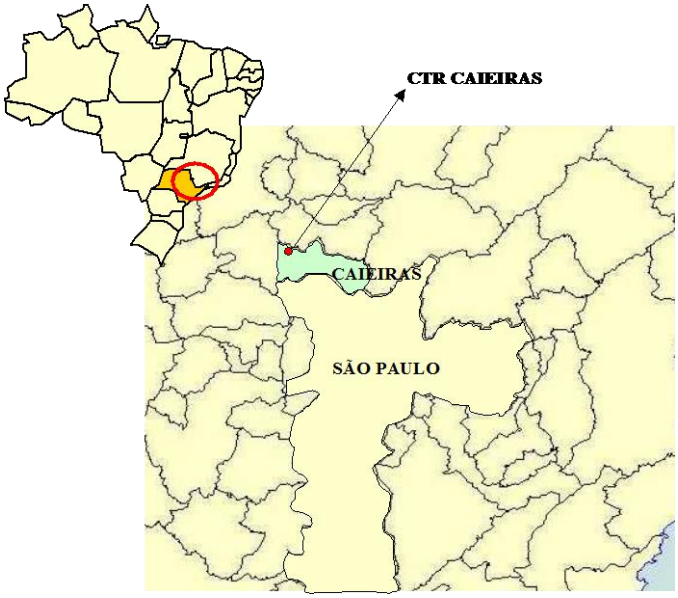

Figure 1: detail on the landfill physical location

The Caieiras landfill (also designated as CTR Caieiras landfill) was constructed respecting all environmental and technical demands of the license and the strict demands of internal standards and requirements of Essencis Soluções Ambientais S.A., like:

- a complete waterproofing and drainage system on the bottom and side of the landfill;
- monitoring wells strategic constructed around the landfill;
- piezometers installed inside the landfill in order to monitor the head of leachate;
- wells to drain LFG outside the waste landfilled

Besides the landfill, the CTR Caieiras has a complete structure to receive and handle waste, such as controlled entrance, weighbridge, laboratory, sludge solidification shed, a hazardous waste landfill, a TDU (Thermal Desorption Unit) to treat contaminated soils, a staff office and a restaurant.

Photo 1: Caieiras landfill view (picture dated year 2005)

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

Sectoral Scope 13 - Waste handling and disposal

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

At the time of the project design initial conceptualization, Essencis Soluções Ambientais S.A. was a Brazilian subsidiary, which was 50% controlled by SUEZ Group's subsidiary in Brazil. As per available data at the time of the project design initial conceptualization, SUEZ Group operated 237 landfills all over the world (206 in Europe) with a total of 34 million tons of treated waste. Most of these landfills were equipped with biogas capture system and treatment, specially those which must comply with European legal demands on waste management. In 2002, 16 of them included power generation using LFG or waste as fuel, generating 370,000 MWh of electricity, using LFG or waste as fuel Hence, at the time of the project design initial conceptualization, this system represented leading-edge technology to LFG capture in Brazil and would serve as a replicable model for such projects.

The LFG collection system includes:

1- equally distributed wells in the landfill to extract LFG through exhaustion (negative pressure) with centrifugal blowers;

2- a network of LFG collection pipes connected to the LFG collection wells transporting collected LFG to a LFG treatment unit;

3- equipment to treat the LFG (drying all humidity before passing through the centrifugal blowers) and sent to flaring.

4- Eventually, an integrated cover with impermeable material, such as PVC or similar, on the waste deposit.[5]

[5]In January 2013, there was no integrated cover with impermeable material (such as PVC or similar) installed in the surface of the CTR landfill as part of the project activity. No integrated cover was ever installed in the CTR Caieiras landfill as part of the implementation of the project activity. No changes in the operation and management of the waste disposal activities in the CTR Caierias landfill was promoted by the project activity. This is in accordance with applicability conditions of the latest version of the ACM0001 baseline and monitoring methodology (version 13).

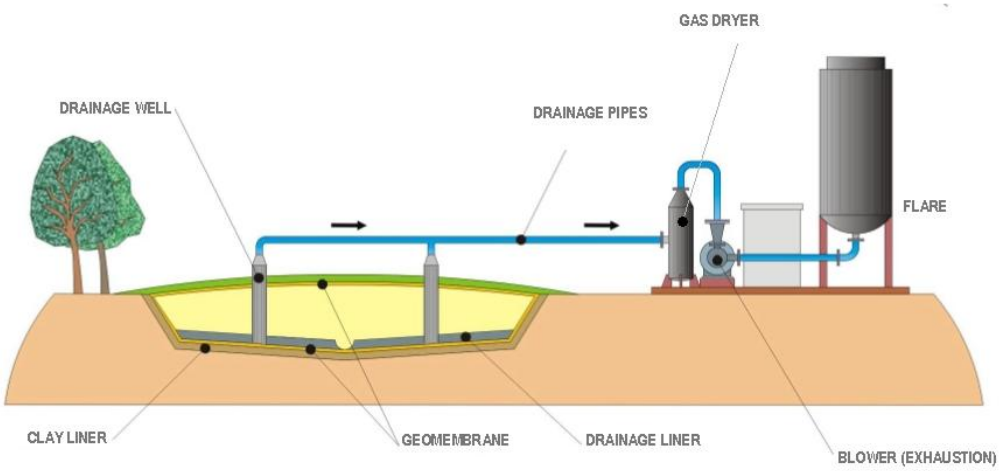

Figure 2: technical structure of the project activity

Collection efficiency:

Passive Venting system: In the absence of the project activity, LFG would be burned directly in the top of the existing LFG drainage well (well head) in the surface of the landfill, with probably less than 90% of combustion efficiency. LFG that reaches these wells is located around the structure, and is drained naturally. Figure 3 illustrates the bulb (region) of influence around the well inside the waste. Consequently, at the time of the project design initial conceptualization, it was assumed that LFG destruction efficiency varies from 5% to 20% of total LFG production, depending on the area type and conditions (in operation or not). This scenario is typically what was practiced in Brazil at the time of the project design initial conceptualization.

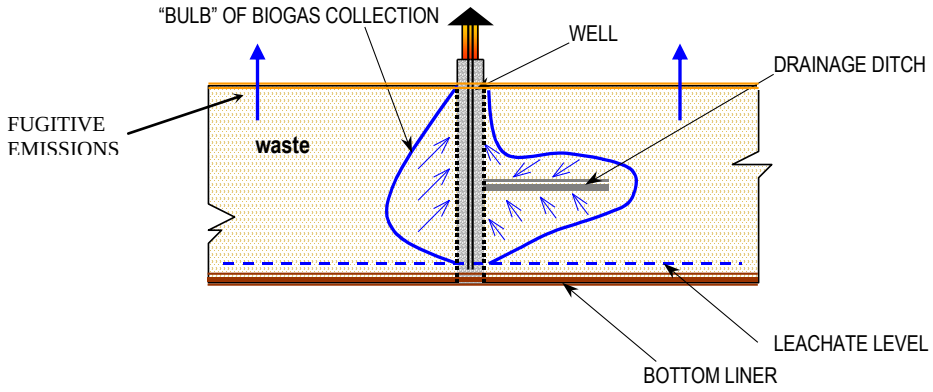

Figure 3: drainage well for gas venting

Forced exhaustion: under the project scenario, LFG is collected through forced exhaustion promoted by centrifugal blowers. The landfill may be eventually covered by a PVC or similar impermeable material to

prevent LFG to come out through the landfill surface[6]. Consequently, the collection efficiency could reach 80% in relation to the total LFG produced, depending on the area type and conditions (in operation or not). Also, the enclosed flare efficiency of combusting LFG in enclosed high temperature flares is between 98% and 99%. Figure 4 illustrates the bulb of influence when using this system.

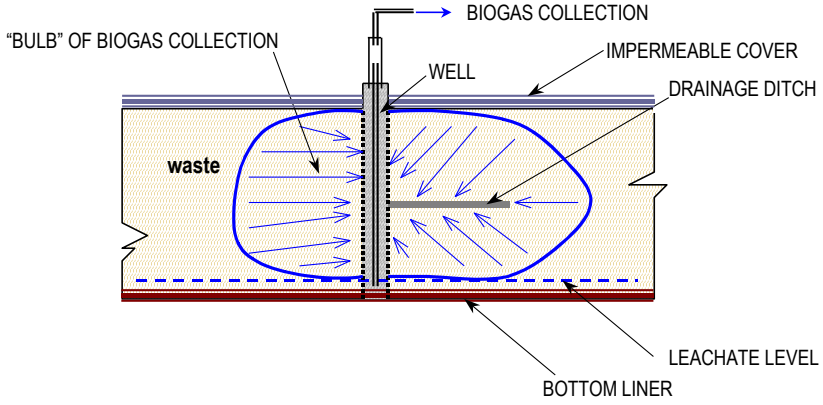

Figure 4: drainage well for gas forced exhaustion

Significant increase in the amount of MSW actually disposed in the CTR Caieiras landfill from the period from March 2007 onwards:
As per the ex-ante estimation of emission reductions in the previously registered version of the PDD (version 3), the project would collect and flare LFG which would be generated from the decomposition of an average historical MSW disposal rate stream of 4,000 tons of waste per day. This MSW disposal rate stream estimation was actually not confirmed during the monitoring period due to the following reasons:

- From March 2007 onwards, other public landfills (which at the time were also used for disposal MSW from the city of São Paulo) faced operational problems:
  - The Bandeirantes landfill (public owned landfill) was closed on March 2007. As a result of that, all MSW stream which were used to be disposed in this landfill started to be disposed to the CTR Caierias landfill, thus increasing the average MSW disposal rate at the CTR Caieiras landfill to about 7,500 ton of MSW per day.

  - Later in August 2007, other owned public landfill serving the city of São Paulo (São João Landfill) suffered with an unfortunate and unexpected severe accident event (slide of disposed waste accident). As a consequence of this severe accident, MSW disposal at the São João landfill was interrupted and significant part of the MSW stream that used to be disposed in this landfill thus started to be also disposed in the CTR Caierias landfill, thus increasing its total MSW disposal rate to about 10,000 ton of MSW per day.

While the permanent interruption of MSW disposal activities at both Bandeirantes and São João landfills was a decision of the environmental authority for the São Paulo State (which is named

[6] In January 2013, there was no integrated cover with impermeable material (such as PVC or similar) installed in the surface of the CTR landfill for covering disposed MSW as part of the project activity. No integrated cover was ever installed in the CTR Caieiras landfill for covering disposed MSW as part of the implementation of the project activity. No changes in the operation and management of the waste disposal activities in the CTR Caierias landfill was promoted by the project activity.

CETESB), the decision of sending an incremental amount of MSW to be disposed in the CTR Caieiras landfill was a decision from the administrative authorities of the municipality of São Paulo.

The occurred heavy increment in the amount of MSW actually disposed in the CTR landfill obviously resulted in a significant increase in the amount of LFG being generated at the CTR landfill and collected & destroyed by the CDM project activity "Caieiras landfill gas emission reduction" from the end of year 2007 onwards. With more LFG being collected and destroyed, baseline emissions and emission reductions achieved by the project activity also increased accordingly.

It is important to note that in the absence of the CDM project activity (baseline scenario), the occurred significant increment of MSW disposal rate at CTR landfill would happen anyway. Thus, baseline emissions are not artificially inflated due to the occurred increment in the amount of MSW disposed at the CTR landfill.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

National/sectoral policies:

As per data valid at the time of the project design initial conceptualization, of the 141,618 ton of Municipal Solid Waste (MSW) that were daily collected in the Southeastern Region of Brazil, 56% was sent to dump sites and controlled landfills, and 37% was sent to landfills[7]. This means that 93% of all collected MWS was being landfilled and generated LFG was not managed or when collected, was burned directly on the head of LFG draining wells under conditions explained and the previous chapter (venting system). Under these few cases, the destruction of LFG is done merely for safety reasons, with the purpose of avoiding fire and explosions.

At the time of the project design initial conceptualization, there was no local, regional or national obligations in Brazil for an efficient treatment of the LFG. Neither has there been a national model governing landfill practices, only technical norms as provisioned by the Brazilian Association of Technical Norms (ABNT) without any requirement regarding LFG management besides gas venting.[8]

At the time of the project design initial conceptualization, a new National Waste Management Policy (Política Nacional de Resíduos Sólidos) was under discussion, but no change was foreseen for the subsequent years[9]. Even the project of such Policy does not specify when and how its legal requirements

[7] Source: National Research on Sanitation, IBGE 2000.

[8] In January 2013, So there was still no legal restriction neither requirement for LFG gas collection and its destruction using active or passive high temperature enclosed flares in Brazil. Moreover, there was still no legal restriction neither requirement for passive venting of LFG or its combustion in conventional LFG destruction systems. Actually, there is no applicable regulation that deals with LFG management in Brazil.

[9] After years of studies and negotiations, the Brazilian Regulation of the National Policy on Waste Management, established by Decree No. 7,404/10 (the Decree), was finally published on 23 December 2010. In force since its publication, this decree regulates the National Policy on Waste Management (PNRS), established by Federal Law No. 12,305/10 (the LPNRS), and creates the Steering Committee for the Implementation of Reverse Logistics Systems (Steering Committee) and the PNRS Interministerial Committee. This new Brazilian Regulation of the National Policy on Waste Management does not establish any requirement, obligation or recommendation related to LFG management at landfills in Brazil.

As outlined by the law firm "Tauil & Chequer Advogados" in a recently published article, *"(...) The Regulation of the National Policy on Waste Management, established by Decree No. 7,404/10 (the Decree), was published on December 23,*

would be implemented. And it is unlikely to occur for the next years, since the landfills are so needy for financial assistance from the public and private sector to operate and comply with the basic requirements such as monitoring, groundwater contamination prevention, leachate proper treatment and etc.

Local context of Caieiras landfill

At the time of the project design initial conceptualization, the CTR landfill had a LFG selling contract under discussion with local industries. At that time it was assumed that whenever the contract was concluded, the associated revenues from the sale of LFG would make collection of LFG in the CTR landfill more economically attractive (collection estimated from 25 to 40% of all methane generated in the landfill), thus without the need of CERs additional revenue for making it economically feasible.

These industries would utilize collected LFG, (after its treatment and purification), for drying up paper after the homogenization of cellulose fibers. This drying process would be made by using steam generated using LFG as fuel in boilers. At the time of the project design initial conceptualization, it was also assumed the company would also had a potential to use LFG for generation of electricity for internal use.

LFG to be sold woud need to contain at least 45% of methane, as to be established in the contract. The rest of generated and not collected LFG would be emitted into the atmosphere without any kind of treatment in the absence of the project activity.

At the time of the project design initial conceptualization, there was another considered internal application for collected LFG under study: collected LFG would be used as fuel to run a TDU (thermal disorption unit) installed in the CTR Caieiras landfill to treat polluted and contaminated soils. At the time

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2010. In force since its publication, the Decree regulates the National Policy on Waste Management (PNRS), established by Federal Law No. 12,305/10 (the LPNRS), and creates the Steering Committee for the Implementation of Reverse Logistics Systems (Steering Committee) and the PNRS Interministerial Committee.

The main purpose of the PNRS Interministerial Committee is to support the PNRS structuring and implementation, in order to enable the accomplishment of the provisions and goals set forth by the LPNRS. The Steering Committee has the basic function of guiding the implementation of reverse logistics.

Among the instruments regulated by the Decree are the Reverse Logistics Systems, the Waste Management Plans (PGRS) and the National Registry for Hazardous Waste Operators.

The Decree lists three specific instruments for the implementation and operation of the reverse logistic systems: (i) sectorial agreements, executed between public authorities and the industry; (ii) regulations, issued by the executive branch; and (iii) commitment agreements—which are to be adopted in the absence of sectorial agreements and regulations and when specific circumstances require more restrictive obligations—to be approved by the competent environmental agency..

Regarding the obligation to prepare a PGRS, which should be required within environmental permitting proceedings, the Decree mentions the possibility of jointly submitting the PGRS under specific conditions and in cases where activities are conducted in the same condominium, municipality, micro-region or metropolitan/urban areas. Additionally, the Decree establishes that small companies that generate household waste, as provided for by article 30 of the LPNRS, are not required to submit a PGRS.

Regarding the National Registry for Hazardous Waste Operators, which must be integrated to the already existing Federal Technical Registry of IBAMA, the Decree establishes a registration obligation for companies that manipulate or operate hazardous waste. The Decree also describes those who are considered generators or operators of hazardous waste, establishing several requirements for their authorization or permitting. These include the preparation of hazardous waste management plan, the demonstration of technical and economic capacity and the obtaining of civil liability insurance for environmental damages."

of the project design initial conceptualization, the TDU was already in operation but with another fuel source[10].

At the time of the project design initial conceptualization, the landfill only burned LFG at the top of the LFG draining wells as described in the LFG venting system above.

At the time of the project design initial conceptualization, it was assumed that if the LFG supply contract with local industry is not concluded, and in the absence of the CDM project, the landfill will continue to practice the passive venting with direct burning at wellheads, what would represent a maximum destruction of 20% of LFG generated by the CTR Caieiras landfill.

Hence, the emission reduction will be achieved by collecting and burning the surplus LFG , reaching a high collection efficiency of 80%.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

Total emission reduction achieved by the project over the 7-year renewable crediting period (tCO2e): 5,352,253[11]

Annual average emission reduction achieved by the project for the 7-year renewable crediting period (tCO2e): 764,646

A.4.5. Public funding of the project activity:

None

[10] At that time, the TDU unit was fuelled by LPG. In January 2013, the installed TDU unit was fuelled by diesel. So far LFG was never used as fuel in the TDU unit.

[11] Ex-ante estimations of emission reductions along the 7-year renewable crediting period were revised in January 2013 by taking into account the occurred quantitative increase in MSW disposal at the CTR Caieiras landfill from year 2007 onwards.

SECTION B. Application of a baseline methodology

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

Consolidated Methodology ACM0001: "Consolidated baseline methodology for landfill gas project activities" (version 2)

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

General Approach:

According to Paragraph 48 of "CDM Modalities and Procedures" the methodology is based on the item (b):

"Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment."

According to ACM0001 (version 2), this methodology is applicable to landfill gas capture projects activities where the captured gas is flared.

And "*it is applicable to landfill gas capture projects activities, where the baseline is partial or total atmospheric release of the gas*".

As a consequence, the conditions for the methodology applicability are:

- the most attractive course of action in the absence of the project is LFG being emitted directly into the atmosphere as demonstrated in the following sections;
- Emission reduction voluntariness not linked to any demand, of any matter;
- Real and measured proof that the baseline emissions correspond to the one chosen in the application of the baseline methodology;
- The proposed project activity won't claim any carbon credit from displacing or avoiding energy from another source.

B.2. Description of how the methodology is applied in the context of the project activity:

To simplify the explanation, the original text from the ACM0001 (version 2) is reproduced in *italics*, in the following topics.

Emission Reduction

"The greenhouse gas Emission Reduction achieved by the project activity during a given year "y"(ER_y) is the difference between the amount of methane actually destroyed/combusted during a given year ($MD_{project,y}$) and the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{reg,y}$), times the approved Global Warming Potential value for methane (GWP_{CH4})."[12]

[12] The determination of emission reductions achieved by the project activity also takes into account project emissions due to the consumption of grid electricity and fossil fuel Liquefied Petroleum Gas (LPG) by the project

In case of Caieiras project, the cases (b) and (c) are not applied and are thus not be mentioned in this document. For that reason, the calculation is done by the formula, simplified:

"$ER_y = (MD_{project,y} - MD_{reg,y}) \times GWP_{CH4}$"[13]

Where:

"ER_y is measured in tons of CO_2 equivalents (tCO_2e);

$MD_{project,y}$ and $MD_{reg,y}$ are measured in tons of methane (tCH_4);

The approved Global Warming Potential value for methane (GWP_{CH4}) for the first commitment period is 21 tCO_2e/tCH_4.

Definition of AF and $MD_{reg,y}$:

"In the case where the $MD_{reg,y}$ is given/defined as a quantity, that quantity will be used"

Using this case defined in the methodology, the Caieiras project will establish $MD_{reg,y}$ as the higher quantity of methane between the potential methane to be sold to industry ($MD_{industry,y}$) or 20% of the methane collected by the project activity (Brazilian BAU).

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

Then, the baseline is defined between two values, like the following:

If $MD_{industry,y} < MD_{project,y} * AF$ (20%)	**then** $MD_{reg,y} = MD_{project,y} * AF$ (20%)
If $MD_{industry,y} > MD_{project,y} * AF$ (20%)	**then** $MD_{reg,y} = MD_{industry,y}$

At the time of the project design initial conceptualization, the specific pre-project condition of the CTR Caieiras landfill was to recover LFG up to a quantity to possibly be sold to a local industry. This quantity would guarantee the local safety conditions and would be beyond any regulation or legal demand applicable for the CTR Caieiras landfill. Moreover, this quantity would be above the usual practices on landfills in Brazil, easier to determine, and more straightforward. Also, collection of this quantity to be sold to local industry (estimated from 23% to 40% of the LFG generated) would be paid with the revenues from its sale[14].

"Project proponents should provide an ex ante estimate of emission reductions, by projecting the future GHG emissions of the landfill. In doing so, verifiable methods should be used. Ex ante emission estimates

activity. For sake of simplification, such project emissions are not considered in the context of ex-ante estimations of emission reductions to be achieved during the 7-year renewable crediting period.

[13] While project emissions due to the consumption of grid electricity and LPG by the project activity are also accounted for the determination of emission reductions, differently than indicated in ACM0001 (version 2) ER_y actually represents baseline emissions and not emission reductions.

[14] In January 2013, no use of any share of collected LFG as fuel by a local industry has yet occurred. At the time of the initial project design conceptualization, a total of 15,698 tCH_4 was earlier forecasted to be annually sold to a local industry as gaseous fuel (to be combusted in industrial boilers) without having associated GHG emission reductions (due to destruction of methane or displacement of fossil fuel in the boilers) being claimed as CERs by the project activity. Essencis Soluções Ambientais S.A. indeed initiated dialogues with industrial facilities for the commercial supply of LFG (or purified LFG) as gaseous fuel. However, no related commercial agreement was yet established. Regardless of the occurred relative increase in the estimated amount of LFG to be generated and collected by the project activity (due to occurred quantitative increment in MSW disposal from year 2007 onwards), the same amount of LFG is still being considered as being eventually exported to an industrial facility.

have an influence on $MD_{reg,y}$.$MD_{project,y}$ will be determined ex post by metering the actual quantity of methane captured and destroyed once the project activity is operational."

Methane Potential in the waste received by CTR Caieiras:

For Lo, according to 1996 IPCC Guidelines for National Greenhouse Gas Inventories, a variation from less than 100 to more than 200m³ of CH_4 per ton of waste is indicated. Normally, Lo adopted to European waste, with approximately 30% of organic matter, is 100 m³/ton of waste.

We can estimate the following value for Equation 5.4 of IPCC guideline, 1996:

DOC = (0.4 * A) + (0.17 * B) + (0.15 * C) + (0.3 * D)

Due to the information available on site, we change that equation to the following one:

DOC = (0.4 * A) + (0.16 * (B + C)) + (0.3 * D)

Where[15]:

A: paper, board and textile = 22.0%

B+C: food and green waste: 43.0%

D: wood: 2.0%

What results that

DOC = 0.162

Lo calculation:

$Lo = MCF * DOC * DOC_f * F * 16/12$

Where:

MCF = 1 (well managed landfill)

DOC = 0.162

DOC_f = 0.77 (high biodegradable fraction in Brazilian waste)

F = 50% (on site measures has shown 40 to 50 % of CH_4 present in the LFG, with few dilution in air)

Resulting:

Lo = 0.083 Gg CH_4 / Gg waste

Lo = 116 m³ CH_4/ton waste[16]

[15] DOC was calculated using the percentages of São Paulo household waste stream from the study "MSW Characterisation 2000" – Limpurb (Solid waste Department of São Paulo Municipality). In the study, the organic matter of the waste going to Caieiras is around 43%.

[16] STP conditions (0°C, 1.013 bar) in which CH4 density is 0.0007168 ton/m³

Biodegradation kinetic:

For k, IPCC indicates a variation from 0.03 (half time of 23 years, dry condition) to 0.20 (half life of 3 years, high temperature and humidity condition).

The Brazilian conditions are quite favorable to biodegradation kinetic; however the project will include a complete cover of the landfill what enables a dry effect on disposed waste.

A half time of 9 years was then chosen, resulting a k value of 0.08.

"The methane destroyed by the project activity ($MD_{project,y}$) during a year is determined by monitoring the quantity of methane actually flared and gas used to generate electricity and/or produce thermal energy, if applicable.

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

In Caieiras project case, the two last terms of the equation above are not considered. The electricity generation using collected LFG as gaseous fuel will not be contemplated by the project. The electricity used to pump LFG (potential project emissions) will also be accounted in the determination of emission reductions achieved by the project activity. Project emissions due to the consumption of LPG by the project activity (to ignite the flares) will also be considered.

Hence, the final equation results:

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

And then, the $MD_{flared,y}$ is expressed as:

"$MD_{flared,y} = LFG_{flared,y} * w_{CH4y} * FE * D_{CH4}$

Where $MD_{flared,y}$ is the quantity of methane destroyed by flaring, $LFG_{flared,y}$ is the quantity of landfill gas sent to the flares during the year measured in normalized cubic meters (Nm^3), w_{CH4y} is the methane fraction of the landfill gas as continuously measured during the year and expressed as a fraction (in m^3CH_4 /m^3LFG), FE is the flare efficiency (the fraction of the methane destroyed), and D_{CH4} is the methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4)".

In the particular context of ex-ante estimation of emission reductions to be achieved by the project activity along the 7-year renewable crediting period, for ER calculation purpose, w_{CH4y} is assumed to be 50%.

FE is assumed to be 98-99% (as measurements and calculations of FE in the particular case of Salvador Landfill[17] (at the time of the project design initial conceptualization) has shown efficiency of around 98-99%). The flare to be used at Caieiras will come from the same supplier than those installed at Salvador de Bahia Landfill.

[17] The Salvador da Bahia landfill is a other landfill existing in Brazil which at the time of the project design initial conceptualization was also operated by SUEZ Ambiental.

Baseline

"The baseline is the atmospheric release of the gas and the baseline methodology considers that some of the methane generated by the landfill may be captured and destroyed to comply with regulations or contractual requirements, or to address safety and odor concerns"

The baseline methodology, as described above, clearly allows to consider the specific condition of the CTR Caieiras landfill in the context of the methodology, i.e., the highest value between venting system and recovery of a partial quantity of LFG to be sold to the local industry. This quantity will guarantee the local safety conditions and is beyond any regulation or legal demand for the CTR Caieiras landfill. Moreover, the quantity will be above the usual practices on landfills in Brazil, easier to determine, and more straightforward. Also, if the collection of this quantity to be sold to local industry is chosen (from 23% to 40% of the generated LFG), it is paid with the revenues from its sale and no CERs will be claimed on that amount.

This is a conservative approach, because at the time of the project design initial conceptualization the LFG collected in baseline was assumed as feasible in itself, either venting system or the quantity sold to industry. However, it is necessary to explain that the costs to implement a LFG collection system are not directly proportional to the collection efficiency to be installed. Each rating of collection efficiency (efficiency per area equipped with collection network) has its own costs associated in exponential scale.

At the time of the project design initial conceptualization, it was assumed that these quantities of LFG to be sold to the client would be measurable, agreed in contract and registered.

The performed corrections (in information which do not affect project design) (in January 2013) do not adversely affect the earlier demonstrated compliance with applicability requirements of ACM0001 (version 2). The scale of the project activity is not adversely affected by performed corrections either.

B.3. 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:

Additionality

This chapter is constructed based on the document: "Annex 1 – Tool for the demonstration and assessment of additionality" from the Sixteenth Meeting of the Executive Board.

The CTR Caieiras landfill current situation is LFG direct emission into the atmosphere plus top well burning. Wells density is around 3.5 wells/hectare.

"Step 0. Preliminary screening based on the starting date of the project activity"

According to the considered project schedule at the time of the project design initial conceptualization, the registration would happen before the starting of the first 7-year renewable crediting period.

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

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

Drawing-up of possible baseline:

ALTERNATIVE 1
Business as usual in Brazil (current situation at the landfill). Continuing simple LFG venting system with direct burning at wellhead for safety reasons, with no investment and no sale of part of the LFG produced.

ALTERNATIVE 2
Investment on a small LFG collection system. LFG will be captured for commercial purposes. The collection efficiency will be driven by client demand. The foreseen demand is estimated from 20% to 45% of LFG generation in the first years (as per quantitative LFG generation considered at the time of the project design initial conceptualization). After a few years, this percentage of LFG may be smaller, considering the increase of the LFG to be generated, leading to a collection efficiency of around 10% of the total generated LFG. Besides the sold quantity, the rest of generated LFG will use the same technology as described in alternative 1.

ALTERNATIVE 3
Alternative 2 plus an additional LFG capture and flaring of around 45% efficiency. Consequently, there will remain around 15% of venting system and fugitive emissions. The LFG collection efficiency in the alternative will reach 80% when running with all its capacity.

ALTERNATIVE 4
Alternative 2 plus electricity generation from another 30% of generated LFG (as per quantitative LFG generation considered at the time of the project design initial conceptualization)**.** The surplus of LFG will be emitted through LFG venting system and fugitive emissions. There will be revenues from electricity exported to the grid.

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

The CTR Caeiras landfill, at the time of the project's initial design conceptualization (alternative 1 above) was attending all applicable legal requirements and as a consequence, had all its necessary licenses in date.

At the time of the project design initial conceptualization, there was no legal and regulatory requirements that would compel specifically in a landfill gas emission reduction, as described in the next steps.

"Step 3. Barrier analysis – determine whether the proposed project faces barriers that:

(a) Prevent the implementation of this type of proposed project activity, and

(b) Do not prevent the implementation of at least one of the alternatives"

Step 3 approach is chosen here, however in some case (alternative 3) the explanation of why the alternative is not attractive will use also sub-step 2b : simple cost analyses, for being the most relevant reason.

"Sub-step 3a. Identification of barriers that would prevent the implementation of type of the proposed project activity :

ALTERNATIVE 1
Business as usual in Brazil.

Main barriers	**No barrier applies to this scenario** as it is what happens naturally at a landfill (fugitive emissions through cover) and as direct burning at wellheads do not imply any significant cost. Such technology has proven to be sufficient enough to prevent odor problems and to guaranty safety conditions in most of the cases.

ALTERNATIVE 2	
Investment to a small collection system for commercial purposes.	
Main barriers	**Gas quality condition**. The technology using this LFG has requirements on LFG quality (minimum of 45% of methane content) and regularity that could be difficult to achieve. These plants work 24 hours, 365 days. **Competition with other fuels**. The industries already have a system in place using natural gas and/or fuel oil. Using LFG will need adaptation in the plants. Moreover, exist an exclusivity to COMGAS company for distribution of energetic gases through pipeline network in the São Paulo state. The LFG from Caieras is therefore in competition with a project of COMGAS. An alternative under study is the delivery of the LFG through tankers trucks, however such technology is very much expensive than delivery through pipeline and had not shown economic feasibility.

ALTERNATIVE 3	
Alternative 2 plus an additional gas capture of around 45% efficiency.	
Main barriers	**The main barrier is economic.** There are no revenues associated with the surplus of around 30% of LFG collection and flaring. Technically, the landfill operator would have to increase the wells density, flaring capacity, energy consumption, among others. This will require significant investments (around 100 US$/$Nm^3$/h of capacity installed for such size of landfill) and will draw up the landfill costs, mainly linked to energy consumption and LFG capture network operation and maintenance (around 10US$/ 1,000$Nm^3$ collected for such size of landfill). At the time of the project design initial conceptualization, potential competitors of the Caieiras landfill were: Bandeirantes, Lara (Maua), Pajoan (Itaquaquecetuba), CTR Pedreira (SP), CTR Paulinia (Paulinia), Anaconda (Sta Izabel), Coveg (Santana do Parnaíba). At the time of the project design initial conceptualization, none of these landfills had LFG collection and flaring system. The ones that had a collection system in place at that time were promoted by financial subsidies, like CDM project or LFG to energy plant. Hence, the costs increasing would difficult Caierias competitiveness.

ALTERNATIVE 4	
Alternative 2 plus energy generation from another 30% of LFG.	
Main barriers	**The main barrier is market options.** At the time of the project design initial conceptualization, electricity generation using LFG as fuel were not competitive with the usual sources. Electricity normal price for the producer (59.65 R$/MWh)[18], was lower than the power generation costs (per MWh) using LFG as fuel. To turn such project feasible, the Brazilian Government has created the "Alternative Sources for Electricity Generation" (PROINFA) Incentive Program. But for the first phase of the program, Caieiras landfill does not fulfill the requirements to participate. And at the time of the project design initial conceptualization, there was no perspective for a second program for the next years.

[18] Extracted from http://www.cesp.com.br/sitefin/index.htm – site of the Energy Company of São Paulo State

"Sub-step 3b. Show that the identified barriers would not prevent the implementation of at least on of the alternatives"

Baseline scenario: 2 alternatives are considered viable: alternative 1 as it comply with Brazilian regulation and represent the Brazilian Business as Usual. Alternative 2 : although Caieiras is in the preliminary discussion phase for LFG selling, exist the probability of turning it feasible, by delivering the LFG by truck, or by entering in an agreement with COMGAS for the distribution of the Caieras LFG. Price for natural gas ir around 0.60 R$/10,000 kCal and preliminary study estimates a possibility to deliver LFG at around 0.50 R$ / 10,000 kCal. The LFG price is then around 16% chipper than natural gas, however, regularity on quality and delivery is not comparable with natural gas, and so the landfill does not have the capacity to feed 100% of industry need immediately. At the time of the project design initial conceptualization, it was considered that the success of the CDM project would be an important element to help mitigating the technical barrier of alternative 2. Therefore, alternative 1 and 2 are the most likely outcome between all baseline scenarios as demonstrated previously.

The project activity scenario corresponds to technology of alternative 3 aiming at maximum collection efficiency. Selling contracts to local industry plus, excellence in state-of-the-art for biogas capture and destruction, reaching at total, around 80% destruction efficiency in relation with total LFG production.(around 5% occurring naturally or by direct burning on wells, around 30% sold to industry and around 45% flared onsite).

The project activity will then be the additional biogas capture and flaring beyond the amount sold to industry.

Additional comments on probability of scenario 3 becoming the baseline scenario:

Brazilian business as usual

According to the recent study "*Estudo do potencial de energia proveniente de aterros sanitários nas regiões metropolitanas e grandes cidades do Brasil*" (Study of the energy potential from LFG in the metropolitan areas and big cities of Brazil) published by CEPEA – USP (Centro de Estudos Avançados em Economia Aplicada – Universidade de São Paulo), data raised are from the best managed landfills and only one or two have biogas forced exhaustion. All the others are just venting systems at most.

Conclusion: based on this study, at the time of the project design initial conceptualization few landfills barely had a LFG capture system and did it for safety reasons, not for legal demands. Furthermore, methane is directly destroyed in the top of the drain wells, without any burning control. This state of the art, in the most conservative approach, results in a neglected destroyed amount of 10% of LFG produced.

Brazilian possible legal demands

At the time of the project design initial conceptualization, a new National Waste Management Policy (Política Nacional de Resíduos Sólidos) was under discussion, but no change was foreseen for the next years. Even the project of such Policy does not specify when and how its legal requirements would be implemented[19]. And it was regarded as unlikely to occur in the next years , since the landfills were at that

[19] After years of studies and negotiations, the Brazilian Regulation of the National Policy on Waste Management, established by Decree No. 7,404/10 (the Decree), was finally published on 23 December 2010. In force since its publication, this decree regulates the National Policy on Waste Management (PNRS), established by Federal Law No. 12,305/10 (the LPNRS), and creates the Steering Committee for the Implementation of Reverse Logistics Systems (Steering Committee) and the PNRS Interministerial Committee. This new Brazilian Regulation of the National Policy on Waste Management does not establish any requirement, obligation or recommendation related to LFG management at landfills in Brazil.

As outlined by the law firm "Tauil & Chequer Advogados", *"The Regulation of the National Policy on Waste Management, established by Decree No. 7,404/10 (the Decree), was published on December 23, 2010. In force since its publication, the Decree regulates the National Policy on Waste Management (PNRS), established by Federal Law No. 12,305/10 (the LPNRS), and creates the Steering Committee for the Implementation of Reverse Logistics Systems (Steering Committee) and the PNRS Interministerial Committee.*

time so needy for financial assistance from the public and private sector to operate and comply with the basic requirements such as monitoring, water contamination, leachate proper treatment and etc.

At the time of the project design initial conceptualization, it was assumed that future legal demands will possibly be developed for LFG collection and destruction. If that happens, it is unlikely that the quantity of LFG required to be destroyed would be more than 20% of the total LFG generated. Considering that the Waste Management Policy may be in force demanding a quantity above the baseline of this project (up to 40%), the project baseline will be recalculated at the renewal of the crediting period to reflect the new BAU.

"Step 4. Common practice analysis

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

Landfill gas emission is a very particular situation that can not be compared with some other activities.

Main reasons of such specificity are :

- Production of a great volume of GHG
- Emissions are not concentrated in a stack, but are surfaces emissions from all the area of the landfill.
- Emissions are not directly linked with the economical activity of the site, i.e. even if the activity stops, emissions continue, as organic matter degradation occurs over 10 to 20 years

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The main purpose of the PNRS Interministerial Committee is to support the PNRS structuring and implementation, in order to enable the accomplishment of the provisions and goals set forth by the LPNRS. The Steering Committee has the basic function of guiding the implementation of reverse logistics.

Among the instruments regulated by the Decree are the Reverse Logistics Systems, the Waste Management Plans (PGRS) and the National Registry for Hazardous Waste Operators.

The Decree lists three specific instruments for the implementation and operation of the reverse logistic systems: (i) sectorial agreements, executed between public authorities and the industry; (ii) regulations, issued by the executive branch; and (iii) commitment agreements—which are to be adopted in the absence of sectorial agreements and regulations and when specific circumstances require more restrictive obligations—to be approved by the competent environmental agency.

Regarding the obligation to prepare a PGRS, which should be required within environmental permitting proceedings, the Decree mentions the possibility of jointly submitting the PGRS under specific conditions and in cases where activities are conducted in the same condominium, municipality, micro-region or metropolitan/urban areas. Additionally, the Decree establishes that small companies that generate household waste, as provided for by article 30 of the LPNRS, are not required to submit a PGRS.

Regarding the National Registry for Hazardous Waste Operators, which must be integrated to the already existing Federal Technical Registry of IBAMA, the Decree establishes a registration obligation for companies that manipulate or operate hazardous waste. The Decree also describes those who are considered generators or operators of hazardous waste, establishing several requirements for their authorization or permitting. These include the preparation of hazardous waste management plan, the demonstration of technical and economic capacity and the obtaining of civil liability insurance for environmental damages."

As a consequence, there is no activity similar to landfill gas capture and flaring.

Sub-step 4b. Discuss any similar options that are occurring".
At the time of the validation of the project activity, there was one project in the region that was subject to comparison, although it does not present the same purposes of Caieiras Project. At that time. the municipal landfill called Bandeirantes, had a LFG collection system in place through forced exhaustion, with collected LFG being used as fuel to generate electricity . The project was financially possible due to very specific local conditions.
Firstly, as implemented before end of December 2003, it took advantage from a specific law giving transportation and distribution taxes exemption.
Secondly, the investor is a Bank Group (UNIBANCO) that would use generated electricity for its own purpose, in its installations and agencies around Brazil. As UNIBANCO is considered as a commercial activity, its applicable normal electricity price rate is around 0.230 R$/kWh. Generating its own electricity from LFG was at that time therefore a economically interesting operation.

At the time of the validation of the project activity, some others project activities of the same nature were under development in Brazil, but all of them were linked to CDM. (Aterro Novagerar, RJ / Aterro Sasa, SP / Aterro Lara, SP)

This leads to the last step of the tool:

"Step 5. Impact of CDM registration"

As indicated in before, no revenues are associated with landfill gas capture and burning. As a consequence, selling CERs will provide the necessary revenue to turn the activity feasible[20].

An important other aspect is related with the investment strategy of Essencis Soluções Ambientais S.A..

Essencis Soluções Ambientais S.A. main purpose is the treatment of industrial waste and it is, and pretend to remain, the leader on that market. Such market is under construction in Brazil and require high level of investment. Essencis Soluções Ambientais S.A. already have some restriction in financing the necessary investment to keep its rank. For such reason, Essencis Soluções Ambientais S.A. will not have condition to invest in some activities, out of its core business, unless such activities brings new opportunities of financing.

As a consequence, project activity will occurs only after project registration and/or establishing a partnership with a buyer or investor for the CERs.

The performed corrections (in information which do not affect project design) (in January 2013) do not adversely affect the earlier demonstrated additionality for the project activity..

[20] In case fractions of all collected LFG end-up being exported to an external industrial facility (to be used as gaseous fuel in industrial boilers) or end-up being utilized as gaseous fuel for electricity generation in quantities differently than specified in this PDD (as a result of higher installed capacity for such combustion sources and/or increased availability of collected LFG inter alia due to the occurred increment in the MSW disposal at the CTR Caieiras landfill), this will be addressed as post-registration permanent changes to the project design of the project activity. In such case, the potential adverse impact over additionality of the project will have to be addressed as per applicable CDM rules.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

All the generation of waste occurs locally, within the confines of the country. The Baseline Study has not found leakage to be a problem for the project as the project is a closed system. Therefore, the MVP does not correct the calculated ERs to account for leakage.

GHG emissions associated with the consumption of grid electricity and LPG by the project activity will be accounted as project emissions in the context of the determination of emission reductions[21]. At the time of the project initial design conceptualization, it was assumed that it could be interesting to have a small electricity production to supply internal demand in the future. In that case, electricity for gas pumping would be produced from biomass source. The box below summarizes the occurred pilot test/evaluations of the implementation of a portable electricity generation facility fuelled by LFG collected by the project activity during the period from April 2009 to June 2009.

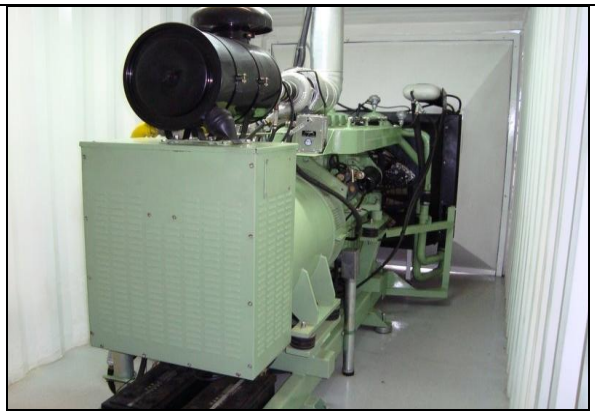
Box 1 - Occurred pilot tests/evaluation of a portable electricity generation facility fuelled by collected LFG at CTR Caieiras Landfill (using LFG collected by the project activity "Caieiras landfill gas emission reduction)"

During the period from April 2009 to June 2009, in the framework of a technical cooperation agreement set between the Biomass Center Institute (CENBIO) of University of São Paulo (USP) and Essencis Soluções Ambientais S.A., a portable 200 kW electricity generation station was installed in the project site in order to have renewable energy experts/scholars of CEMBIO/USP performing some field tests/analysis related to the use of collected LFG as fuel for electricity generation.

Testing/evaluation of electricity generation using LFG as fuel was performed by a portable 200 kW electricity generation station (Model LANDSET 200 assembled by Brasmetano Ind. e Com. Ltda.) the following specifications:

- Engine: Brasmetano (based on the Mercedes-Benz 447-LA engine with a modified cylinder head)
- Generator: WEG
- Output voltage: 440 V / 60Hz

[21] According to the document "Atlas de Energia Elétrica do Brasil - 2002" from ANEEL (National Agency of Electric Energy - http://www.aneel.gov.br/aplicacoes/Atlas/index.html), the hydro energy is around 90% of all electricity produced in the country. Moreover, the other 10% (from biomass, fossil fuel and others) is not even entirely connected to the national grid (Caieiras is connected to the National Grid), hence, making the hydro source more important.



In the context of the performed field research, a relative small amount of LFG collected by the project activity ended up being consumed for testing purposes only. it is however crucial to note that all LFG used under the academic test/evaluation was collected by installing a temporary "T" junction in a section of the project's LFG pipeline which is located prior to the installed LFG flow meter (which measures amount of LFG collected by the project activity and sent to the flares). Thus, no LFG measured by the project activity (LFG_{flare}) was actually utilized as gaseous fuel for electricity generation under this temporarily field academic research/testing events. Furthermore, all electricity which was generated under the test/evaluation activities were discharged in a resistive load bank. Thus, in accordance with applicable rules and regulations of the Brazilian power market, no generated electricity was consumed internally by the project activity or by other facilities of the CTR Caieiras landfill or exported to the grid.

Detailed information about the whole field research initiative performed by CEMBIO/USP are available on-line at http://cenbio.iee.usp.br/projetos/biogas_aterro/aterro.htm

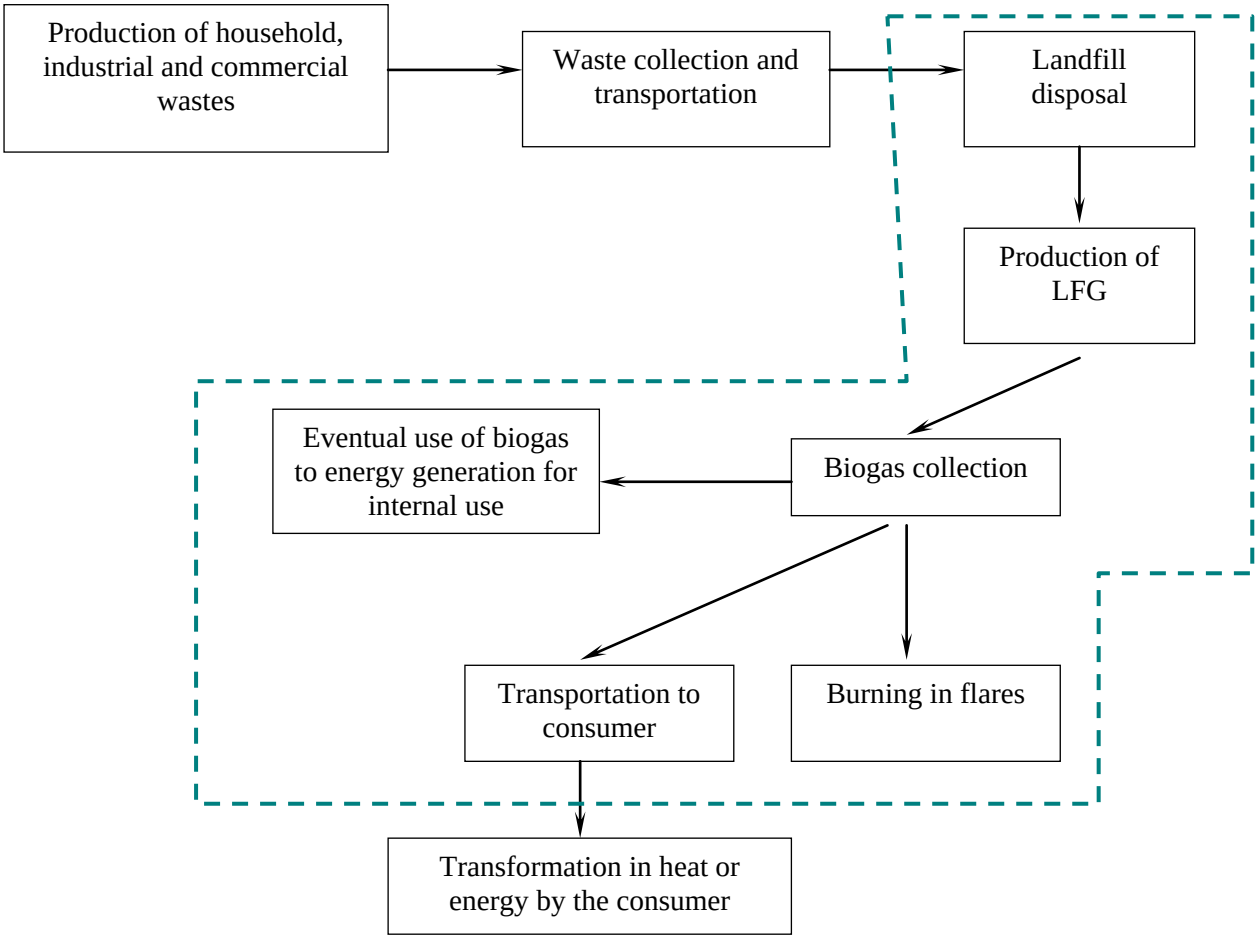
In January 2013, more than 3 years after the finalization of the field research by the scholars/researchers of CENBIO/USP, the installed equipment was still being located in the project site, but without any. The equipment is completely disconnected from the project's LFG collection pipeline (since the time the tests were finalized in June 2009). It is also relevant to note that this power generation equipment is currently under very bad conditions (with not maintained, rusted and even damaged components) and it is probably not even under conditions to be operated anymore without major overhauling work. Essencis Soluções Ambientais S.A. is still awaiting the decision/position from CENBIO regarding the date of removal of such equipment from the project site. Moreover, further developments in the framework of technical cooperation agreement earlier set between Essencis and CENBIO/USP are also uncertain.

Essencis Soluções Ambientais S.A. highlights that the occurred research / tests performed by CENBIO/USP in the project site does not represent a change in the design and or operation of the project activity "Caieiras landfill gas emission reduction" (that, as per the current CDM rules, would need to be addressed via applicable procedure for addressing post-registration changes) due to the following aspects:

- The temporary and not actually continuous operation of the small scale electricity generation facility under CENBIO/USP's research consumed LFG which was indeed collected by the project activity. However such relative small LFG stream was not measured and accounted in the context of the monitoring of quantity of LFG collected and combusted by the project activity.
- Essencis Soluções Ambientais S.A. (and the other project participant for the project activity) did not have any economic benefit by allowing CENBIO/USB to use a very small fraction of collected LFG for testing/evaluation purposes under the established technical cooperation agreement: no sale of LFG occurred, no use of generated electricity occurred (as all electricity was generated by using a resistive load bank connected to the power generation equipment), no renting of space occurred either.
- The whole concept of the temporary and not continuous operation of the small-scale pilot

electricity generation facility was under a technical research and testing focus (not commercial). The interest of the academics and scholars in the issue of utilization of biogas/LFG generated in landfills and waste water treatment plants (WWTP) as fuel was actually trigged by the CDM. This is one of the positive externalities of the CDM in Brazil: promoting investigations (at least at academic level) of the use of non-conventional renewable energy sources.

Thus, the project activity boundaries are shown in the next diagram:



B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

Detailed information on baseline is on Annex 3.
Date of completion of this baseline: 07/11/2004
Person/entity determining the baseline (contact details provided in Annex 1):
SUEZ Ambiental
Florent Mailly and Juliana Scalon

In January 2013, the PDD was revised by ZLF Consultoria S/C Ltda. / Unicarbo - Energia e Biogás Ltda. in order to address the following issues related to corrections in information (that do affect the project design):

- Revised quantitative information about occured and forecasted disposal of municipal solid waste (MSW) at the CTR Caieiras landfill from the period from year 2007 onwards;
- Revised ex-ante estimations of emission reductions (due to revision of the amount of MSW historically disposed in the landfill as well as revised MSW disposal forecasts from year 2007 onwards);
- Corrections of minor typo errors/mistakes and general text improvements.

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:

March 2006

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

19 years

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

C.2.1. Renewable crediting period

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

31/03/2006

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

Approved consolidated monitoring methodology ACM0001: "Consolidated monitoring methodology for landfill gas project activities" (version 2)

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

"Applicability:

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

a) the captured gas is flared"

The items b and c are not applicable to the CTR Caieiras landfill gas emission reduction project and then will not be mentioned in this PDD.

In case electricity generation using collected LFG as fuel occurs, associated GHG emission reductions will not be claimed by the project activity. GHG emissions associated with the consumption of grid electricity and LPG by the project activity will be accounted as project emissions in the context of the determination of emission reductions.

Methane collected and flared:

The amount of methane actually flared ($MD_{flared,y}$) will be determined by monitoring, as follows:

- Total amount of landfill gas collected (LFG_y) in m³, using a continuous flow meter;
- amount of landfill gas sent to the flares ($LFG_{flare,y}$) in m³, using a continuous flow meter;
- amount of landfill gas supplied to the industry, using a continuous flow meter;
- Percentage of landfill gas that is methane (w_{CH4y}) in %, using a continuous gas analyzer;
- Flare working hours, using a run time meter;

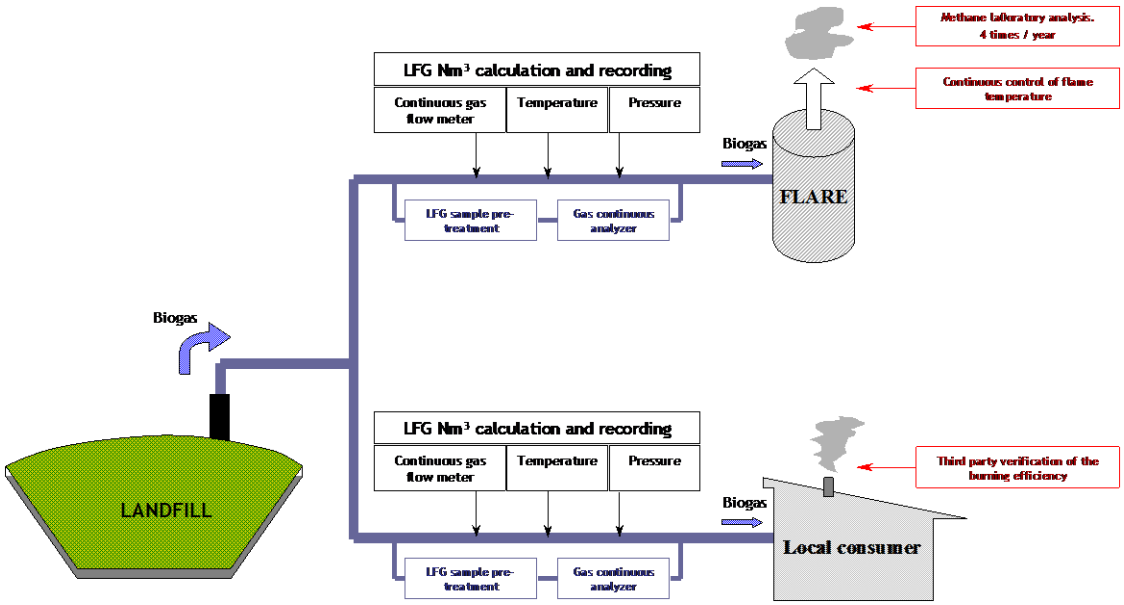


Figure 5: schematic of methane monitoring

In addition, the methane content of the flare emissions will be analyzed at least quarterly to determine the flare efficiency (FE), the fraction of methane destroyed.

And also, regarding quality procedures:

- The equipment to measure LFG flow must be appropriated to the local climate conditions and to any contaminant that might exist in collected LFG;
- All the equipment must be calibrated periodically.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

Not chosen

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Not chosen

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
3.1	$LFG_{total,y}$	Total amount of landfill gas captured	[m³]	m and c	contin uous	100%	electronic	Measured by a flow meter. Data will be aggregated monthly and yearly.
3.2	$LFG_{flare,y}$	Amount of landfill gas flared[22]	[m³]	m and c	Contin uous	100%	electronic	Measured by continuous flow meter, or complementary method.
3.3	$LFG_{electricity,y}$	Amount of landfill gas going into electricity generator	[m³]	m and c	Contin uous	100%	electronic	Not Applicable. The project will not generate electricity for the moment.

[22] As per ACM0001 (version 2), the description of the monitoring parameter $LFG_{flare,y}$ is "Amount of landfill gas flared". However, $LFG_{flare,y}$ actually corresponds to the amount of collected LFG sent to the flares for combustion. In accordance with ACM0001 (version 2), for the determination of the amount of LFG actually flared, monitoring records of parameter "Flare combustion/ efficiency" (FE) are also required.

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
3.4	$LFG_{thermal,y}$	Amount of methane combusted in boiler	[m³]	M	Continuous	100%	electronic	Not Applicable. The project will not generate electricity for the moment.
3.5	FE	Flare combustion/ efficiency determined by the operation hours (1) and the methane content in the exhaust gas (2)	%	m and c	Quarterly and continually	N/a	electronic	(1) Periodic measurement of methane content of flare exhaust gas. (2) Continuous measurement of operation time of flare (e.g. with temperature)
3.6	$w_{CH4,y}$	Methane fraction in the landfill gas	%	m and c	Continuous	100%	electronic	Measured by continuos gas quality analyzer
3.7	T	Temperature of the landfill gas	[°C]	M	Continuous / periodic	100%	electronic	Measured to determine the density of methane D_{CH4}
3.8	P	Pressure of the landfill gas	[Pa]	M	Continuous / periodic	100%	electronic	Measured to determine the density of methane D_{CH4}
ID number ***(Please use numbers to ease cross-referencing to table D.3)***	**Data variable**	**Source of data**	**Data unit**	**Measured (m), calculated (c), estimated (e),**	**Recording frequency**	**Proportion of data to be monitored**	**How will the data be archived? (electronic/ paper)**	**Comment**

3.9	Energy	Total amount of electricity and/or other energy carriers used in the project for gas pumping and heat transport (not derived from the gas)	[MWh]	M	Continuous	100%	electronic	Required to determine CO_2 emissions from use of electricity or other energy carriers to operate the project activity
3.10	CO2 emission	CO2 emission intensity of the electricity and/or other energy carrires in ID 3.9	[m³]	M	Annually	100%	electronic	Required to determine CO_2 emissions from use of electricity or other energy carriers to operate the project activity
3.11	HE	Regulatory requirements relating to landfill gas projects	Test	n/a	Annually	100%	electronic	Required for any changes to the adjustment factor (AF) or directly $MD_{reg,y}$
3.12	$MD_{industry,y}$	Amount of methane sold to industry	[m³]	M	Continuous	100%	Electronic and invoice	Measured by continuos gas quality analyzer

Note: Archived data above will be kept during crediting period and 2 years after

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Baseline emissions for the project's methane destruction component will be determined on the basis of continuous measurements of LFG actually combusted by LFG flow meters as follows:

$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4}$

Where:

ER_y is determined in tons of CO_2 equivalent (tCO_2e);

$MD_{project,y}$ and $MD_{reg,y}$ are determined in tons of methane (tCH_4);

The approved Global Warming Potential value for methane (GWP_{CH4}) for the first commitment period is 21 tCO_2e/tCH_4.

For the Caieiras project, $MD_{reg,y}$ is established as the higher quantity of methane between the potential methane to be sold to industry ($MD_{industry,y}$) or 20% of the methane actually collected by the project activity (Brazilian BAU).

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

Then, the baseline will be defined between two values, like the following:

If $MD_{industry,y} < MD_{project,y} * AF$ (20%)	**then** $MD_{reg,y} = MD_{project,y} * AF$ (20%)
If $MD_{industry,y} > MD_{project,y} * AF$ (20%)	**then** $MD_{reg,y} = MD_{industry,y}$

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

No leakage is applicable to the project, once the energy used to pump gas is from hydro power source.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

See item B.2. for the full explanation

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
3.1 – 3.4	Low	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy
3.5	Medium	Regular maintenance should ensure optimal operation of flares. Flare efficiency should be checked quarterly, with monthly checks if the efficiency shows significant deviations from previous values.
3.6	Low	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy
3.7 – 3.8	Low	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy
3.12	Low	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy

The performed corrections (in information which do not affect project design) (in January 2013)do not compromise the compliance of the monitoring plan with the applied methodologies. The level of accuracy and completeness in overall monitoring of the project activity is not compromised by the made corrections either.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

All the CTR Caieiras activities have procedures under ISO 9000 and ISO 14000
One engineer (responding directly to Operational Director of Essencis Soluções Ambientais S.A.) + one technician + 2 maintenance operators subordinated to the engineer.

D.5 Name of person/entity determining the monitoring methodology:

Person/entity determining the monitoring (contact details provided in Annex 1):

SUEZ Ambiental
Florent Mailly and Juliana Scalon

In January 2013, the PDD was revised by ZLF Consultoria S/C Ltda. / Unicarbo - Energia e Biogás Ltda. in order to address the following issues related to corrections in information (that do affect the project design):

- Revised quantitative information about occured and forecasted disposal of municipal solid waste (MSW) at the CTR Caieiras landfill from the period from year 2007 onwards;
- Revised ex-ante estimations of emission reductions (due to revision of the amount of MSW historically disposed in the landfill as well as revised MSW disposal forecasts from year 2007 onwards);
- Corrections of minor typo errors/mistakes and general text improvements.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

The proposed Landfill Gas Emission Project in Caieiras/SP creates real, measurable and verifiable net GHG emission reduction. At the time of the project design initial conceptualization, the amount of LFG expected to be sold to the local consumer was from 28% to 40% of the methane collected in project activity[23], according comparison between the baseline quantities and the LFG estimation study (Table 4) using the *First Order Decay* model for landfill gas generation estimation (IPCC guideline, 1996). The LFG collecting system capacity is assumed to be capable to collect 80% of generated LFG. The surplus amount will be destructed in the kind of emission reduction.

Based on available historical figures from Essencis Soluções Ambientais S.A. regarding MSW disposal at the CTR Caieiras landfill (for the period from year 2002 to 2012) + related forecasted annual MSW disposal figures (for the period from year 2013 to 2030), the MSW disposal pattern at the landfill is as follows:

Table 3: Historical data and projection of MSW disposal at the CTR Caieiras landfill

Year	Forecasted annual disposal of MSW (ton)[24]	Historical disposal of MSW (ton)
2002		70,981
2003		415,797
2004		454,349
2005		701,725
2006		735,517
2007		2,111,539
2008		2,881,103
2009		2,580,009
2010		3,450,052
2011		3,283,595
2012		3,096,657
2013	3,158,590	
2014	3,221,762	
2015	3,286,197	
2016	3,351,921	
2017	3,418,960	

[23] No fraction of collected LFG was ever exported/sold to local consumer. In January 2013, all LFG historically collected by the project activity has been sent to destroction in high temperature enclosed flares.

[24] As per forecasts of Essencis Soluções Ambientais S.A. (dated January 2013), the annual quantity of MSW to be disposed at the CTR Caieiras landfill during each year of the period from year 2013 to 2030 is equal to the amount of MSW disposed in the previous year with an increment of 2.0%. In January 2013, the expected closure for the CTR Caieiras landfill was year 2030 (when the landfill is expected to reach its maximum accumulated technical MSW disposal capacity).

2018	3,487,339	
2019	3,557,086	
2020	3,628,227	
2021	3,700,792	
2022	3,774,808	
2023	3,850,304	
2024	3,927,310	
2025	4,005,856	
2026	4,085,973	
2027	4,167,693	
2028	4,251,046	
2029	4,336,067	
2030	4,422,789	

It is expected disposed MSW stream to continue on the same basic characteristics along the time (same quantity of degradable organic matter) and, hence, it is expected to have the average potential of methane generation of about 116 m^3/ton of waste (as per estimations at the time of the initial project design conceptualization). The normal trend, in most developing countries, is to see a gradually reducing proportion of organic materials as other types of waste enter the waste stream. Based on this characterization of the waste stream, the amount of waste disposed, the current quantity of waste in place, and the current methane emissions, the landfill emissions of methane are estimated to follow the curve demonstrated in Figure 6 (below), according to IPCC good practices methodology.

Table 4: Projection of methane generation and collection during the project lifetime:

Year	A: Tons of CH4 (50% of LFG) generated in the landfill (ton/year)[25]	B: Collection efficiency reached by the project each year (%)	**C = A x B** $\mathbf{MD_{project,y}}$ Quantity of methane collected by the project activity (ton CH_4/year)	**D = C x 21 Quantity of CO2e collected by the project activity (ton CO_2e/year)**
2006	13,690	60	8,214	106,568
2007	26,112	70	18,279	251,988
2008	42,490	80	33,992	516,038
2009	55,687	80	44,550	671,818
2010	73,422	80	58,737	903,827
2011	88,730	80	70,984	1,161,016
2012	102,862	80	82,290	1,382,469
2013	114,715	80	91,772	1,541,765
2014	126,051	80	100,841	1,694,126
2015	136,919	80	109,535	1,840,191
2016	147,362	80	117,890	1,980,552
2017	157,850	80	126,280	2,121,508

[25] Calculated using the First Order Decay Model. The formula is very complex and it is shown in the Document: "IPCC Guidelines, 1996"

2018	167,968	80	134,374	2,257,491
2019	177,753	80	142,202	2,389,001
2020	187,240	80	149,792	2,516,502
2021	196,932	80	157,546	2,646,771
2022	206,362	80	165,089	2,773,500
2023	215,557	80	172,446	2,897,090
2024	208,301	80	166,641	2,799,568
TOTAL	**2,446,003**	**-**	**1,951,454**	**32,451,789**

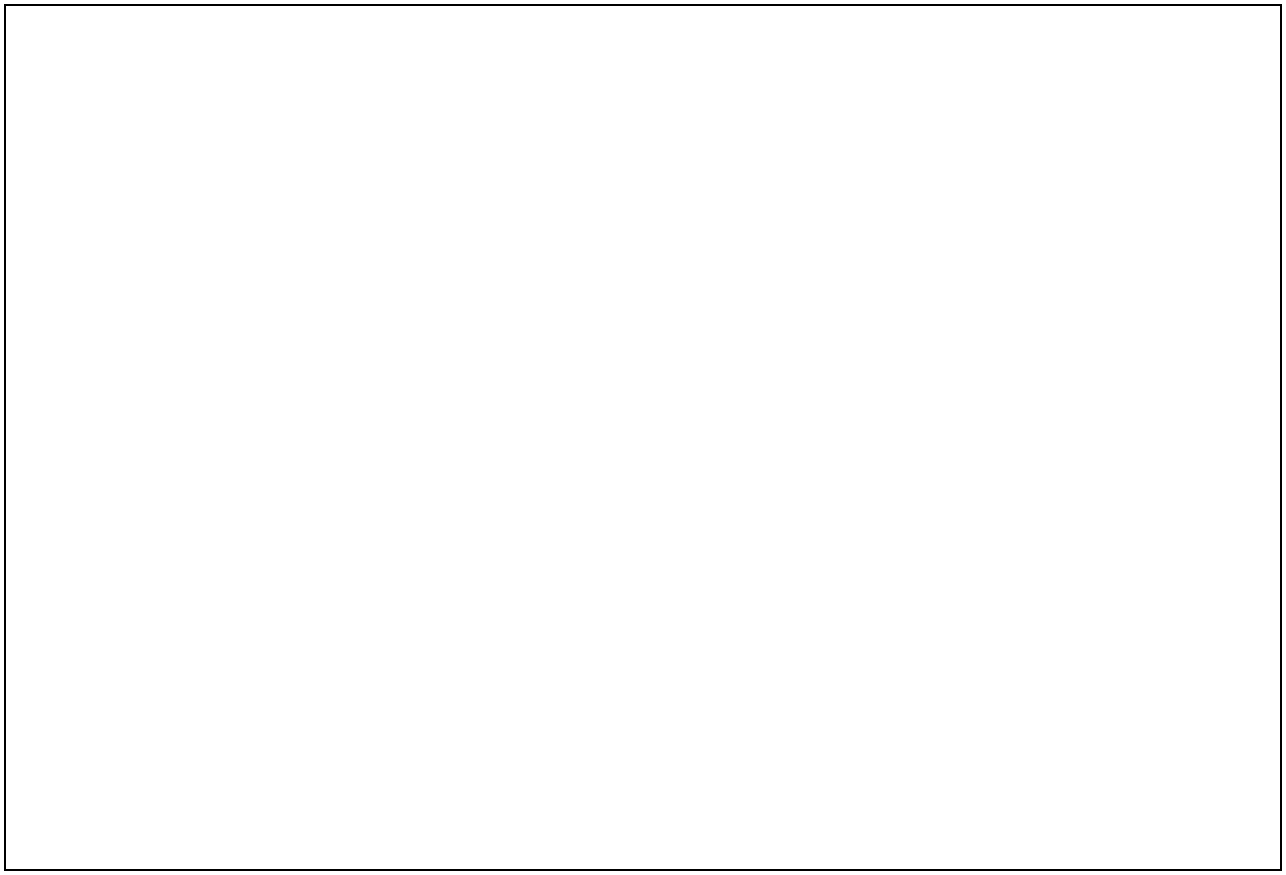


Figure 6: Biogas and methane production by the landfill

The attached spreadsheet illustrates how the 58.000 tons per year (initially), 116 m^3/ton of household and the decay rate (k = 0.08), reflect the values shown in Graphic above.

The emission reductions are calculated based on a certain number of main hypotheses on methane generation and its combustion. The emission reduction from methane production and capture depend on:

- Quantity of waste disposed per year;
- Lifetime methane generation potential of that waste;

- Waste decay;
- Fraction of methane in the collected LFG;
- LFG collection efficiency and flare efficiency.

The quantity of waste disposed was shown in Table 3. The other variables are listed in the tables below.

Table 5: Factor used to convert methane in carbon dioxide equivalent:

Factor (CO_2e/CH_4)	Applicable period	Source
21	1996-actual	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories

Table 6: Key variables in methane production and collection

Variable	Unit	Value
Lo (methane potential)	m^3/ton of household waste	116
K (decay rate)		0.08
% of biogas that is methane	%	50
Collection efficiency in project	%	80

Table 7: Conversion equivalence:

Factor	Unit	Applicable period	Description / Source
0.0007168	ton CH_4/m^3(STP[26]) CH_4	Standard	Project manager should assess the density of methane being collected and correct this factor so that it accurately represents the local situation.

E.2. Estimated leakage:

No leakage emissions are predictable.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

Same as E.1 above.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

The baseline to determine the landfill destroyed CH_4 emissions (due to significant improvements on LFG collection and desctruction efficiency at the CTR Caierias landfill as a result of the implementation of the project activity) is the higher volume between the amount of LFG to be eventually sold to local consumer and the 20% of the amount of methane actually destroyed by the project activity. The choice of this

[26] At standard temperature and pressure (0 degree Celsius and 1,013 bar) the density of methane is 0.0007168 tCH4/m3CH4.

baseline is justified in the chapter B.2. Table 8 below indicates (column two) the volume of methane expected to be eventually sold, the 20% of biogas collected and the third column is the result between the two.

If	$MD_{industry,y} < MD_{project,y} * AF (20\%)$	**then** $MD_{reg,y} = MD_{project,y} * AF (20\%)$
If	$MD_{industry,y} > MD_{project,y} * AF (20\%)$	**then** $MD_{reg,y} = MD_{industry,y}$

Table 8: Volume of methane in the baseline

Year	B: Selling contract of the supply agreement in m³/h of LFG (biogas)[27]	**$MD_{industry,y}$** (tons/year) =B*365*24*0,5*0,0007168	**$MD_{projecty}$*AF** AF = 20% 20% of methane collected by the project activity	**MD_{regy}** highest quantity (ton/yr of CH_4)
2006	1,000	3,140	1,643	1,643
2007	2,000	6,279	3,656	3,656
2008	3,000	9,419	6,798	6,798
2009	4,000	12,558	8,910	8,910
2010	5,000	15,698	11,747	11,747
2011	5,000	15,698	14,197	14,197
2012	5,000	15,698	16,458	16,458
2013	5,000	15,698	18,354	18,354
2014	5,000	15,698	20,168	20,168
2015	5,000	15,698	21,907	21,907
2016	5,000	15,698	23,578	23,578
2017	5,000	15,698	25,256	25,256
2018	5,000	15,698	26,875	26,875
2019	5,000	15,698	28,440	28,440
2020	5,000	15,698	29,958	29,958
2021	5,000	15,698	31,509	31,509
2022	5,000	15,698	33,018	33,018
2023	5,000	15,698	34,489	34,489
2024	5,000	15,698	34,938	34,938

[27] Regardless of the occurred relative increase in the estimated amount of LFG to be generated and collected by the project activity (due to occurred quantitative increment in MSW disposal from year 2007 onwards), the same amount of LFG is still being considered as being eventually exported to an industrial facility (as earlier considered at the time of the project design initial conceptualization).

TOTAL	**85,000**	**266,864**	**356,963**	**356,963**

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

$ER_y = \Sigma MD_{project,2006\text{-}2024} - \Sigma MD_{reg,2006\text{-}2024}$

Figure 7: Methane production and collection, in baseline and project scenarios.

E.6. Table providing values obtained when applying formulae above:

Summary of Estimated Emission Reductions for the CDM project activity "Caieiras landfill gas emission reduction" during the crediting period from 31/03/2006 to 30/03/2013

(Tons of CO_2 equivalent per year.)

Year	ER_y Emissions reduction in tons of CO_2 equivalent
2006	79,926
2007	251,988
2008	516,038
2009	671,818
2010	903,827
2011	1,161,016
2012	1,382,469
2013	385,441
TOTAL	**5,352,523**
ANNUAL AVERAGE	**764,646**

As a result the performed revision of ex-ante estimations of emission reductions, the average annual emission reduction value along the 7-year renewable crediting period (from 31/03/2006 to 30/03/2013) is 764,646 tCO_2e per year. The accumulated ex-ante estimated value of total emission reductions to be achieved by the project activity during the 7-year crediting period is 5,352,523 tCO_2e. Both calculated values assumes as 79,926 tCO2e and 385,441 tCO2e as the emission reductions estimated for the shares of the crediting period which encompass years 2006 and 2013 respectively (periods from 31/03/2006 to 31/12/2006 and from 01/01/2013 to 30/03/2013).

SECTION F. Environmental impacts

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

Collection and flaring of landfill gas results in destruction of other gases besides methane. These emissions include volatile organic compounds and sulfur dioxides, among others. These emissions are not considered in this assessment.

If the project subsequently decides to offset electricity from the grid, emissions of ozone and nitrogen oxides that would otherwise be generated from fossil fuels are avoided. These impacts are all of a positive nature but have not been quantified. They contribute to the overall sustainable development attributes of the project.

F.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:

No significant negative impacts are applicable.

SECTION G. Stakeholders' comments

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

The process of local stakeholders consultation was entirely based on the Resolution #1 of the Brazilian Interministerial Commission on Climate Change. The invitations where sent to all entities and/or people listed in item II of Article 3rd of the Resolution.

Therefore, on August and September 2004, a local stakeholders' consultation was held for the local community, NOGs, Municipalities, District Attorneys, State Departments and private sector.
The consultation was done by means of folders, letters, and internet.

On the internet, the project documents (PDD version 0 and a explanatory folder) are available, inviting free comments on subjects related to the activity and a simple questionnaire in order to stimulate comments.

The comments were received by an exclusive e-mail address and by mail to the landfill hearing administration.

All comments received were taken into account.

G.2. Summary of the comments received:

1.

Name (person / entity)	Mauro Guilherme Jardim Arce State Secretariat of Energy, Water Resources and Sanitation of São Paulo
Main comments / suggestions	Environment: his suggestion is to assess the possibility to supply methane to local residences, as it is done by Comgás in the western area of Metropolitan Area of São Paulo Social & Economic: generate electricity with lower costs using micro turbines (for self – consumption). Technological: the project shows new technology to reduce methane emissions Regional integration: he suggests to profit from the project for studies with universities

2.

Name (person / entity)	Lourival Carmo Monaco State Secretariat of Science, Technology, Economic Development and Tourism of São Paulo
Main comments / suggestions	Congratulations regarding the sustainability of the project, safety, local community benefit, new technology acquisition, and dissemination of the awareness of sustainable development to other municipalities.

3.

Name (person / entity)	Victor Mendes Cardoso Professor Researcher of the Botanic Department of São Paulo State University (Unesp)
Main comments / suggestions	Environment: he incited to investigate if the burning of methane could generate more CO_2 emissions. Social, Economic and regional integration: generate energy from methane for a productive process inside the landfill or to a neighboring installation.

4.

Name (person / entity)	Messias Cândido da Silva Mayor – Municipality of Cajamar
Main comments / suggestions	Environment: the project is very positive, because it reduces the GHGs emissions. He suggests the creation of Monitoring and Assessment Systems at regional level to measure the effects of the project activity. Once positive, all landfills of Brazil should adopt projects like this as procedures to waste management. Social and Economic: the impacts are important, as they will disseminate the sustainable development to the other municipalities, through job creation, pollution emission reduction, compelling these municipalities to be environmentally careful, economically and socially honest and to have strong participation on political subjects. Hence, bringing quality of life to the population. Also, job generation should pass through Caieras municipality to the surrounding cities. Regional integration: Caieras project should be the initial landmark on instrumentalization and normatization on the subject, with the creation of a legal and institutional frame guiding waste management and final destination. Also encourage NOGs, Public sector and Private to develop such a frame.

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

Environment:

- Reduction of odors: the biogas has traces of sulfur and other organic compounds that cause odors. Once the waterproof cover is installed, the odor and gases emanation is stopped and the complete burning of these compounds decreases considerably, being restricted to the landfill operation area.
- CO_2 emissions: The CO_2 emission from methane destruction is not used to discount from emission reduction because biogas is from biomass source, and according to IPCC Guidelines, this CO_2 is within the cycle of carbon and must not be counted in the emissions.
- Essencis Soluções Ambientais S.A. intends to implant selective collection in the surrounding municipalities and extends the ones already in place. For that, Essencis Soluções Ambientais S.A. will use a part of the revenue from CERs selling.
- Also the company will present this project whenever possible in seminars and workshops and will establish partnerships with universities in order to stimulate its reproduction in other areas.

Social and Economical:

- Essencis Soluções Ambientais S.A. will enlarge the social projects already in place and will create new ones on behalf of local communities;
- The job positions created by the project will be preferentially given to Caieiras habitants and further to habitants of the other municipalities;
- The project revenues will also help to enlarge the existing environmental education program with emphasis on health and sanitation;
- Enlargement of the CTR seedling nursery in order to give plants to schools, and general public besides internal reforestation;
- Implants a project of capacitating young people from the surroundings to act as ecomonitors in the community.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUPLIC FUNDING

The implementation of the project do not involve any public funding.

Annex 3

BASELINE INFORMATION

Table A.1: Historical data and projection of MSW disposal at the CTR Caieiras landfill

Year	Forecasted annual disposal of MSW (ton)[28]	Historical disposal of MSW (ton)
2002		70,981
2003		415,797
2004		454,349
2005		701,725
2006		735,517
2007		2,111,539
2008		2,881,103
2009		2,580,009
2010		3,450,052
2011		3,283,595
2012		3,096,657
2013	3,158,590	
2014	3,221,762	
2015	3,286,197	
2016	3,351,921	
2017	3,418,960	
2018	3,487,339	
2019	3,557,086	
2020	3,628,227	
2021	3,700,792	
2022	3,774,808	
2023	3,850,304	
2024	3,927,310	
2025	4,005,856	
2026	4,085,973	
2027	4,167,693	
2028	4,251,046	
2029	4,336,067	
2030	4,422,789	

[28] As per forecasts of Essencis Soluções Ambientais S.A. (dated January 2013), the annual quantity of MSW to be disposed at the CTR Caieiras landfill during each year of the period from year 2013 to 2030 is equal to the amount of MSW disposed in the previous year with an increment of 2.0%. In January 2013, the expected closure for the CTR Caieiras landfill was year 2030 (when the landfill is expected to reach its maximum accumulated technical MSW disposal capacity).

Table A2: Key variables on baseline estimation

Variable	Unit	Value
Lo (methane potential)	m^3/ton of household waste	116
K (decay rate)		0.08
D_{CH4} (methane density)	Ton CH_4/m^3 (0°C and 1,013 bar) CH_4	0.0007168
AF (Adjustment Factor)	%	20
GWP_{CH4} (Global Warming Potential)		21

Table A3: Methane quantity to supply industry

Year	Selling contract of the supply agreement in m^3/h of biogas[29]	$MD_{industry,y}$ (tons/year) =B*365*24*0,5*00007168
2006	1,000	3,140
2007	2,000	6,279
2008	3,000	9,419
2009	4,000	12,558
2010	5,000	15,698
2011	5,000	15,698
2012	5,000	15,698
2013	5,000	15,698
2014	5,000	15,698
2015	5,000	15,698
2016	5,000	15,698
2017	5,000	15,698
2018	5,000	15,698
2019	5,000	15,698
2020	5,000	15,698
2021	5,000	15,698
2022	5,000	15,698
2023	5,000	15,698
2024	5,000	15,698
TOTAL	**85,000**	**266,864**

[29] Regardless of the occurred relative increase in the estimated amount of LFG to be generated and collected by the project activity (due to occurred quantitative increment in MSW disposal from year 2007 onwards), the same amount of LFG is still being considered as being eventually exported to an industrial facility (as earlier considered at the time of the project design initial conceptualization).

Annex 4

MONITORING PLAN

Monitoring Plan as well as its data to be collected., are detailed is item D.