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:

Brazil MARCA Landfill Gas to Energy Project. Version Number 02, 24 July 2005.

A.2. Description of the project activity:

Brazil MARCA Landfill Gas to Energy Project is a joint initiative between EcoSecurities, an environmental finance company which specializes in greenhouse gas (GHG) mitigation issues and MARCA Ltda, a local Brazilian landfill management company with operations in several municipalities in the state of Espirito Santo. MARCA is an experienced landfill operator with thorough knowledge in regards to local landfill policies and regulations.

The objective of the project is to collect and utilize the landfill gas of the landfill managed by MARCA. This will involve investing in a gas collection system, leachate drainage system, flairing equipment and a modular electricity generation plant (with expected final total capacity of 11 MW), as well as a generator compound at each site. The generators will combust the methane in the landfill gas to produce electricity for export to the grid. Excess landfill gas, and all gas collected during periods when electricity is not produced, will be flared. Combustion and flaring combined are expected to reduce emissions by 4,859,503 tonnes of CO_2e over the next 21 years.

The main social and environmental impacts of this project will be a positive effect on health and amenity in the local area. Contaminated leachate and surface run-off from landfills can affect down-gradient ground and surface water quality consequently affecting the local environment. The uncontrolled release of landfill gas can also impact negatively on the health of the local environment and the local population and lead to risks of explosions in the local surroundings. By managing the Vitoria landfill properly the environmental health risks and the potential for explosions is greatly reduced. Economic benefits include the project acting as a clean technology demonstration project, encouraging less dependency on grid-supplied electricity and better management of landfills throughout Brazil, which could be replicated across the region.

A.3. Project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host party)	MARCA Ltda	No
UK	EcoSecurities Ltd	No
UK	Biogas Technology ltd	No
UK	Shell Trading International Ltd.	No
Japan	Showa Shell Sekiyu K.K.	No

Contact information is provided in Annex 1

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

City of Cariacica, Espirito Santo State, Brazil

A.4.1.1. Host Party(ies):

Brazil (the host country)

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

Espirito Santo State

A.4.1.3. City/Town/Community etc:

Nova Rosa da Penha community, City of Cariacica.

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

The landfill site is located at Km 282 of BR 101 highway, that links Vitoria (capital of Espirito Santo State) with Rio de Janeiro. Figure 1 shows an aerial view of the site:

1)"Nursery Seedling" project	2) "Ecological Brooms" and "Ecological Bricks" projects areas
3) Thermoelectric area	4) Leachate treatment lagoons
5) Industrial waste deposit	6) Hospital waste deposit
7) Cell 2	8) Cell 3

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

Fugitive gas capture and alternative/renewable energy (please note that the emission reductions from the renewable energy activities will not be claimed by the project at this stage).

According to the categories listed on the UNFCCC website, this project falls under the category: 13 - Waste Handling and Disposal (see http://cdm.unfccc.int/DOE/scopes.html).

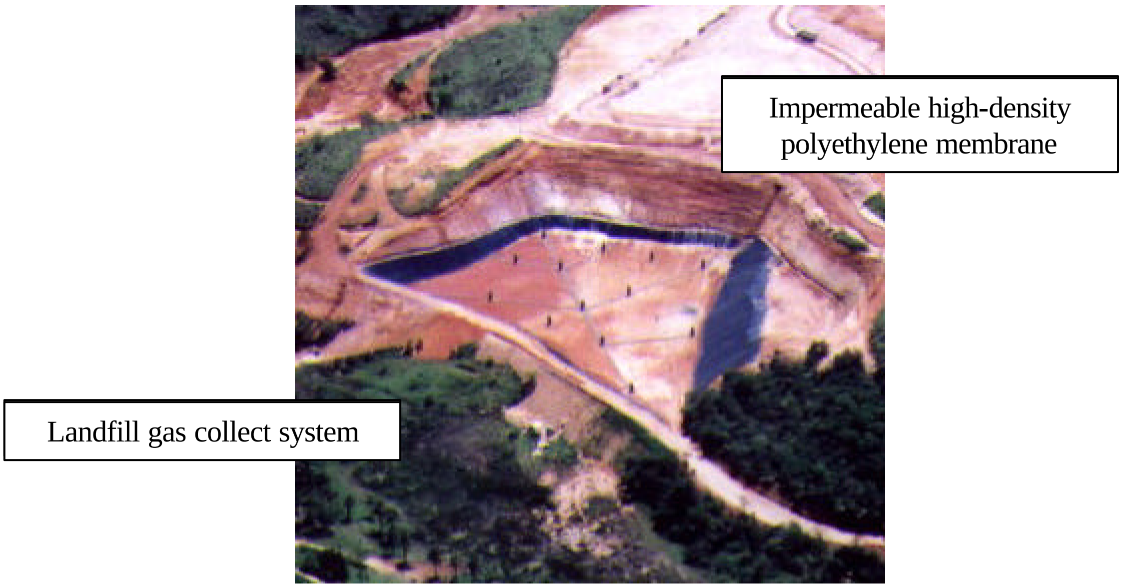
A.4.3. Technology to be employed by the project activity:

Landfill gas collection system:

The project will use state-of-the-art gas collection technology. This includes:

? ? landfill cells coated with an impermeable high-density polyethylene membrane,
? ? water residues channelled and treated in a wastewater treatment plant
? ? vertical wells used to extract gas
? ? optimal well spacing for maximum gas collection whilst minimizing costs,
? ? gas headers designed as a looping system in order to allow for partial or total loss of header function in one direction without losing gas system functionality, and
? ? condensate extraction and storage systems designed at strategic low points throughout the gas system.

Figure 2: Picture from cell 3 during the construction of landfill gas collect system



All efforts will be made to minimize problems in condensate management.

Energy generation technology:

As and when the project secures a power purchase agreement sufficient to enable the generation of electricity, a modular reciprocating engine facility will be installed. Small modular reciprocating engine generator units make it possible to adapt the equipment to the site-specific gas volumes.

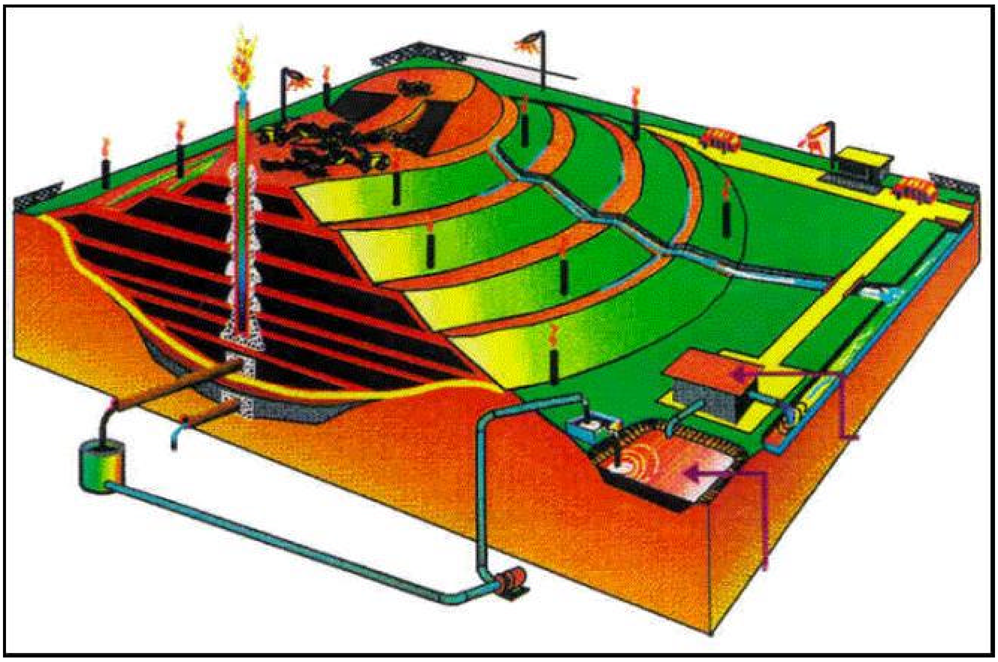
The technology used to collect, destroy and generate electricity is from Biogas Technology ltd L from UK. Equipments were imported and installed in Brazil, representing a transfer of technology.

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:

This project is based on two complementary activities, as follows:

- ? ? The collection and flaring of combustion of landfill gas, thus converting its methane content into CO_2, reducing its greenhouse gas effect; and,
- ? ? The generation and supply of electricity to the regional grid, thus displacing a certain amount of fossil fuels used for electricity generation (although no emission reductions will not be claimed by the project at this stage)

Figure 3: Landfill gas collection system schematic.



The baseline scenario is defined as the most likely future scenario in the absence of the proposed CDM project activity . Establishing this future scenario requires an analysis and comparison of possible future scenarios using a comparison methodology that is justified for the project circumstances. Based on this analysis (see sections B.3. and B.4. below), the baseline scenario is the continued uncontrolled release of landfill gas to the atmosphere, similarly to most landfills in Brazil.

Given that the results of the financial analysis conducted clearly show that that implementation of the this type of project is not the economically most attractive course of action and therefore this kind of project is not part of the baseline scenario, it is concluded that the MARCA Project is additional.

Capture and combustion of the landfill gas methane component through flaring or combustion to generate electricity will result in the avoidance of methane emissions to the atmosphere and the reduction of 4,859,503 tonnes of CO2e emissions over 21 years (conservative estimate as the landfill gas generation estimates have been discounted by 25% to take into account uncertainties in the estimation method and as the final ERs will be discounted by 10% to conservatively deduct the amount of flaring that would occur in the absence of the project).

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

The chosen crediting period is 21 years

Years	Annual estimation of emission reductions in tonnes CO_2e
2004	50259
2005	130578
2006	157776
2007	182387
2008	204655
2009	224804
2010	243036
2011	259533
2012	274460
2013	287966
2014	300188
2015	311246
2016	321251
2017	330305
2018	298872
2019	270431
2020	244696
2021	221410
2022	200340
2023	181275
2024	164024
Total estimated reductions (tonnes of CO_2e)	**4,859,503**

Total number of crediting years	**21**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**231,405**

A.4.5. Public funding of the project activity:

There is no Official Development Assistance in this project and the project will not receive any public funding from Parties included in Annex I

SECTION B. Application of a baseline methodology

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

The Baseline methodology used is the AM0003, "Simplified financial analysis for landfill gas capture projects", version 2, which was approved by the UNFCCC on 8 July 2005.

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

Approach 48(b) appears to be most appropriate to investment projects. The proposed project involves a significant investment in gas collection and power generation that must compete with other such investments. It is therefore appropriate to assume that the decision between alternative baseline scenarios is based on an investment calculus. This justifies an investment or financial analysis as an appropriate baseline methodology for this type of project situation.

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

The following paragraphs first describe how the proposed baseline methodology is applied to single out the baseline scenario for the MARCA project. Secondly, emissions resulting from the baseline scenario are estimated.

1. Identification of the baseline scenario through the baseline methodology

The baseline methodology is applied in the following way:

1. Analysis of the economic attractiveness of the project alternative without the revenue from carbon credits using an IRR calculation and comparison of the results with a reasonable expected return on investment in Brazil. The results show that the project is not an economically attractive course of action.
2. The only other plausible scenario is the continued venting of landfill gas, with no or inappropriate flaring or utilization. This scenario is determined as the baseline scenario based on an analysis of current practices and current and foreseeable regulations in the waste management sector.

The methodology is applied in the following steps:

Step 1: Draw up a list of possible baseline scenario alternatives.

Step 2: If possible, reduce the list of possible baseline scenario alternatives to the BAU scenario and the proposed project alternative through elimination of implausible alternatives. Always provide convincing justification for the elimination an alternative. For instance, a possible alternative is not plausible if it is not permissible under applicable law.

Step 3: Calculate a conservative IRR for the proposed project activity not taking carbon finance into account. The calculation must use the incremental investment as well as operation, maintenance and all other costs of upgrading the BAU scenario to the proposed project activity, and it must include all revenues generated by the project activity except carbon revenues. An IRR is calculated conservatively, if assumptions made tend to result in a rather higher than a lower IRR.

Step 4: Determine that the project IRR is clearly and significantly lower than a conservatively (i.e. rather low) expected and acceptable IRR for this or a comparable project type in this country.

Step 5: Conclude that the project is therefore economically unattractive and that therefore the remaining BAU alternative is the most likely baseline scenario.

Step 6: Analyze and describe the anticipated development of the most likely baseline scenario during the crediting period.

Step 7: Provide a complete description of the baseline scenario.

Step 1 and 2: Possible and plausible baseline scenarios

Alternative 1: The landfill operator could continue the current business as usual practice of not collecting and flaring landfill gas from his waste operations. In this case, no power would be generated at the sites and the Brazilian power system would remain unaffected.

Alternative 2 The landfill operator would invest in some LFG collection and flaring but not in power generation. The Brazilian power system would remain unaffected.

Alternative 3: The landfill operator would invest in a landfill gas collection system of high effectiveness, as well as a high efficiency flaring system and in LFG power generation equipment (the proposed project activity). The operation would marginally reduce the generation of power for other grid-connected sources.

According to the National GHG Emissions Inventory conducted by CETESB in 1994, Brazil had over 6,000 waste deposition sites, receiving over 60,000 tonnes of waste per day (please note this study is currently being updated). According to the same study, 84% of Brazil's methane emissions came from the deposition of waste in uncontrolled rubbish dumps.

Currently, 76% of the total waste generated in Brazil is disposed in 'rubbish dumps' ("lixões") with no management, gas collection, or water treatment whatsoever. The remaining 24% of waste is disposed in 'controlled' landfills (as opposed to 'sanitary' landfills, as planned by the project), and subject to regulation by the environmental authorities.

Current Brazilian legislation does not require that landfills collect and dispose of landfill gases. So far, only two landfills in Brazil, Salvador and Tremembé, located in State of Bahia and State of São Paulo respectively have been designed to collect and utilize (or even flare) the full amount of gas generated. Both landfills were financially supported by the sale of Carbon Credits.

In the few cases where gases are collected, this is done for safety reasons (to avoid explosions), and it is often the case that the amounts effectively collected are very low, due to high levels of leachate (which is often not drained or treated, as well) blocking the drainage pipes.

The implementation of environmental protection legislation in Brazil has a relatively long lead-time, and the Ministry of the Environment has no immediate plans to introduce legislation requiring the collection and flaring of landfill gas from landfill sites. Historically in Brazil there also tends to be a gulf between stated regulations and practice with regards to the implementation of environmental protection legislation.

Given the regulatory situation in Brazil and the location and conditions of the landfill, the realization of alternative 2 is not required and would also not be an economically attractive course of action for the landfill owner and/or operator. It is therefore not considered a plausible alternative.

This reduces the list of plausible alternatives to Alternative 1 (i.e. BAU) and Alternative 3 (the proposed project).

<u>Steps 3, 4 and 5: Financial analysis and selection of baseline scenario</u>

Given that the main potential financial returns derived from the collection of gas is the sale of electricity, the feasibility of this project is, thus, dependent on factors related to energy sector and to the decentralization of electricity generation in Brazil. It is necessary to conduct a financial analysis to determine whether the project is an economically attractive course of action.

Energy sector and electricity market: Hydro electricity accounts for an average of 81.42 per cent of national electricity production in Brazil. This high proportion in Brazil's electricity generation technology matrix was a consequence of a policy addressed at increasing Brazilian energy independence, as the country had few oil reserves and very poor coal reserves, but rich hydrology resources. In the mid 1980's, Brazil's power sector went through a serious financial crisis, leading to the interruption of construction of many power plants - mostly hydro. In 1993 decentralization of the power sector started which added to delays in implementing planned projects.

The current Brazilian 10-year expansion plan 2004/2012 reduces the importance of hydro in the short-term, but emphasizes its role again at the end of the period. However it is unclear how the large-scale investments will be financed, particularly in view of the trend towards decentralization of the sector. During 2001 power shortages occurred, caused by a scarcity of hydrological resources. It is unclear how this will affect the National Expansion Plan data. However, in the past couple of years there has been a push towards the introduction of thermal power to avoid future blackouts, and therefore a greater reliance on fossil fuels.

Historically, tariff levels have been relatively low due to a centralized pricing structure fixed by the government. While tariff increases may be expected in locations where there is a large growth in demand for electricity, such as Espirito Santo, the ability to capture such tariffs are still uncertain due to the risks of a still incipient free electricity market in Brazil.

In parallel to the risks related to the sale of electricity, the exact amounts of landfill gas and the performance of the plants also concerns landfill operators. Given that currently there isn't a single landfill site in Brazil generating electricity, this is seen as 'unproven' technology by local investors.

Financial analysis: Financial analysis conducted for the Project (see Annex 3) using assumptions that are conservative from an investment decision point of view shows that the Internal Rate of Return of the project without carbon finance is negative.

A sensitivity analysis was undertaken using assumptions that are highly conservative from the point of view of analyzing additionality, i.e. the best case scenario IRR was calculated. Given that the landfill operations started in 1995, the waste in place in Jan 2004 is 1,336,327 tonnes, and it was assumed that, from Jan 2004 onwards the average waste placement rate at the landfill is 1000 tonnes per day. The landfill gas generation model used, the US EPA First Order Decay Model, has an inherent error up to 50%. For the best case IRR it was assumed that there was a 0% error margin, therefore again increasing the expected landfill gas volumes from the site, and the expected electricity to be generated from the site. It was assumed that the project has unlimited access to capital to invest in all the equipment necessary to use the increased amount of gas produced. It was assumed that the US$:Rs$ exchange rate was fixed at 3.0 and the electricity tariff was fixed at R$ 120.00 over the 21 year period (equivalent to U$ 40,00/MWh at this exchange rate). These best case assumptions were inputted into the models and financial analysis to recalculate the IRR. The IRR (without carbon) is 8.94 % and still exposed to a series of risks (project, country, currency, etc.). The rate of return of Brazilian government bonds is 22%. These results show that even with the best possible conditions, which are obviously quite unrealistic, the MARCA project is still not an economically attractive course of action.

Given that the project is not an economically attractive course of action, the only remaining plausible baseline scenario is Alternative 1, i.e. the continuation of the status quo (BAU) without any LFG treatment.

<u>Step 6 and 7: Baseline development in time and description of baseline scenario</u>

It has been shown that the BAU baseline holds at the time of preparing the project. The main determinants of this baseline are:

- ? ? Landfill regulations applicable to the site
- ? ? The economics of landfill gas utilization.

The baseline scenario for the proposed project can thus be described as follows:

Inadequate collection and treatment of LFG at the landfill site and thus the unimpeded release of LFG to the atmosphere until some future time when the collection and treatment of LFG may either be required by law or becomes an economically attractive course of action.

This baseline scenario is the basis for the determination of the project's ERs as per the monitoring plans instructions.

2. Estimation of emissions associated with baseline scenario (including estimation of the amount of flaring that would occur in the absence of the project)

This was conducted by estimating the amount of LFG that could be generated in the baseline scenario using the US EPA First Order Decay Model and deducting the amount that would have been flared in the absence of the project according to the effectiveness of the gas collection systems imposed by regulatory requirements at the time of inception of the project (the 'Effectiveness Adjustment Factor').

The First Order Decay Model was used with the assumptions listed in Annex 3 and estimated that in the baseline there will be the production of 9.2 million tCO_2e during the project's 21-year lifetime.

Adjustment Factor:

The estimation of the adjustment factor for this project was based on the regulatory requirements imposed on MARCA (the landfill operator) at the time they signed a contractual agreement with the Municipal waste management company to operate the landfill and by the practices that MARCA have been doing before the MDL project proposal. In essence, MARCA is not required to flare any amount of the gas that it currently emits. There is no legislation or contractual terms that require the flaring of landfill gas. Currently, cell 1 of the site, the unique totally project before the MDL project proposal, doesn't even have gas collection wells, while Cell 2 has 12 wells (very insufficient) just for safety purpose, and Cells 3 and 4 will also have wells for safety purposes only. Currently, the company has already a small flare in Cell 2, as a pilot for the gas collection project that will be implemented with carbon finance.

When a cell is full, and the activities are closing, MARCA seals the cell with marble industry residue dust layer, then a clay layer and finally vegetation recovering all the cell. With this actions the oxygen disposable to the cell will be very small, inhibiting spontaneous combustion and methane oxidation. For this reason, the adjustment factor for the project was fixed at 10%.

The effectiveness of a landfill gas collection and flaring system can be affected by a number of factors including:

? ? The frequency of gas wells;
? ? The depth of gas wells;
? ? Whether suction is applied to the gas wells;
? ? The efficiency of the flares used.

These factors will impact on the area of influence of a gas well, for example a gas collection system where suction is applied will draw gas from a larger area of waste than a system without suction. Similarly, a deep gas well will have a larger area of influence than a shallow well.

The project scenario proposes the installation of pipes connecting the gas wells, the application of suction to the wells, and the installation of Modular Ground Gas flares. The flares are based on an advanced design and will be skid or base frame mounted ground flares. Ground flare stacks enable higher burning temperatures to ensure low emissions. The burner unit is fully adjustable to enable high temperature flaring of the landfill gas, which will vary in both quality and quantity from site to site, and over time. The average effectiveness of this system is estimated to be 75%.

Although current legislation does not require any collection of the gas collected through the project, and MARCA do not flare the landfill gas out of MDL project scope, all emission reductions arising from the project will nonetheless be reduced by 10%, in order to provide a large enough margin to what could have been flared in the baseline scenario during the first baseline crediting period. Hence, the chosen discount value for MARCA is conservative.

Once the project becomes operational, the emission reductions associated with project can be calculated directly by quantifying the amount of GHGs flared and deducting this 10% Adjustment Factor to conservatively account for any flaring that may have taken place in the baseline scenario. At the end of the crediting period, this 'Effectiveness Adjustment Factor' will be revised, as described in Section D.2.

The following table shows the key information and data used to determine the baseline scenario:

Variable	Data Source
Flow of landfill gas to flares	Project Developer
Pressure of landfill gas to flares	Project Developer
Temperature of landfill gas to flares	Project Developer
Percentage of flaring in baseline	Conservative estimate based on legal requirement or common practices only for safety reasons. The most conservative.
Methane fraction in LFG	Project Developer

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:

A CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would occur in the absence of the registered CDM project activity, i.e. in the baseline scenario.

Given that the results of the financial analysis conducted clearly show that that implementation of the this type of project is not the economically most attractive course of action and therefore this kind of project is not part of the baseline scenario, it is concluded that the MARCA Project is additional.

Furthermore, the additional value derived from the sale of carbon credits appears to increase the project's financial returns to a level sufficient to justify the inherent risks associated with long-term investment decisions and capital allocation for landfill gas collection systems and electricity generation equipment. This key role that carbon credits could play in the investment decision and financial feasibility of the project, indicates that this investment will lead to emission reductions in relation to the baseline investment scenario.

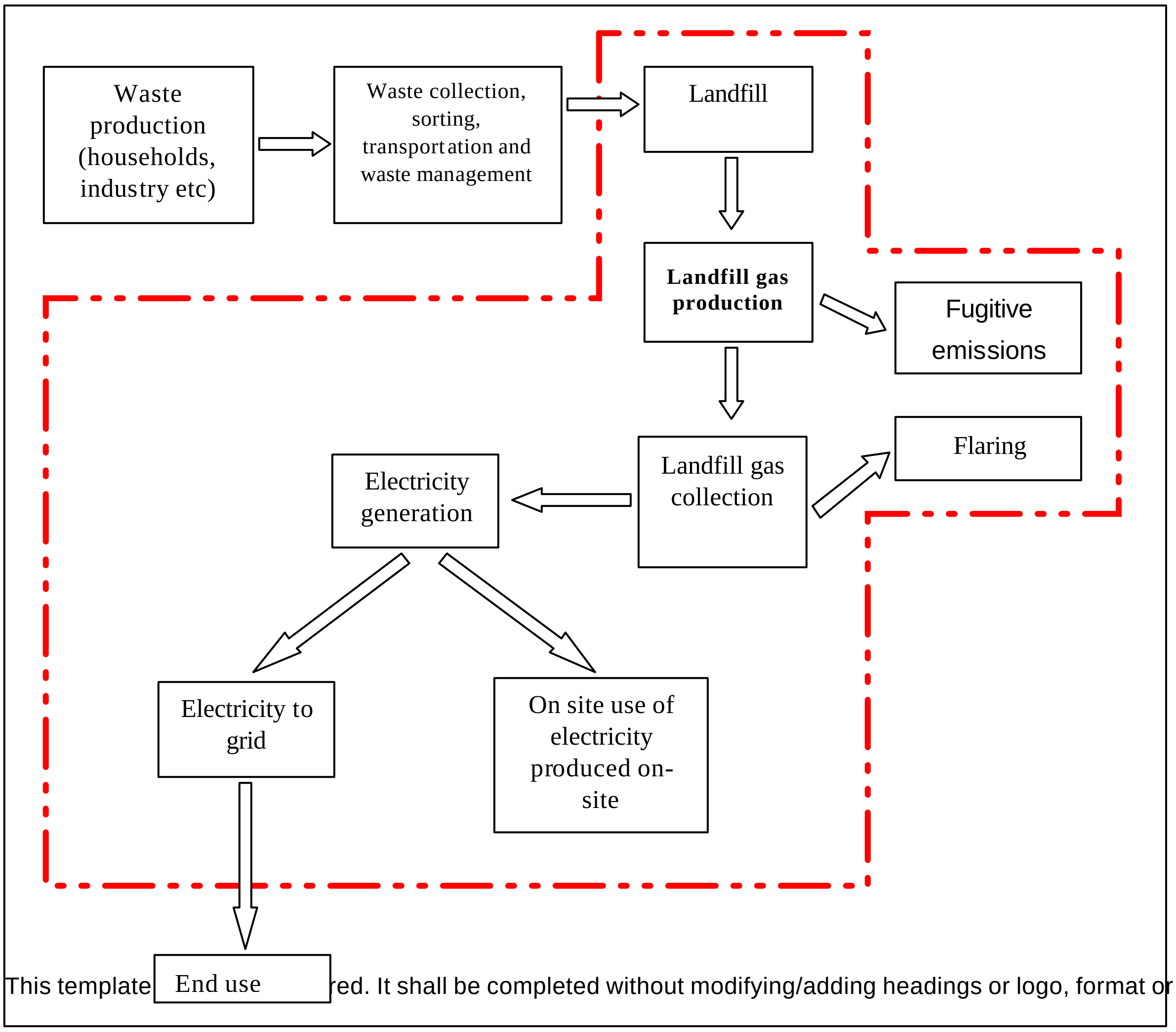
In the baseline scenario (business-as-usual scenario), without any gas collection or utilization schemes in place at the landfill, the site (using estimations from the US EPA First Order Decay Model) would be responsible for the release of approximately 480,000 tonnes of methane during 21 years.

The MARCA project scenario is based on the collection and flaring or combustion of landfill gas for the generation of electricity. Flaring or combustion of the landfill gas to produce electricity will convert the highly potent methane content to less potent carbon dioxide, and result in significant greenhouse gas emission reductions. Using the US EPA Model gas predictions and projecting the amount of landfill gas which will either be combusted in engines or flares it is estimated that only 2.5 million tonnes of CO_2e will be emitted as fugitive emissions in the project scenario during the period 2004-2023, compared to 9.0 million tCO_2e in the baseline scenario. Therefore capture and combustion of the landfill gas methane to generate electricity will effectively result in the avoidance of 4.8 million tonnes of CO_2 emissions over 21 years.

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

A full flow diagram of the project and system boundaries is presented in Figure 4. The flow diagram comprises all possible elements of the landfill gas collection systems and the equipment for electricity generation.

Figure 4: Flow chart of system boundaries



The table below contains a summary of the system and project boundaries for the MARCA project.

Table 1: Summary of system and project boundaries

Emissions	**Project Scenario**	**Baseline Scenario**
Direct on-site	Emissions associated with fugitive landfill gas emissions. EcoSecurities estimates that only 75% of LFG generated will be captured meaning the remaining 25% is released as fugitive emissions.	Uncontrolled release of landfill gas generated.
Direct off-site	Transportation of equipment to project site – excluded	None identified
	Use of electricity generated from landfill gas, reducing CO_2 emissions in the electricity grid	Emissions associated with use of grid electricity – in the interests of conservatism emission reductions arising from the displacement of more carbon intensive electricity will not be included in the projects volume of CERs
Indirect on-site	Emissions from electricity use for operation of lights and fans of on-site workshop – excluded, since it is carbon neutral Emissions from construction of the project – excluded as would occur even if an alternative project was constructed	–
Indirect off-site	Transport of waste to the landfill site(s) – excluded	Transport of waste to the landfill site(s) - excluded

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

Detailed baseline information is attached in Annex 3.

The baseline study was carried out by EcoSecurities Ltd. EcoSecurities Ltd is also a project participant. The baseline study was completed on 31/12/2003.

The contact details for the person (s)/entity (ies) determining the baseline are as follows:

Pedro Moura Costa (contact also in annex 1)
Ecosecurities Ltd.
21 Beaumont Street

Oxford OX1 2NH
Telephone (44) 1865 202635
Fax: (44) 1865 251438
www.ecosecurities.com

Nuno Cunha e Silva and Henrique Moura Costa
Ecosecurities Brasil Ltda.
Rua da Assembléia 10/2011
Rio de Janeiro – RJ
Brasil
Telefone: (21) 2222-9018
Fax: (21) 2222-7615
www.ecosecurities.com

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:

Estimated as 01/07/2004 (defined as the start of operation of the landfill gas collection and electricity generation system).

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

21 years

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

The project will use a renewable crediting period

C.2.1. Renewable crediting period

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

Estimated as 01/07/2004

C.2.1.2. Length of the first crediting period:

7 years or 84 months.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

C.2.2.2. Length:

SECTION D. Application of a monitoring methodology and plan

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

The monitoring methodology used is the AM0003, “Simplified financial analysis for landfill gas capture projects”, version 2, which was approved by the UNFCCC on 8 July 2005.

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

For a landfill methane gas capture project such as this one it is most appropriate to accurately measure the methane combusted in flares and generators, i.e. the emission reductions attributable to the project.

Characteristic for LFG collection and utilization projects of the kind described above is that the emissions not released to the atmosphere can directly be monitored. The emissions reductions achieved by the project do not have to be derived from a comparison between baseline and project emissions, because every ton of methane collected and destroyed equals one ton of methane not released to the atmosphere and thus one tone of methane emissions reduced. In other words, a monitoring and ER calculation method can be used that does not rely on information about baseline emissions, i.e. the quantity of emissions in the baseline scenario can remain unknown. This is convenient, since the monitoring of baseline emissions from landfills is also unpractical except on a sample basis. The proposed monitoring and ER calculation method can also be expected to be more accurate than an attempt to derive ERs as the difference between monitored or estimated baseline and project emissions.

In cases where a certain collection and treatment of LFG is already part of the baseline and information exist on the efficiency of the collection system actually installed by the project (e.g. the installed system captures 75 per cent of all LFG emissions), direct monitoring of LFG quantities not released can be corrected by applying an appropriate factor.

The MARCA monitoring plan sets out a number of monitoring tasks in order to ensure that all aspects of projected greenhouse gas (GHG) emission reductions for the MARCA project are controlled and reported. This requires an ongoing monitoring of the project to ensure performance according to its design and that claimed Certified Emission Reductions (CERs) are actually achieved.

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

Not applicable, because the project directly monitors and calculates emission reductions.

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.)

Not applicable since the project will directly measure emissions reductions rather than comparing the baseline and project emissions.

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 applicable since the project will directly measure emissions reductions rather than comparing the baseline and project emissions.

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
1	Flow of landfill gas to flares	Project Developer	M^3	m	Continuous	100%	Electronic (spreadsheet)	*Data will be aggregated monthly and yearly*
2	Pressure of landfill gas to flares	Project Developer	BAR	m	Continuous	100%	Electronic (spreadsheet)	*Data will be aggregated monthly and yearly*
3	Temperature of landfill gas to flares	Project Developer	°C	m	Continuous	100%	Electronic (spreadsheet)	*Data will be aggregated monthly and yearly*

4	Gross electricity produced	Project Developer	MWh	M	Continuous	100%	Electronic (spreadsheet)	*Data will be aggregated monthly and yearly*
5	Generator heat rate	Project Developer	GJ/ MWh	M & C	Semi-annual determination of flare efficiency (if significant variation since last monitoring, monitoring repeated every month)	Semi-annually or more frequent depending on observed deviation from previous rating	Electronic (spreadsheet)	*Data will be used to test and, if necessary correct the generators' standard heat rate plate ratings*
6	Flare efficiency	Project Developer	%	M & C	Semi-annual determination of flare efficiency (if significant variation since last monitoring, monitoring repeated every month)	Semi-annually or more frequent depending on observed deviation from previous rating	Electronic (spreadsheet)	*Data will be used to test and, if necessary correct the flares' efficiency ratings.*
7	Methane fraction in LFG	Project Developer	%	M & C	Continuous	100%	Electronic (spreadsheet)	*Data will be aggregated monthly and yearly.*
8	LFG collected by Control group	Project Developer	%	E	Every 7 years	A minimum of 10 control sites	Electronic (spreadsheet)	-

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

For project emissions calculated for this project activity, please see Item D.2.4.

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 (e)/ paper (p))	Comment

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

Not applicable. Only the construction of the LFG collection and utilization system will lead to some GHG emissions that would not have occurred in the absence of the project. These emissions are however insignificant and would likely also occur if alternative power generation capacity were to be constructed at alternative sites. No increases in emissions are discernable other than those targeted and directly monitored by the project. Moreover, because the project employs direct monitoring of ERs, indirect emissions will not distort their calculation

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.)

Although once the project is operational the emission reductions for the project can be calculated directly (i.e., without the need for calculating the project and baseline emissions separately), in a preliminary phase the emissions in the project and baseline scenarios were estimated using a first order decay model equation for landfill gas generation. Here the formulae that will be used to directly calculate the emissions reductions are given as is consistent with the baseline methodology.

The greenhouse gas emission reduction achieved by the project activity (ER_y) during a given year is the difference between the amount of methane actually destroyed ($MDproject_y$) and the amount of methane destroyed in the absence of the project activity ($MDbaseline_y$), times the approved Global Warming Potential value for methane (GWP_CH_4).

$$ER_y = (MDproject_y – MDbaseline_y) \times GWP\_CH_4$$

The amount of methane destroyed in the absence of the project activity is the amount of landfill gas that would be flared or otherwise destroyed absent the project activity taking into account the effectiveness of the gas collection systems that would be imposed by regulatory or contractual requirements or similar circumstances at the time of inception of the project 2 (the “Effectiveness Adjustment Factor” (EAF)).

$$MDbaseline_y = MDproject_y \times EAF$$

Based on the above equations, the greenhouse gas emission reduction (ER_y) achieved by the project activity during a given year (*y*) is equal to the methane destroyed ($MDproject_y$, expressed in tonnes) due to the project activity during that year less the effectiveness adjustment factor (EAF) multiplied by the approved Global Warming Potential value for methane (GWP_CH_4).

$$ER_y = MDproject_y (1 - EAF) \times GWP\_CH_4$$

The methane destroyed by the project activity (MDprojecty) during a year is determined by monitoring the quantity of methane actually flared and used to generate electricity.

$$MDproject_y = MDflared_y + MDelectricity_y$$

$$MDflared_y = LFG_y * F\_CH_{4y} * FE * D\_CH_4$$

Where LFGy is the quantity of landfill gas flared during the year measured in cubic metres (m^3), F_CH_{4y} is the methane fraction of the landfill gas as measured periodically during the year, FE is the flare efficiency (the fraction of the methane destroyed) expressed as a fraction, D_CH_4 is the methane density expressed in tonnes of methane per cubic metre of methane (tCH_4/m^3 CH4).

$$MDelectricity_y = EG_y * HR / EC\_CH_4$$

The quantity of methane destroyed by electricity generation is the amount of electricity generated (EGy) generated during the year measured in MWh, HR is the heat rate measured in GJ/MWh, and EC_CH_4 is the energy content of methane measured in GJ/tCH_4.

Revision of the Effectiveness Adjustment Factor

Please note that, in the interests of making a conservative claim to ERs achieved by the project, the monitoring plan proposed to reduce the directly monitored ERs by an 'effectiveness adjustment factor' of 10 % (see annex 4). The effectiveness adjustment factor will need to be revised at the time of each baseline revision (at the end of each baseline crediting period), by estimating the amount of GHG flaring taking place as part of common industry practices at that point in the future.

As the baseline scenario is the continued uncontrolled release of landfill gas to the atmosphere, similarly to most landfills in Brazil. The Brazilian Ministry of the Environment has no immediate plans to introduce legislation requiring the collection and flaring of landfill gas from landfill sites. The implementation of environmental protection legislation in Brazil has a relatively long lead-time. In addition, historically in Brazil there also tends to be a gulf between stated regulations and actual practice with regards to the implementation of environmental protection legislation. Therefore it is considered sufficient to reconfirm the baseline assumptions at seven-year intervals, i.e. when the crediting period is renewed.

However, to account for the implementation of regulatory requirements, or improvements in waste management practices, within Brazil, a control group will be formed and surveyed at each baseline revision point in the future. The survey will aim at estimating the amount of GHG flaring taking place as part of common industry practices at that point in the future, within the companies in the control group. At every baseline revision point in the future, an expert consultant will provide an estimation of:

? ? Whether there are sufficient gas collection wells in place;
? ? The depth of the wells in relation to the depth of the sites;
? ? The number of gas collection wells operating satisfactorily i.e. gas is flowing;
? ? The number of gas collection wells not operating i.e. blocked by leachate, poorly maintained etc.;
? ? The number of flares operating satisfactorily i.e. burning landfill gas;
? ? Whether the site applies suction to the wells;
? ? Whether the site is appropriately capped, to avoid venting;
? ? The efficiency of the flares utilized.

A Control Group was already formed and a preliminary initial survey was conducted by the MARCA project and has shown that none of these landfills is currently capturing and/or flaring landfill gas except for safety purposes (see table below).

Table 2: The MARCA control group.

Landfill	*Waste in place (million of tons)*	*Waste deposition rate (tons/day)*	*Current flaring status*
Natal (RN)	8.0	450.0	No exhaust system, no flaring
Salvador (BA)	2.5	2500.0	Only natural exhaust system, no controlled flaring
São João landfill (SP)	17.0	6500.0	Only natural exhaust system, no controlled flaring
Cariacica (ES)	4.3	800.0	No exhaust system, no flaring
Marambaia (RJ)	3.0	1100.0	No exhaust system, no flaring
Guarulhos (SP)	3.5	1000.0	Only natural exhaust system, no controlled flaring
Itaquaquecetuba (SP)	2.0	2000.0	Only natural exhaust system, no controlled flaring
Maua (SP)	3.0	1500.0	Only natural exhaust system, no controlled flaring
Osasco (SP)	3.4	500.0	Only natural exhaust system, no controlled flaring
Florianópolis (SC)	1.2	350.0	Only natural exhaust system, no controlled flaring
Gravatai (RS)	4.3	1000.0	Only natural exhaust system, no controlled flaring
Joao Pessoa (PB)	2.8	400.0	No exhaust system, no flaring
Total	**55.0**	**18,100**	

Based on the data collected, the expert will estimate the percentage of gas being flared at each of the control group landfills and a decision will be made on whether the discount factor of 10% is still appropriate, or whether it should be changed to 10% + n%. If the average collection practice exceeds the discount factor of the first commitment period of 10%, a new discount factor shall be established, based on the findings of the control group. A new conservative factor based on current practice and reasonably anticipated changes shall be determined. If the average collection practice however stays below the initial discount factor, no changes to the factor shall be made. The new discount factor of X% shall be proposed by MARCA and the appropriateness of the proposed factor reviewed and verified by the designated Operational Entity in the context of the renewal of the project crediting period.

In addition, after the first and second crediting periods, the consultant will also determine whether electricity generation has become the most attractive course of action.

Please note that for the purpose of comparing the two factors, the 10% discount factor applied to MARCA needs to be converted into overall collection efficiency. The 10% discount factor applied to MARCA represents the share of methane that would also have been captured in the baseline scenario, by which the emission reductions need to be reduced. It does not represent the overall collection efficiency of the baseline scenario. As the project is not able to collect 100% of the emissions generated in the landfill, the share of 10% methane captured also in the baseline scenario represents a collection efficiency lower than 10%.

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.
1	Low	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy
2	Low	Meters will be subject to a regular maintenance and testing regime to ensure accuracy
3	Low	Meters will be subject to a regular maintenance and testing regime to ensure accuracy
4	Low	Meters will be subject to a regular maintenance and testing regime to ensure accuracy. Their readings will be double-checked by the electricity distribution company
5	Low	Regular maintenance will ensure optimal operation of engines and generators. The heat rate used for calculation of ERs will be checked annually or more often if significant deviations from standard or previously used heat rate is observed.
6	Low	Regular maintenance will ensure optimal operation of flares. Flare efficiency will be calibrated annually or more often, if significant deviation from previous efficiency rating is observed.
7	Low	Gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy
8	Low	Whenever is possible, the data will be collected with entity classes, statistical institutes or public data. If the data is not disposable in these sources, the project developer will apply a standard questionnaire.

The quality assurance practices that will be corroborated by the implementation of ISO 9001 program, the certification is expected to the end of 2004. All the landfill activities will be inside the certification scope.

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

The management structures that will be implemented in the context of the MARCA project are as follows:

- ? ? Daily Monitoring Records
- ? ? Gas Field Monitoring Records
- ? ? Routine Reminders for Site Technicians
- ? ? Site Audits
- ? ? Outstanding Work Notice
- ? ? Service Sheets
- ? ? Calibration of measurement equipment
- ? ? Corrective Actions:

The quality assurance measures include procedures to handle and correct non-conformities in the implementation of the Project or this Monitoring Plan. In case such non-conformities are observed:

- ? ? An analysis of the nonconformity and its causes will be carried out immediately by MARCA staff
- ? ? MARCA management will make a decision, in consultation with the EPC, on appropriate corrective actions to eliminate the non-conformity and its causes
- ? ? Corrective actions are implemented and reported back to the MARCA management.

In addition to the quality assurance measures described above, MARCA will prepare an Operational Manual. The Operational Manual will include procedures for training, capacity building, proper handling of equipment, emergency plans, reforestation plans and work security. The environmental agency, IEMA (ES), monitors compliance with the Operational Manual is a precondition for the issuance of the operational license for the Project and the landfill operations.

MARCA will also ensure that both MARCA staff, EPC operator staff the landfill operator staff will receive appropriate training on the implementation of this Monitoring Plan and of the project.

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

Pedro Moura Costa
Ecosecurities Ltd. (listed as project participant. Contact details in Annex I)
21 Beaumont Street
Oxford OX1 2NH
Telephone (44) 1865 202635
Fax: (44) 1865 251438
www.ecosecurities.com

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

It is not applicable to estimate project greenhouse emissions by sources, because the project uses an *ex-post* calculation of baseline emissions, directly monitoring and calculating ERs. Therefore the emissions reductions of the project are given below as an alternative.

The destruction of methane in flares and engines will lead to a conversion of methane emissions to CO_2 emissions. The source of the methane and therefore the CO_2 emissions is the organic fraction in deposited waste, which forms part of the natural organic CO_2 cycle. The project sponsors therefore take the view that these CO_2 emissions should not be counted as net contributors to climate change. The global warming potential thus applied to the methane destroyed by the project is 21.

The only source of project emissions identified within the system boundary is fugitive methane emissions from the landfill. It has been assumed that the gas collection system installed will have an average efficiency of 75%. Therefore 25% will continue to escape as fugitive emissions. See section D.2.4 for formulae used to estimate the landfill gas and corresponding methane generation and table in Section E.6 for the estimated amounts of fugitive gas.

The directly estimated emissions reductions due to the project activity will amount to 4,859,503 tonnes of CO_2e emissions over 21 years.

E.2. Estimated leakage:

The only source of leakage is the emissions resulting from generating the electricity used to pump the landfill gas in the additional collection equipment. Sufficient electricity will be generated from recovered landfill gas to operate the collection system, therefore there is no leakage and calculating leakage is not applicable.

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

Not applicable

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

Not applicable. See section E.1 for more details.

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

Not applicable, because the project directly monitors and calculates ERs. The only discernable and significant difference between baseline and project emissions comes from the collection and destruction of methane contained in LFG, which is monitored and calculated directly. The only discernable yet insignificant (indirect) modification of emissions is associated with the physical construction of the project (see discussion under D.2.3.2 above).

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

Due to the nature of the ER monitoring and calculation process most appropriate for this project (i.e., direct monitoring of emission reductions), the above formula cannot be directly used to complete the table below. However, given that the monitoring method proposed by the project is only applicable after the project becomes operational, the emissions occurring in the project and baseline scenarios were estimate using a first order decay model from US EPA. Based on a variety of assumptions regarding waste volume and deposition rates, methane generation profile, LFG collection efficiency, methane contents in LFG, flare efficiency, engine heat rates and so forth, the projected emission reductions are as shown in the following tables. Please note that these tables are only an estimate of expected values.

Year	**Estimation of project activity emissions (tonnes of CO_2 e)**	**Estimation of baseline emissions (tonnes of CO_2 e)**	**Estimation of leakage (tonnes of CO_2 e)**	**Estimation of emission reductions (tonnes of CO_2 e) (adjusted for uncertainty)**
Year1	51.548	185.574	0	50.259
Year 2	66.963	241.067	0	130.578
Year 3	80.911	291.280	0	157.777
Year 4	93.532	336.715	0	182.387
Year 5	104.952	377.826	0	204.656
Year 6	115.285	415.024	0	224.805
Year 7	124.634	448.683	0	243.037
Year 8	133.094	479.139	0	259.533
Year 9	140.749	506.696	0	274.460
Year 10	147.675	531.631	0	287.967
Year 11	153.943	554.193	0	300.188
Year 12	159.613	574.608	0	311.246
Year 13	164.745	593.081	0	321.252
Year 14	169.387	609.795	0	330.306
Year 15	153.268	551.765	0	298.873
Year 16	138.683	499.258	0	270.431
Year 17	125.485	451.747	0	244.696
Year 18	113.544	408.758	0	221.410
Year 19	102.739	369.859	0	200.340
Year 20	92.962	334.663	0	181.276
Year 21	84.115	302.815	0	164.025
Total (tonnes of CO_2 e)	**2,517,827**	**9,064,177**	**0**	**4,859,503**

SECTION F. Environmental impacts

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

An Environmental Impact Assessment (EIA-RIMA, in Brazil) was conducted as a requirement to obtain the necessary environmental licenses. All the licenses necessary to the operation of landfill were obtained.

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:

According to the National GHG Emissions Inventory conducted by CETESB in 1994, at that time Brazil had over 6,000 waste depositing sites, receiving over 60,000 tonnes of waste per day (please note this study is currently being updated). Of this amount, 76% of the total waste is disposed in 'rubbish dumps' ("lixões") with no management, gas collection, or water treatment whatsoever, and usually without any license or under no control by the environmental agencies concerned. According to the same study, 84% of Brazil's methane emissions come from the deposition of waste in uncontrolled rubbish dumps. The remaining 24% of waste is disposed in 'controlled' landfills (as opposed to 'sanitary' landfills, as planned by the project), but these are usually highly ineffective in relation to emissions and percolate control. In the few cases where gases are collected, this is done for safety reasons (to avoid explosions), and it is often the case that the amounts effectively collected are very low, due to high levels of percolates (which are often not drained or treated, as well) blocking the drainage pipes.

By collecting and combusting landfill gas, the MARCA project's 'sanitary' landfills will reduce both global and local environmental effects of uncontrolled releases. The major components of landfill gas, methane and carbon dioxide, are colorless and odorless. The main global environmental concern over these compounds is the fact that they are greenhouse gases. Although the majority of landfill gas emissions are quickly diluted in the atmosphere, in confined spaces there is a risk of asphyxiation and/or toxic effects if landfill gas is present at high concentrations. Landfill gas also contains over 150 trace components that can cause other local and global environmental effects such as odor nuisances, stratospheric ozone layer depletion, and ground-level ozone creation. Through appropriate management of the site, landfill gas will be captured and combusted, removing the risks of toxic effects on the local community and local environment.

Landfill gas electricity generators can also produce nitrogen oxides emissions that vary widely from one site to another, depending on the type of generator and the extent to which steps have been taken to minimize such emissions. Combustion of landfill gas can also result in the release of organic compounds and trace amounts of toxic materials, including mercury and dioxins, although such releases are at levels significantly lower than if the landfill gas is flared. These emissions are also viewed as significantly less harmful than the continued uncontrolled release of landfill gas.

Where methane is used for electricity generation, operational practices at the landfill are improved thus contributing to sustainable development. Specifically for landfills, sustainable means accelerating waste stabilization such that the landfill processes can be said to be largely complete within one generation (30-

50 years). This ensures that both leachate and methane are more carefully managed and controlled, and the degradation processes are accelerated.

Groundwater and surface water can be contaminated by untreated leachate from landfill sites. Leachate may cause serious water pollution if not properly managed. Surface water runoff from a landfill site can also cause unacceptable sediment loads in receiving waters, while uncontrolled surface water run-on can lead to excessive generation of leachate and migration of contaminated waters off-site. With MARCA providing appropriate management on the site, these potential problems should be avoided. Also there are few water impacts associated with landfill gas electricity generation plants. Unlike other power plants that rely upon water for cooling, landfill gas power plants are usually very small, and therefore pollution discharges into local lakes or streams are typically quite small.

Other potential hazards and amenity impacts minimized by appropriate management of the MARCA landfill site include the risks of fire or explosions, landfill gas migration, dust, odor, pests, vermin, unsightliness and litter, each of which may occur on-site or off-site. More information about environmental impact see the environmental impact assessment and the environmental impact report (EIA – RIMA, protocol number nº 3439/02 – Process nº 23997141.)

The following aspects of the operation of the landfill gas to energy project have also been addressed:

?? Noise – There will be some increase in noise from the site associated with energy recovery, although the engines will be housed to reduce noise emissions. The impacts are likely to be marginal given the noise typically associated with operations at the landfills.

?? Visual amenity – Placement of energy recovery facilities at the landfill site will increase the visual presence of the site, however the impacts are expected to be marginal given the visual intrusion currently associated with the waste disposal operations.

Where landfill gas utilization schemes, such as the MARCA project, are developed in countries like Brazil, there is also an opportunity to promote best practices to improve landfill management standards, and contribute towards global sustainable development.

SECTION G. Stakeholders' comments

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

According with the Resolution n°. 1 dated on December 2nd, 2003, from the Inter-Ministerial Commission of Climate Change (Comissão Interministerial de Mudança Global do Clima -CIMGC), decreed on July 7th, 1999, any CDM project must send a letter with description of the project and an invitation for comments by local stakeholders. In this case, the local stakeholders are represented by:

?? City Hall of Cariacica;
?? Chamber of Alderman of Cariacica;
?? Environmental agencies from the State and Local Authority;

?? Brazilian Forum of NGOs;
?? District Attorney (known in Portuguese as Ministério Público, i.e. the permanent institution essential for legal functions responsible for defend the legal order, democracy and social/individual interests) and;
?? Local communities associations.

Local stakeholders were invited to raise their concerns and provide comments on the project activity for 30 days after they received the letter of invitation. EcoSecurities Brasil Ltda. and MARCA were prepared to answer any doubts about the project during this period. Letters were delivered by MARCA or dispatched by registered letters (post-mail) to the institution mentioned above. The project was disposable, at MARCA internet web site (www.marcaambiental.com.br), in Portuguese and English versions.

The letters were sent from 10th to 12th march, 2004. The period to provide comments was from 12th march until 12th April, 2004. The entities contacted were:

?? Grande Nova Rosa da Penha Popular Organization, a local community association,
?? City Halls of Serra, Domingos Martins, Marechal Floriano, Viana, Linhares, Vitória and Cariacica municipalities;
?? Fórum Lixo e Cidadania, a local NGO related to waste activities;
?? Large industries from Espírito Santo State as Queiroz Galvão S.A., Corpus Ltda., Noberto Odebrecht S.A., Companhia Siderúrgica de Tubarão, Samarco S.A., Vale do Rio Doce S.A. and B.M.P. Siderurgia S.A;
?? SEAMA/IEMA and IBAMA, state and federal environmental agencies, respectively.
?? Cariacica´s Environmental secretariat, Serra Environmental secretariat , Vitória Environmental secretariat, Vila Velha Environmental secretariat;
?? SEDETUR (Secretaria Estadual de Desenvolvimento Econômico e Turismo);
?? Chamber of Alderman of Cariacica, Vitória (cities) and Espirito Santo state;
?? State District Attorney and
?? Brazilian Forum of NGOs.

G.2. Summary of the comments received:

No comments were received during the 30 days.

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

Not applicable. No comments were received during the 30 days.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	MARCA Construtora e Serviços
Street/P.O.Box:	Avenida Alfredo Alcury, 6, Dom Bosco
Building:	
City:	Cariacica
State/Region:	Espírito Santo
Postfix/ZIP:	29140-000
Country:	Brazil
Telephone:	+55 (27) 2123-7750
FAX:	
E-Mail:	
URL:	http://www.marcaambiental.com.br/
Represented by:	
Title:	Director
Salutation:	Mr.
Last Name:	Ribeiro
Middle Name:	Almenara
First Name:	Sérgio
Department:	
Mobile:	
Direct FAX:	
Direct tel:	+55 (27)-3337-7748
Personal E-Mail:	marcacs@escelsa.com.br

Organization:	EcoSecurities Ltd.
Street/P.O.Box:	21, Beaumont Street
Building:	
City:	Oxford
State/Region:	
Postfix/ZIP:	OX12NH
Country:	United Kingdom of Great Britain
Telephone:	+44 1865 202635
FAX:	+44 1865 251438
E-Mail:	Br@ecosecurities.com
URL:	www.ecosecurities.com
Represented by:	
Title:	Director
Salutation:	Mr.
Last Name:	Moura Costa
Middle Name:	
First Name:	Pedro
Department:	
Mobile:	
Direct FAX:	
Direct tel:	+44 1865 297483
Personal E-Mail:	Pedro@ecosecurities.com

Organization:	Biogas Technology Ltd.
Street/P.O.Box:	6, Brookside Industrial Estate
Building:	
City:	Sawtry
State/Region:	Cambridgeshire
Postfix/ZIP:	PE28 5SB
Country:	
Telephone:	+44 1487 831701
FAX:	+44 1487 830962
E-Mail:	E-mail - info@biogas-technology.ltd.uk
URL:	http://www.biogas.co.uk/
Represented by:	
Title:	Managing Director
Salutation:	Mr.
Last Name:	Gadsby
Middle Name:	
First Name:	Ian
Department:	
Mobile:	
Direct FAX:	
Direct tel:	+44 487 833890
Personal E-Mail:	ian.gadsby@biogas.co.uk

Organization:	Shell Trading International Ltd.
Street/P.O.Box:	80 Strand
Building:	80 Strand
City:	London
State/Region:	
Postfix/ZIP:	WC2R 0ZA
Country:	United Kingdom
Telephone:	+44 20 7546 5000
FAX:	+44 20 7546 5134
E-Mail:	Roon.osman@Shell.com
URL:	http://www.shell.com
Represented by:	
Title:	CDM Manager
Salutation:	Miss
Last Name:	Osman
Middle Name:	
First Name:	Roon
Department:	Environmental Products Trading Business
Mobile:	+44 7984 767 099
Direct FAX:	+44 20 7546 5134
Direct tel:	+44 20 7546 5126
Personal E-Mail:	Roon.osman@shell.com

Organization:	Showa Shell Sekiyu K.K.
Street/P.O.Box:	3-2, Daiba 2 chome, Minato-ku
Building:	Daiba Frontier Building
City:	Tokyo
State/Region:	
Postfix/ZIP:	135-8074
Country:	Japan
Telephone:	+81-3-5531-5627
FAX:	+81-3-5531-5767
E-Mail:	Takashi.Hasegawa@showa-shell.co.jp
URL:	www.showa-shell.co.jp
Represented by:	
Title:	GHG manager
Salutation:	Mr.
Last Name:	Takashi
Middle Name:	
First Name:	Hasegawa
Department:	New Business Development Division
Mobile:	
Direct FAX:	+81-3-5531-5767
Direct tel:	+81-3-5531-5627
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no Official Development Assistance in this project, and the project receives no public funding from parties in Annex 1.

Annex 3

BASELINE INFORMATION

The project follows the approved baseline methodology AM0003 "Simplified financial analysis for landfill gas capture projects". The suggested methodology is based on the premise that investment analysis can be seen as an appropriate and practical operationalisation of the baseline approach defined in 48(b) and can adequately identify "an economically attractive course of action" as indicated by this particular baseline approach. The suggested methodology uses the Internal Rate of Return (IRR) calculations to assess the financial attractiveness of the investment project and to determine whether the investment for which the IRR has been calculated is likely to be made given the forecasted rate of return from the investment.

The following tables show the key data and assumptions used in the case of MARCA:

Financial Parameters	
Tariff (Rs$/MWh)	120.0
Tariff (Us$/MWh)	40.00
Taxes on Electricity Sales	20.25%
Net price of carbon (U$/tCO2)	3.50
Taxes on Carbon Sales	13.25%
Rs$/US$	3.00
Power Plant O&M (US$/MWh)	13.00
Gas Plant & Flaring O&M (U$/TCO2)	0.56
Flaring Units	150,000
Civil works and drilling	150,000
1 MW Engine (US$)	544,000
Instrumentation and telemetry systems	31,789
Import Duties	34%
Assembl ing and testing	20,000
Connection to Main	80,000
Compoud	100,000
Administrative Expenses (U$/y)	60,000
Pre-operational costs (US$)	50,000
Validation Costs	20,000
Verification Costs	8,000
Discount rate	12%
Income Tax	34%

Financial Results	with carbon	without carbon
Present Value @ 12% (AT)	**1,562,992**	**(762,108)**
IRR	**17.84%**	**8.94%**

INPUTS	
LANDFILL	
Year started landfill operation	1995
Year finished operation	2017
Year started Project	2004
Waste in place at beginning of project	1,336,327
R = Average daily waste rate	1,000
Lo (cf/lb) =	2.63
k (1/year)=	0.1
Methane GWP	21
Methane content of landfill	0.5
BASELINE DATA	
Residual emission factor CH4 to	0
Proportion of methane flared in baseline	10%
PROJECT	
Date gas collection project starts	2004
Proportion of methane collected	75%
Reduction due to	25%
Electricity generaion factors:	
Engine Heat	10,625
Reciprocating Engine Generator Rating:	840
Parasitic Power Loss (%)	5%
Estimated On-line availability of Equipment	91%
Flaring capacity	2,000

RESULTS

LANDFILL GAS AND	10 yrs	21 yrs
Total Landfill Gas Produced (m3)	511,497,836	1,365,451,746
Total Methane Produced (t)	201,780	479,586

LANDFILL ERUs (t CO2e)	Emissions Baseline	Emissions Project	ERUs
7 yrs	2,110,595	586,276	1,193,499
10 yrs	3,628,061	1,007,795	2,015,459
14 yrs	5,959,738	1,655,483	3,278,451
21 yrs	9,064,177	2,517,827	4,859,503

TOTAL ERUs (landfill + electricity)	Emissions Baseline	Emissions Project	ERUs
7 yrs	2,110,595	586,276	1,193,499
10 yrs	3,628,061	1,007,795	2,015,459
14 yrs	5,959,738	1,655,483	3,278,451
21 yrs	9,064,177	2,517,827	4,859,503

ELECTRICITY	10 yrs	21 yrs
Total Net Power Output: MWh	381,680	1,215,015

Annex 4

MONITORING PLAN

The management structures that will be implemented in the context of the MARCA project are as follows:

Daily Monitoring Records: On the larger more active sites site staff takes daily gas field and engine readings and fax these to head office. These readings are then checked for any anomalies before being filed for future reference.

Gas Field Monitoring Records: Taken on a weekly basis or at periods to be determined. The Site Technician walks the gas field taking readings at each gas well and recording these on a form, which is then faxed to head office. These readings are then checked for any anomalies before being filed for future reference. A gas analyzer will be installed in order to enable accurate measurement of the methane content on the landfill gas. These gas field inspections will also observe occurrence of any unintended releases of landfill gas. In case unintended releases are observed, appropriate corrective action will be taken immediately.

Routine Reminders for Site Technicians: All Site Technicians are issued with a reminder list to guide them through their daily, weekly and monthly routine. The Engineering Manager,Operations Manager and Training and Health & Safety Co-ordinator go through this routine during site visits to ensure all aspects of the role are being performed. In addition paperwork due at head office is checked to ensure it has arrived. This includes monitoring records, oil sample reports and meter readings.

Site Audits: The Engineering Manager, Operations Manager and Training and Health & Safety Co-ordinator make regular site visits. In addition to ensuring the site routines are being performed any additional training needs are assessed and an audit is taken of any outstanding task on site.

Outstanding Work Notice: Following the Site Audit a ‘Plant Outstanding Works Notice’ is issued to the Site Technician listing all the jobs that the management team consider necessary to be undertaken. This is checked on subsequent site audits to ensure these jobs have been carried out.

Permit to Work Scheme: The form is completed before any work is carried out. This is forwarded to head office and attached to the service records for each engine. The same form is used for any works associated with the gas field.

Service Sheets: A specialist landfill-gas-to-energy company carries out 750, 1500, and 3000 hour services on all 1MW engines followed by major servicing at 12,000 hours, and 500 and 1000 hours on the 1000kW engines with a major service at 16,000 hours. Service sheets are completed for each service to ensure all aspects of the service are completed and recorded. An engineer is present at all major services and on earlier services if the site technician or management team feel this would be beneficial. Based on these services operators will determine whether the generator heat rate changes throughout the project life. It is anticipated that with such a rigorous maintenance the heat rate is likely to stay constant throughout the life of the engine.

Calibration of measurement equipment: Calibration of measurement equipment will be done monthly in accordance with the requirements of the National Measurement Regulation Agency, INMETRO (Instituto Nacional de Metrologia).

Corrective Actions: The quality assurance measures include procedures to handle and correct non-conformities in the implementation of the Project or this Monitoring Plan. In case such non-conformities are observed:

- ? ? An analysis of the nonconformity and its causes will be carried out immediately by MARCA staff
- ? ? MARCA management will make a decision, in consultation with the EPC, on appropriate corrective actions to eliminate the non-conformity and its causes
- ? ? Corrective actions are implemented and reported back to the MARCA management.

All the information about monitoring plant and quality assurance measures described above, will be included in the Operational Manual. The Operational Manual will include procedures for training, capacity building, proper handling of equipment, emergency plans, reforestation plans and work security. MARCA will also ensure that both MARCA staff, EPC operator staff the landfill operator staff will receive appropriate training on the implementation of this Monitoring Plan and of the project.

[1] If emission reductions from fossil fuel displacement were to be claimed, this amount of ERs would need to be added here.