LANDFILL GAS EMISSION REDUCTION – CAIEIRAS, SP BRAZIL

PROJECT DESIGN DOCUMENT (PDD)

Version 2

Essencis Soluções Ambientais SA

Rodovia dos Bandeirantes, km33

Caieiras, SP

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

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

CONTENTS

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 waste landfilled, through its decomposition, produce large quantities of biogas. The biogas major contents are methane (CH_4) and carbon dioxide (CO_2), powerful greenhouse gases.

The project activity involves the installation of methane collection and destruction equipment with capacity of 200 m³/h in 2005, expanding its capacity to 48.000 m³/h in 2024. This equipment will consist of pipes connected to the drainage wells leading to enclosed flares, which are capable of performing the complete burn and destruction of the methane.

The project also purposes to increase de waste disposal volume through optimizing the waste decomposition, hence increasing the landfill lifetime and postponing the need for another area.

Besides the GHGs emission reduction, the project activity will co-operate to sustainable development in Brazil. The project is consistent with criteria that are mentioned in a discussion paper dated April 2002 on performance metrics for sustainable development for CDM projects in Brazil published by the Environment State Department (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*."). For example, utilization of a new technology to capture and destroy biogas in Brazil, switch fossil fuel in the neighboring industry and also possible generation of electricity from a renewable source. Moreover, Essencis 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 has a strong past record of demonstrating corporate social responsibility through initiatives in the communities where it is settled.
Currently, the landfill is studying the possibility of signing a biogas selling contract with a local industry of 600Nm³/h for 2005, expanding to 9.800 Nm³/h as of 2006. The client is located within 3 km from the landfill. The rest of the biogas is emitted without any control to the atmosphere. This quantity supplied to the industry, as well as direct burning on wellheads, is sufficient to promote gas draining avoiding risk of fire and explosions on the landfill.

A.3. Project participants:

ESSENCIS SOLUÇÕES AMBIENTAIS SA - BRAZIL
JPOWER 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 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 area is in Franco da Rocha municipality, which will not be used for the site activity, completing the area to be preserved. The site access is by Bandeirantes Highway, km 33.

UTM

N 7418600 to 7416000

E 317800 to 319800

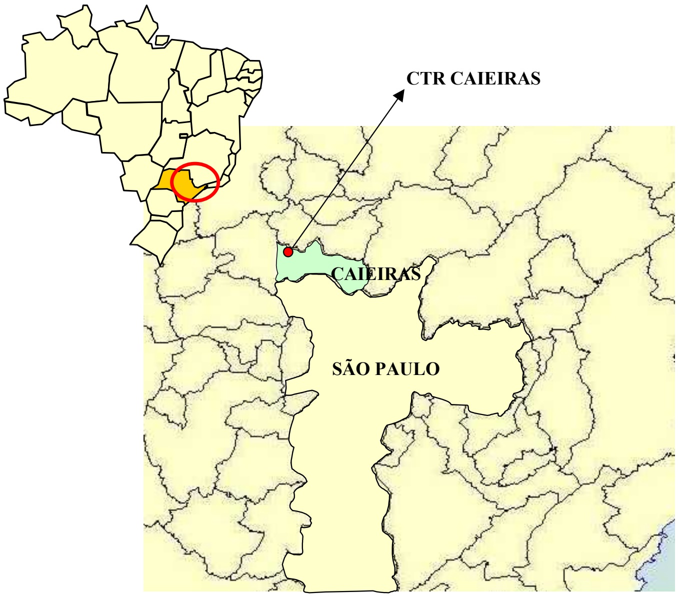


Figure 1: detail on the landfill physical location

The Caieiras landfill was constructed respecting all environmental and technical demands of the license and the strict demands of the group standards, 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 the waste, such as controlled entrance, weighbridge, laboratory, sludge solidification shed, a hazardous waste landfill, a TDU (Thermal Desorption Unit) to treat contamined soils, a staff office and a restaurant.

Photo 1: Caieiras landfill view

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

Waste handling and disposal

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

Essencis is a Brazilian subsidiary, which is 50% controlled by SUEZ in Brazil. SUEZ Group operates 237 landfills all over the world (206 in Europe) with a total of 34 million tons of treated waste in 2002. Most of these landfills are equipped with biogas capture system and treatment, specially those which must comply with European legal demands on waste management. In 2002, 16 of them received energy from waste equipment, producing 370.000 MWh of electricity, using biogas. Hence, this system will represent leading-edge technology to LFG capture in Brazil and will serve as a replicable model for such projects.

The gas collection system includes:

1- equally distributed wells in the landfill to extract LFG through exhaustion (negative pressure) with blowers;
2- a network of pipes connected to the wellheads transporting the biogas to the treatment unit;
3- equipment to treat the LFG drying all humidity before passing through the blowers and sent to flaring.
4- Eventually, an integrated cover with impermeable material, as PVC or similar, on the waste deposit.

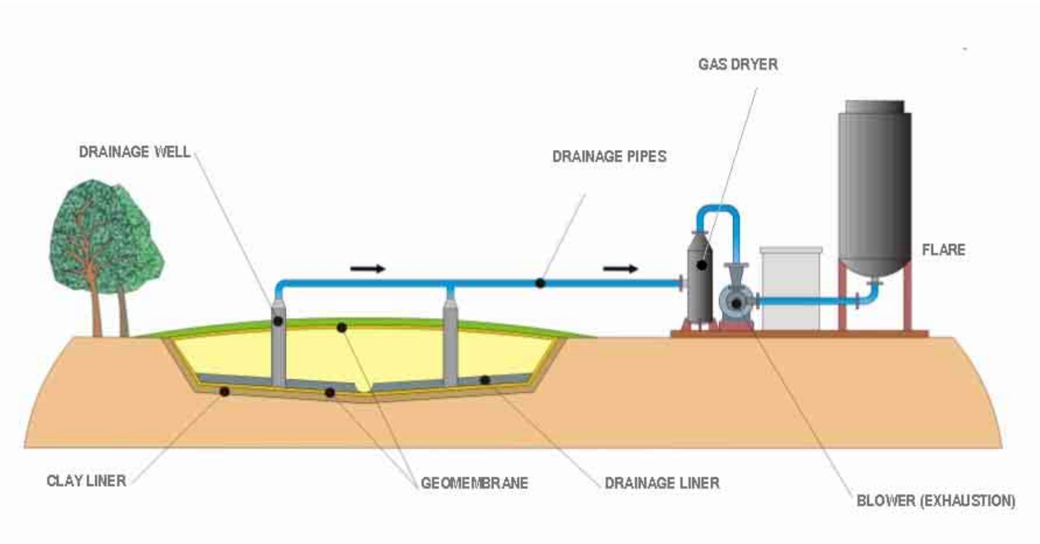


Figure 2: technical structure of the project activity

Collection efficiency:

Passive Venting system: the biogas is burned directly in the top of the well (well head), with probably less than 90% of combustion efficiency. The biogas that reaches these wells is located around the structure, and is drained naturally. Figure 3 illustrates the bulb (region) of influence around the well inside the waste. Consequently, the LFG destruction efficiency varies from 5% to 20% of total LFG production, depending on the area type and conditions (in operation or not). This scenario is typically what is practiced in Brazil.

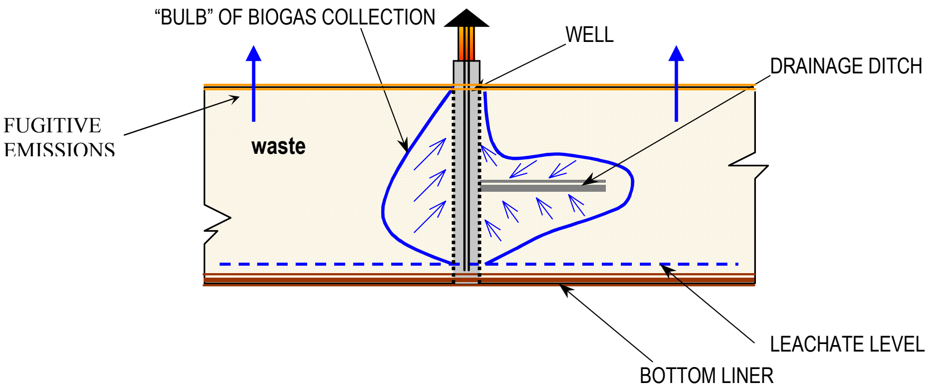


Figure 3: drainage well for gas venting

Forced exhaustion: the biogas is collected through forced exhaustion promoted by blowers. The landfill is covered by a PVC or similar impermeable material to prevent the biogas to come out through the landfill surface. 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 is between 98% and 99%. Figure 4 illustrates the bulb of influence when using this system.

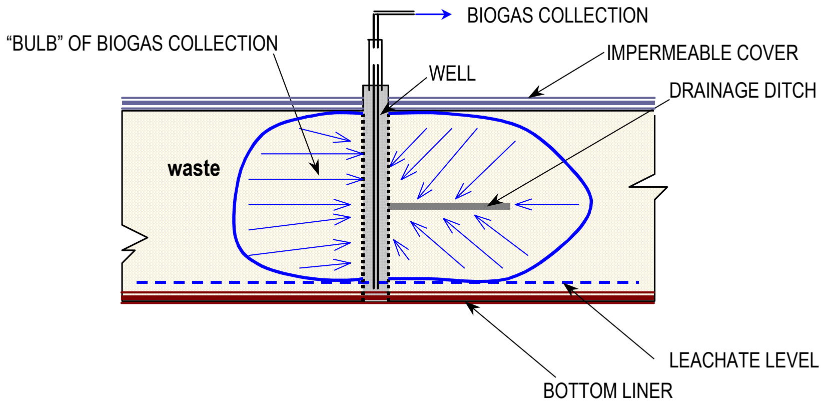


Figure 4: drainage well for gas forced exhaustion

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:

Of the 141,618 tons that are daily collected in the Southeastern Region of Brazil, 56% is sent to dumps and controlled landfills, and 37% is sent to landfills[1]. This means that 93% of all the waste landfilled and the biogas produced is not managed or when collected, is burned directly on the well head under conditions explained and the previous chapter (venting system). In these few cases, the destruction is done for safety reasons, with the purpose of avoiding fire and explosions.

So far, there have not been local obligations 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.

A new National Waste Management Policy (Política Nacional de Resíduos Sólidos) is under discussion, but no change is foreseen for the next years. Even the project of such Policy does not specify when and how its legal requirements would be implemented. And it is unlikely to occur for the next years, since the landfills are 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

The landfill has a LFG selling contract under discussion with local industries. If the contract is concluded, the revenues from the gas sale will make this methane collection feasible (estimated from 25 to 40% of the methane produced) without the need of CERs additional revenue.

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

These industries will utilize this biogas, previously treated, for drying up paper after the homogenization of cellulose fibers. This drying process is made by using steam from biogas burning. The company also has a potential to use this biogas for energy production for internal use.

The quantity sold must contain at least 45% of methane, as it will be established in the contract. The rest of LFG will be emitted to the atmosphere without any kind of treatment.

Also, there is another internal application for the biogas under study to run a TDU (thermal disorption unit) installed in the CTR to treat polluted soils. The TDU is already in operation but with another fuel source.

At the moment, the landfill only burns the biogas at the top of the wells as described in the venting system above.

If the contract with local industry is not conclude, and in the absence of the CDM project, the landfill will continue to practice the passive venting with direct burning at wellheads, what represent a maximum destruction of 20% of LFG produce by the landfill.

Hence, the emission reduction will be achieved by collecting and burning the surplus biogas, 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 (in tons of CO_2e) : 14.698.336

A.4.5. Public funding of the project activity:

None

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"

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, 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 is LFG emitted directly to 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 de ACM0001 will be reproduced in italics, in the following topics.

Emission Reduction

"The greenhouse gas Emission Reduction achieved by the project activity during a given year "y"(ERy) 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})*."*

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

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

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 will be defined between two values, like the following:

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

The specific condition of Caieiras landfill will be to recover a biogas quantity to possibly be sold to a local industry. This quantity guarantees the local safety conditions and is beyond any regulation or legal demand for Caieiras landfill. Moreover, this quantity is 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 (from 23% to 40% of the biogas produced) is paid with the revenues from its sale.

"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 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 IPCC good practice, 1996, 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 100m³/ton of waste.

We can estimate the following value for Equation 5.4 of IPCC guideline, 1995:

DOC = (0,4 x A) + (0,17 x B) + (0,15 x C) + (0,3 x D)

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

DOC = (0,4 x A) + (0,16 x (B + C)) + (0,3 x D)

Where[2]:

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 x DOC x DOCf x F x 16/12

Where:

MCF = 1 (well managed landfill)

DOC = 0.162

DOCf = 0,77 (high biodegradable fraction in Brazilian waste)

F = 50% (on site measures has shown 40 to 50 % of CH4 present in the LFG, with few dilution in air)

[2] 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%.

Resulting:

Lo = 0.083 Gg Ch4 / Gg waste

Lo = 116 m³ CH4/ton waste[3]

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 are not considered. The electricity generation from biogas will not be contemplated by the project. The electricity used to pump biogas (potential leakage) is from the grid, hydro power source predominant in the region.

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 flared during the year measured in cubic meters (m³), w_{CH4y} is the average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3CH_4 /m³LFG), 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)".

For ER calculation purpose, w_{CH4y} is supposed to be 50%.

FE is considered to be 98-99% as recent measurement at Salvador Landfill 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.

[3] STP conditions (0°C, 1,013 bar) in which CH4 density is 0,0007168 ton/m³

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 Caieiras landfill in the context of the methodology, i.e., the highest value between venting system and recovery of a partial quantity of biogas to be sold to the local industry. This quantity will guarantee the local safety conditions and is beyond any regulation or legal demand for 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 biogas produced), it is paid with the revenues from its sale and no CERs will be claimed on that amount.

This is a conservative approach, because the LFG collected in baseline is feasible in itself, either venting system or the quantity sold to industry. However, it is necessary to explain that the costs to implement a biogas collection system is 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.

These quantities sold to the client will be measurable, agreed in contract and registered.

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 Caieiras landfill current situation is LFG direct emission to 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 project schedule, the registration will happen before the starting of the first 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 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 collection system. The 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. After a few years, this percentage of biogas may be smaller, considering the increase of the biogas produced, leading to a collection efficiency of around 10% of the biogas produced. Besides the sold quantity, the rest will use the same technology as described in alternative 1.

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

ALTERNATIVE 4
Alternative 2 plus energy generation from another 30% of LFG. The surplus of biogas will be emitted through venting system and fugitive emissions. There will be revenues from electricity exported to the grid.

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

Caeiras landfill, at the moment (alternative 1 above), is attending all applicable legal requirements and as a consequence, has all its necessary licenses in date.

There are 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 gas 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 feasability.

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 100US$/Nm3/h of capacity installed for such size of landfill) and will draw up the landfill costs, mainly linked to energy consumption and LFG capture network operation and maintenance (around 10US$/ 1.000Nm3 collected for such size of landfill). Competitors of the Caieiras landfill are: Bandeirantes, Lara (Maua), Pajoan (Itaquaquecetuba), CTR Pedreira (SP), CTR Paulinia (Paulinia), Anaconda (Sta Izabel), Coveg (Santana do Parnaíba). None of these landfills have LFG collection and flaring system. The ones that have a collection system in place are 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.** The electricity from LFG is not competitive with the usual sources. Electricity normal price for the producer(59,65 R$/MWh)[4], is much more lower than the price of LFG electricity. 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 there is no perspective for a second program for the next years.

"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 0.60R$/10.000 kCal and preliminary study estimates a possibility to deliver LFG at around 0.50R$/10.000kCal. 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. The success of the CDM project will 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.

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

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 baseline:

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), the 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, few landfills barely have a LFG capture system and do it for safety reasons, not for legal demands. Furthermore, the 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

A new National Waste Management Policy (Política Nacional de Resíduos Sólidos) is under discussion, but no change is foreseen for the next years. Even the project of such Policy does not specify when and how its legal requirements would be implemented. And it is unlikely to occur in 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, water contamination, leachate proper treatment and etc..

Future legal demands will possibly be developed for LFG collection and destruction. If that happens, it is unlikely that the quantity of LFG to be destroyed would be more than 20% of the LFG produced. 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 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

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 moment of the validation of this document, there is one project in the region that is subject to comparison, although it does not present the same purposes of Caieiras Project. The municipal landfill called Bandeirantes, has a biogas collection system in place through forced exhaustion, 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 will use the energy produced for its own purpose, in its installations and agencies around Brazil. As UNIBANCO is considered as a commercial activity, its normal energy rate is around 0,230 R$/kWh. Generating its own energy from biogas is therefore a economically interesting operation.

Some others project activities of the same nature are under development in Brazil, but all of them are 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.

An important other aspect is related with the investment strategy of Essencis.

Essencis 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 already have some restriction in financing the necessary investment to keep its rank. For such reason, Essencis 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.

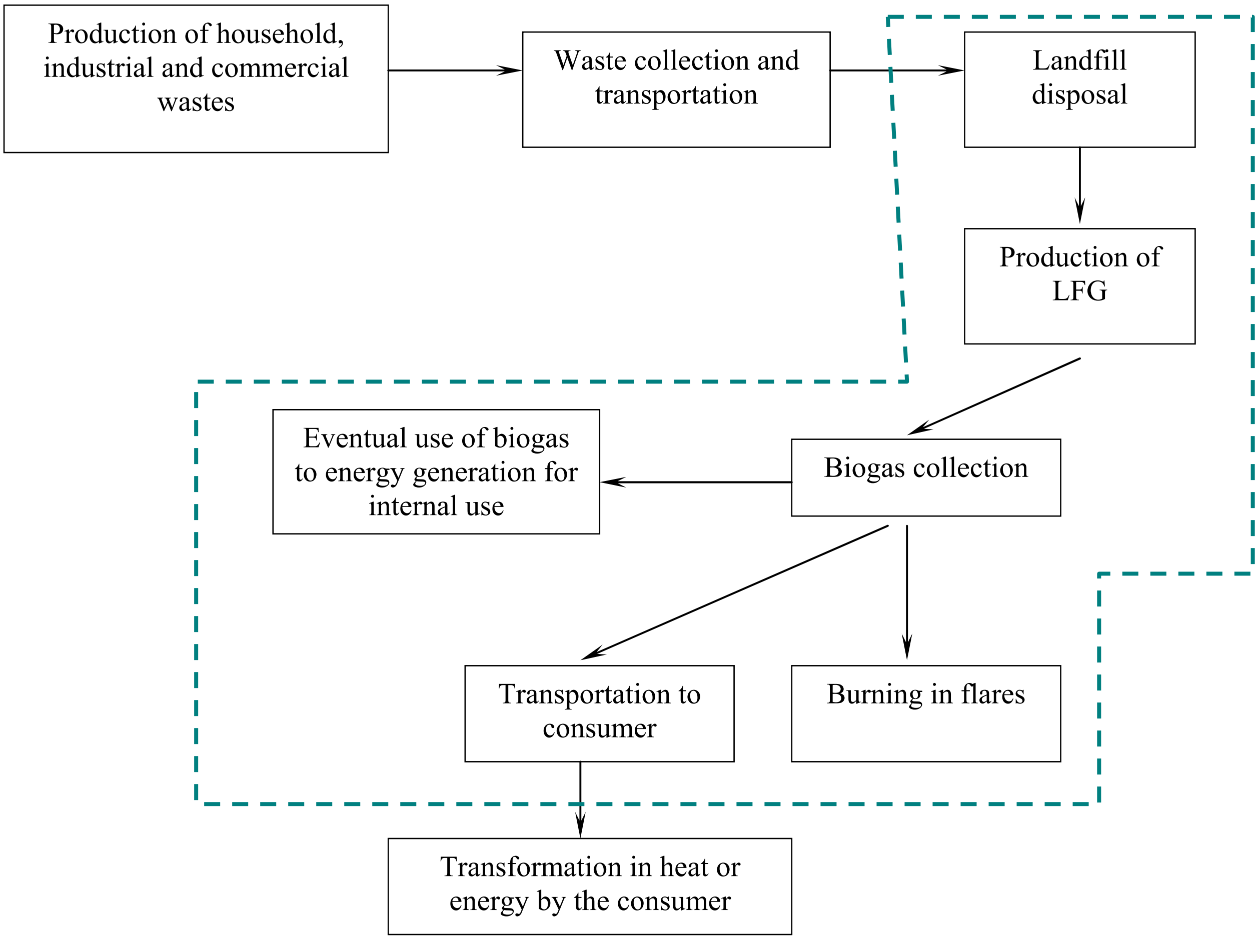
B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

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.

The potential source considered was the emissions resulting from electricity being used to pump LFG in the new collection equipment. Given the domination of hydro in the energy resource mix for São Paulo

State[5], this was also deemed to be immaterial. It could be interesting to have a small electricity production to supply internal demand in the future. In that case, electricity for gas pumping will be produced from biomass source.

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



[5] 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.

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

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:

September 2005

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

20 years

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

C.2.1. Renewable crediting period

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

01/September/2005

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”

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 Caieiras landfill gas emission reduction project and then will not be mentioned in this PDD.

The electricity generation from biogas will not be contemplated by the project. The electricity used to pump biogas (potential leakage) is from the grid, hydro power source predominant in the region.

Methane collected and flared:

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

- amount of landfill gas collected (LFG_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 analyzer;
- Flare working hours, using a run time meter;

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 the biogaz flow must be appropriated to the local climate conditions and to any contaminant that might exist in the biogas;
- All the equipment must be calibrated periodically.

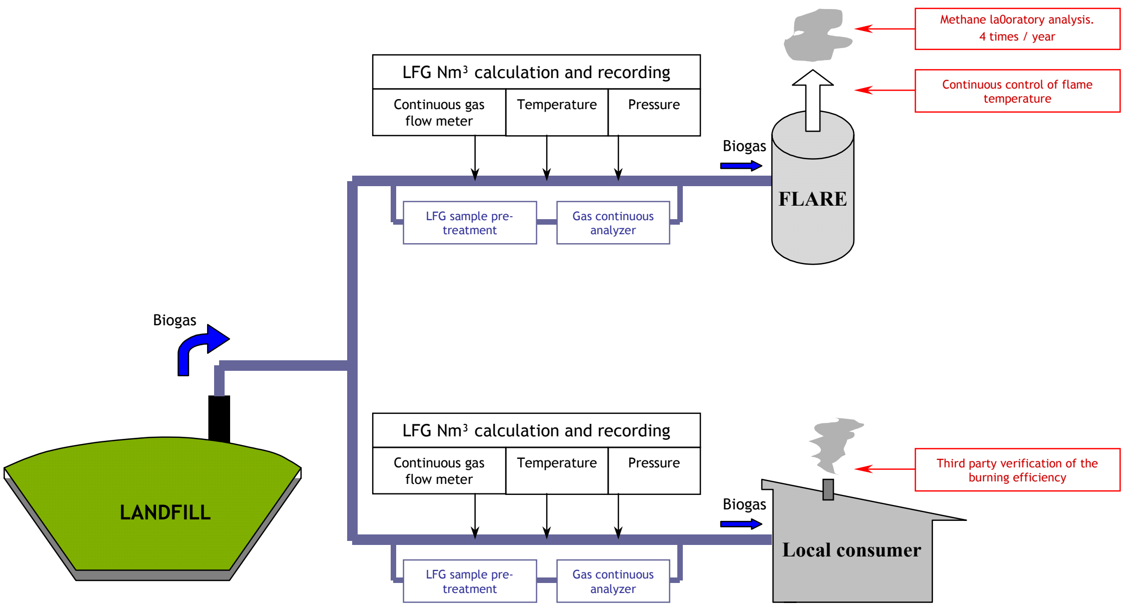


Figure 5: schematic of methane monitoring

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	continuous	100%	electronic	Measured by a flow meter. Data will be aggregated monthly and yearly.
3.2	$LFG_{flare,y}$	Amount of landfill gas flared	[m³]	m and c	Continuous	100%	electronic	Measured by continuous gas quality analyser and flow meter, or complementary method (% CH4, Sm3/h of LFG, LFG temperature and pressure, flare temperature, flare working hours)
3.3	$LFG_{electricity,y}$	Amount of landfill gas going into electricity generator	[m³]	m and c	Continuous	100%	electronic	Not Applicable. The project will not generate electricity for the moment.
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 de 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.):

Project emissions will be directly measured in flow meters. The formulae used to transform in CO_{2eq} is:

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

Where:
ER_y is measured in tonnes 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.

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 will be defined between two values, like the following:

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

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 Essencis Operational Director) + 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

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

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

Based on Essencis estimates, the CTR Caieiras/SP, from 2005 on, is expected to begin to receive part of São Paulo household waste, according to the table below:

Table 3: projection of waste disposal in CTR Caieiras/SP

Year	Estimated annual waste tonnage (ton)	Real waste tonnage disposed (ton)
2002		70.979
2003		415.810
2004		454.354
2005	730.000	
2006	730.000	
2007	1.460.000	
2008	1.460.000	
2009	1.460.000	
2010	1.460.000	
2011	1.460.000	
2012	1.460.000	
2013	1.460.000	
2014	1.460.000	
2015	1.460.000	
2016	1.460.000	
2017	1.460.000	
2018	1.460.000	
2019	1.460.000	
2020	1.460.000	
2021	1.460.000	
2022	1.460.000	
2023	1.460.000	
2024	1.460.000	

It is expected this waste 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 potential of methane generation of about 116 m3/ton of waste. 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 during the project lifetime:

Year	A: Tons of CH4 (50% of LFG) generated in the landfill (ton/year)[6]	B: Collection efficiency reached by the project each year (%)	**C = A x B** **$MD_{project,y}$** 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)**
2005	9.952	40	3.981	**83.599**
2006	13.845	60	8.307	**174.453**
2007	22.098	70	15.468	**324.837**
2008	29.716	80	23.772	**499.221**
2009	36.748	80	29.398	**617.361**
2010	43.239	80	34.591	**726.417**
2011	49.323	80	39.385	**827.089**
2012	54.763	80	43.811	**920.021**
2013	59.870	80	47.896	**1.005.808**
2014	64.583	80	51.667	**1.085.000**
2015	68.935	80	55.148	**1.158.103**
2016	72.951	80	58.361	**1.225.585**
2017	76.659	80	61.328	**1.287.879**
2018	80.082	80	64.066	**1.345.384**
2019	83.242	80	66.594	**1.398.467**
2020	86.159	80	68.927	**1.447.470**
2021	88.851	80	71.081	**1.492.705**
2022	91.337	80	73.070	**1.534.462**
2023	93.631	80	74.905	**1.573.008**
2024	95.749	80	76.600	**1.608.591**
TOTAL	**1.221.644**	**-**	**968.335**	**20.335.459**

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

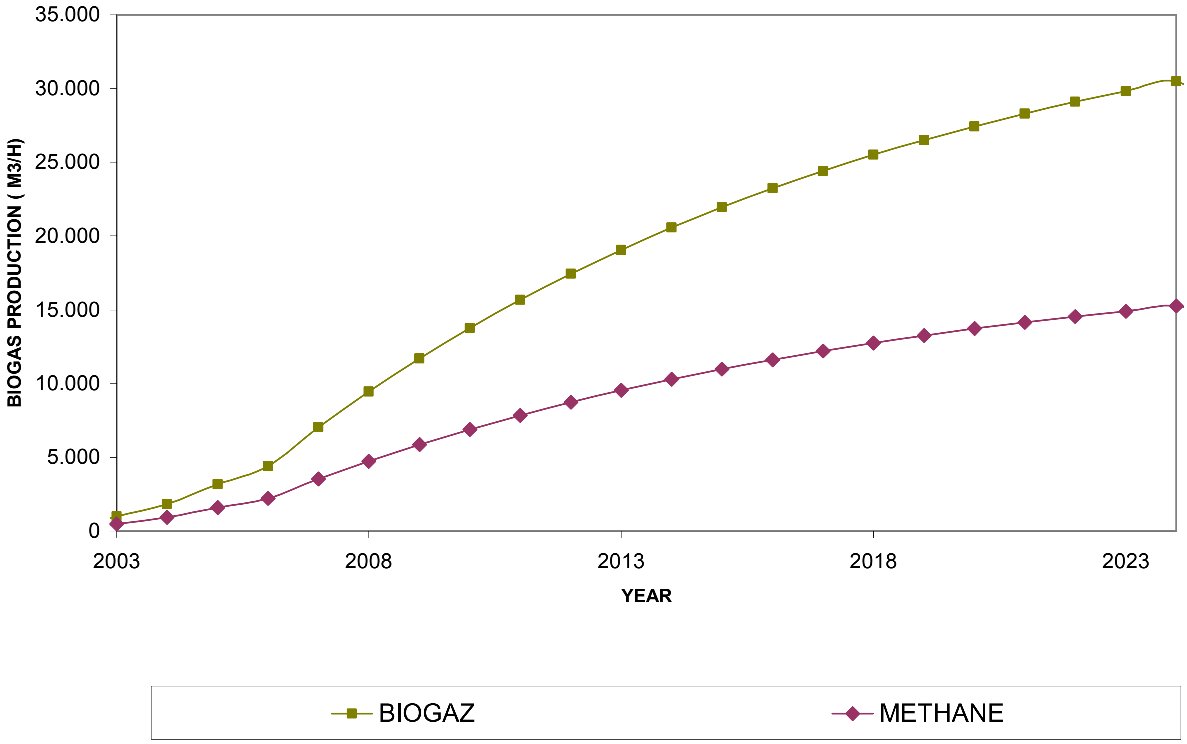


Figure 6: Biogas and methane production by the landfill

The attached spreadsheet illustrates how the 58.000 tons per year (initially), 116 m3/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 potential of that waste;
- Waste decay;
- % of the biogaz that is methane;
- 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)	m³/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/m³(STP[7])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 is predictable, once the electricity supplied to the CTR Caieiras is from hydraulic source (clean energy).

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 avoided emissions (due to project improvements on collection) is the higher volume between the gas to be sold to local consumer and the 20% of the biogas collected by the project activity. The choice of this baseline is justified in the chapter B.2. Table 8 below indicates (column two) the volume of methane to be sold, the 20% of biogas collected and the third column is the result between the two.

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

Table 8: Volume of methane in the baseline

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

Year	B: Selling contract of the supply agreement in m^3/h of biogas	**$MD_{industry,y}$** (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)	**MD_{regy}** **(ton CO_{2e})**
2005	500	1.570	796	1.570	**32.970**
2006	1.000	3.140	1.661	3.140	**65.940**
2007	2.000	6.279	3.094	6.279	**131.859**
2008	3.000	9.419	4.754	9.419	**197.799**
2009	4.000	12.558	5.880	12.558	**263.718**
2010	5.000	15.698	6.918	15.698	**329.658**
2011	5.000	15.698	7.877	15.698	**329.658**
2012	5.000	15.698	8.762	15.698	**329.658**
2013	5.000	15.698	9.579	15.698	**329.658**
2014	5.000	15.698	10.333	15.698	**329.658**
2015	5.000	15.698	11.030	15.698	**329.658**
2016	5.000	15.698	11.672	15.698	**329.658**
2017	5.000	15.698	12.266	15.698	**329.658**
2018	5.000	15.698	12.813	15.698	**329.658**
2019	5.000	15.698	13.319	15.698	**329.658**
2020	5.000	15.698	13.785	15.698	**329.658**
2021	5.000	15.698	14.216	15.698	**329.658**
2022	5.000	15.698	14.614	15.698	**329.658**
2023	5.000	15.698	14.981	15.698	**329.658**
2024	5.000	15.698	15.320	15.698	**329.658**
TOTAL	**85.500**	**268.434**	**193.671**	**268.434**	**5.637.156**

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

$ER_y = \Sigma MD_{project,2005-2024} - \Sigma MD_{reg,2005-2024}$

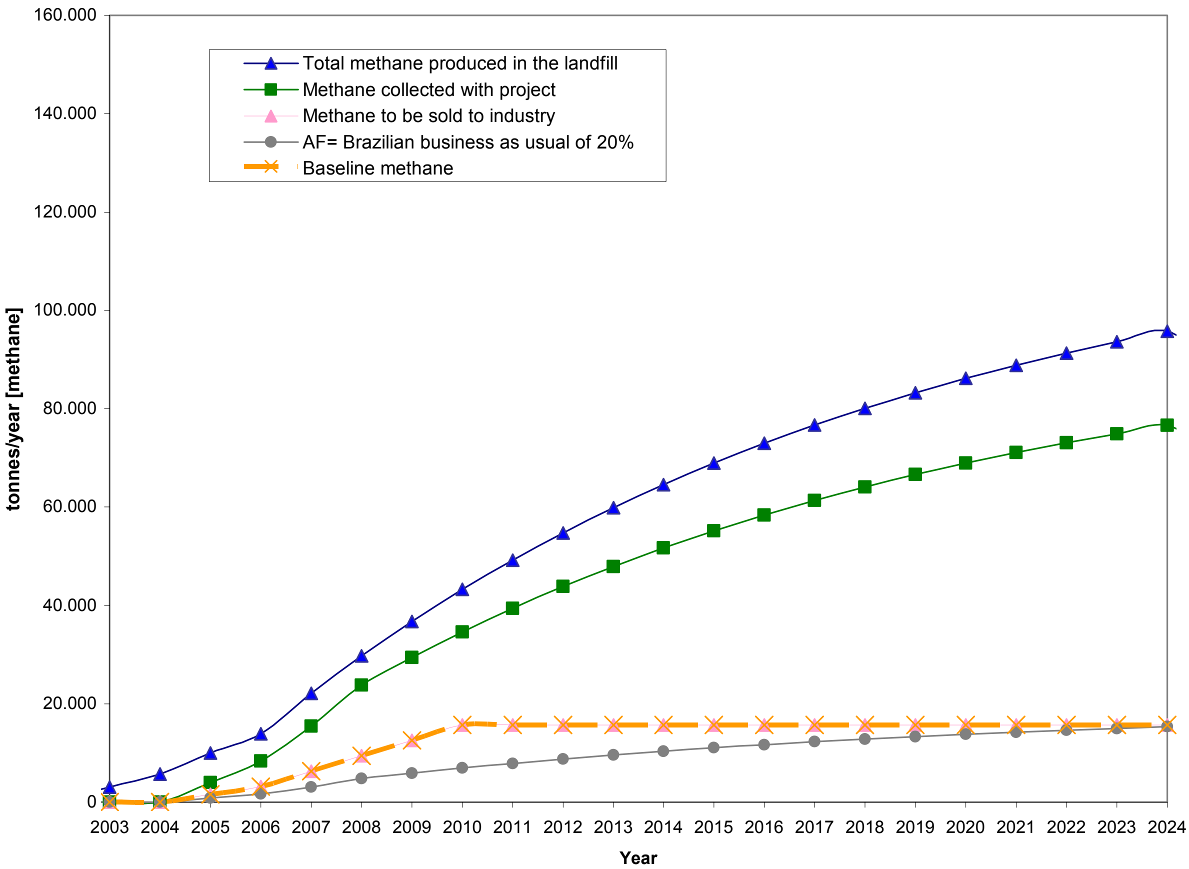


Figure 7: Methane production and collection, in Baseline and Project.

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

Summary of Estimated Emission Reductions for the Caieiras Landfill Gas management
(Tons of CO2 equivalent per year.)

Year	ER_y Emissions reduction in tons of CO_2 equivalent
2005	50.633
2006	108.522
2007	192.974
2008	301.427
2009	353.636
2010	396.761
2011	497.433
2012	590.365
2013	676.152
2014	755.343
2015	828.446
2016	895.929
2017	958.223
2018	1.015.728
2019	1.068.811
2020	1.117.813
2021	1.163.048
2022	1.204.805
2023	1.243.352
2024	1.278.935
TOTAL	**14.698.336**

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 intends to implant selective collection in the surrounding municipalities and extends the ones already in place. For that, Essencis 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 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

Organization:	ESSENCIS SOLUÇÕES AMBIENTAIS S.A.
Street/P.O.Box:	Rodovia dos Bandeirantes, km 33
Building:	
City:	Caieiras
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Title:	Project Officer
Salutation:	Mr.
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Annex 2

INFORMATION REGARDING PUPLIC FUNDING

No Public funding is claimed by the project.

Annex 3

BASELINE INFORMATION

Table A1: projection of waste disposal in CTR Caieiras/SP

Year	(C) Estimated annual waste tonnage (ton)	Real waste tonnage disposed (ton)
2002		70.979
2003		415.810
2004		454.354
2005	730.000	
2006	730.000	
2007	1.460.000	
2008	1.460.000	
2009	1.460.000	
2010	1.460.000	
2011	1.460.000	
2012	1.460.000	
2013	1.460.000	
2014	1.460.000	
2015	1.460.000	
2016	1.460.000	
2017	1.460.000	
2018	1.460.000	
2019	1.460.000	
2020	1.460.000	
2021	1.460.000	
2022	1.460.000	
2023	1.460.000	
2024	1.460.000	

Table A2: Key variables on baseline estimation

Variable	Unit	Value
Lo (methane potential)	m³/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 m³/h of biogas	**$MD_{industry,y}$** (tons/year) =B*365*24*0,5*0,0007168
2005	500	1.570
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	**85.500**	**268.434**

Annex 4

MONITORING PLAN

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