CASE STUDY: LFG to Energy Project in NOVA IGUAÇU, BRAZIL

Inception Report and Expanded Outline

J. H. Penido Monteiro – Consultant

September, 2003

CURRENCY EQUIVALENTS

(Exchange Rate Effective 08/ 2003)

Currency Unit = R$ (Real)

1 **US$** = **R$** 3.00

1 **R$** = **US$** 0.33

1 € = **US$** 1.15

1 **R$** = € 0.29

FISCAL YEAR: 2003

ABBREVIATIONS AND ACRONYMS

ANEEL	Agencia Nacional de Energia Elétrica (National Agency for Electric Energy)
BL	Baseline
C	Carbon
CER	Certificate for Emission Reduction
CDM	Clean Development Mechanism
CH4	Methane
CO2	Carbon dioxide
ER	Emission Reduction
ERPA	Emission Reduction Purchase Agreement
FEEMA	Fundação Estadual de Engenharia do Meio Ambiente (State Environmental Agency)
FIRR	Internal Rate of Return
FY02	Fiscal Year 2003
GHG	Green House Gas
IBAMA	Brazilian National Environmental Agency
IMCCC	Interministerial Commission on Climate Change
IPCC	Intergovernmental Panel on Climate Change
KP	Kyoto Protocol
MME	Ministry of Energy
NCDF	Netherlands Clean Development Facility
NGO	Non Governmental Organization
N2O	Nitrous Oxide
PCD	Project Concept Document
PCF	Prototype Carbon Fund
PCH	Pequenas Usinas Hidroelétricas – Small Hydroelectric Power Plants
PROINFA	National Program for Supporting Alternative Energy Sources
SUDAM	Superintendência de Desenvolvimento da Amazônia – Amazonian Development Agency
SUDENE	Superintendência de Desenvolvimento do Nordeste – Northeast Development Agency
tCO2	Tons of Carbon Dioxide
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES
(Following Text)

APPENDICES

1. Pictures taken in April 2003
2. Pictures taken in May and September 2003
3. Pictures of the gas drainage system

APPENDIX C

OPINION SURVEY ON THE OPEN DUMP REMEDIATION AND THE IMPLEMENTATION OF THE NEW NOVA IGUAÇU SANITARY LANDFILL WITH ENERGETIC USE OF METHANE GAS

1.0 INTRODUCTION TO THE CASE STUDY

The final disposal of household waste is one of the most critical sanitation issues in developing countries. With the massive migration of people from the countryside towards the cities over the last 50 years, public authorities are neither technically or economically capable of expanding urban infrastructure to properly receive their new dwellers coming from rural areas because of agricultural mechanization or droughts in their original regions that hinder subsistence agriculture. This resulted in disorderly urban development in most of the cities within Latin America and caused a large portion of urban population to live in places under appalling sanitation conditions, which has a negative effect on their health and quality of life.

Among the different aspects of basic sanitation (water supply, sewage collection and treatment, waste collection and disposal), solid waste management has generally received less attention and fewer resources from public administration. It is certainly not the top priority for town administration, which, in most of the cities within developing countries, is in charge of household waste management in the cities despite the recurring lack of resources to meet all of its obligations. Activities within this segment are usually restricted to fairly regular waste collection in urban areas where there is intense business activity or high-income population. The problem of final disposal has taken on alarming proportions. Taking into consideration only household waste (industrial waste management is a responsibility of the generator itself), it may be noted that for years public administration activities have been limited to only remove the collected waste from urban areas, sometimes dumping it in absolutely inappropriate places such as forested mountainsides, mangroves, rivers, bays and valleys. Over 80% of the towns in Brazil currently disposes waste in open places, in waterways or in environmentally protected areas, most of which are frequented by scavengers, among whom there are children, and that brings to surface the social issues that result from poor waste management.

However, the attention waste management gets from public institutions in developing countries has increased recently at all government levels. Federal and state governments

have been allocating higher resources and creating programs and lines of credit with towns as sole beneficiaries. On the other hand, municipal administrations have been more seriously engaged in addressing urban cleaning issues and creating universal service conditions and maintaining quality standards through time. This situation has been monitored with growing seriousness by the population, environmental control agencies and non-government organizations engaged in environmental defense. However, in most towns, there is one definite corroboration: only society's pressure or a dedicated mayor, aware of the importance of urban cleaning for public health and for the environment, may change the situation of neglect undergone by this segment. This change is only possible through a political decision and will necessarily result in a financial burden for the municipal governments, which will require an increase in taxes or the reallocation of resources from other segments within municipal administration. In turn, this will be politically rewarded with the improved quality of the services rendered and the positive effects on population's health and quality of life.

The use of biogas generated in landfills as a power source may become a useful tool in the process of recovering unmanaged waste deposits (open dumps) and/or the implementation of new sanitary landfills, since this may result in additional resources, which come not only from its use as fuel, but also from awarding carbon emission reduction certifications within the Clean Development Mechanism set forth in the Kyoto Protocol.

Some considerations about final disposal of waste in Brazil

The final disposal of waste is one of the most critical segments of waste management in Brazil, and only recently it has attracted the necessary attention from public authorities.

The accumulation of waste in a certain place increases its pollution potential and therefore demands a greater effort to treat it. The most usual form of final disposal of urban waste in Brazilian municipalities is the well known open dump (lixão), the accumulation in sites far from urban agglomerations without any kind of treatment, causing damage to the environment such as the contamination of water tables, the proliferation of disease-transmitting agents (rodents, roaches, mosquitoes), the silting up of rivers and channels, the pollution of water resources and of the atmosphere by the combustion of residues or by the release of biogas, in addition to compromising the local landscape.

In 2000, IBGE – The Brazilian Institute of Geography and Statistics – developed a research on the sanitation sector in all 5,507 municipalities in Brazil (now, they are 5,561, including the Federal District of Brasilia). This research involved water and sewage systems, drainage and waste management. This is actually the only source of information, on a national level, available in Brazil. There are of course some municipal waste management plans that could provide a good amount of information about some cities in this regard, but even in more developed federal States, in the south and southeast regions of the country, specific information about this theme is very scarce.

Because of some deficiencies in getting the information from the municipalities, the result of the research referring to the Characterization of Waste Disposal Sites indicates an

excessively favorable situation. The results assessed, in short, are the following: if we take as a parameter the quantity of waste collected and dumped in final disposal units, we notes that 40.87%, according to the answers obtained, were dumped in sanitary landfills, 22.04% in controlled landfills and only 31.14% in inadequate sites. That is, more than 66% of all waste collected in Brazil is properly disposed of in sanitary and/ or controlled landfills. If the reference of the analysis is in number of municipalities, the result is not so favorable: 61.9% of them say that they deposit their waste in dumps and only 25.5% declare they have adequate landfills, and there is still a percentage of 12.6% that did not inform to where their waste is taken. The charts below provide further information on this.

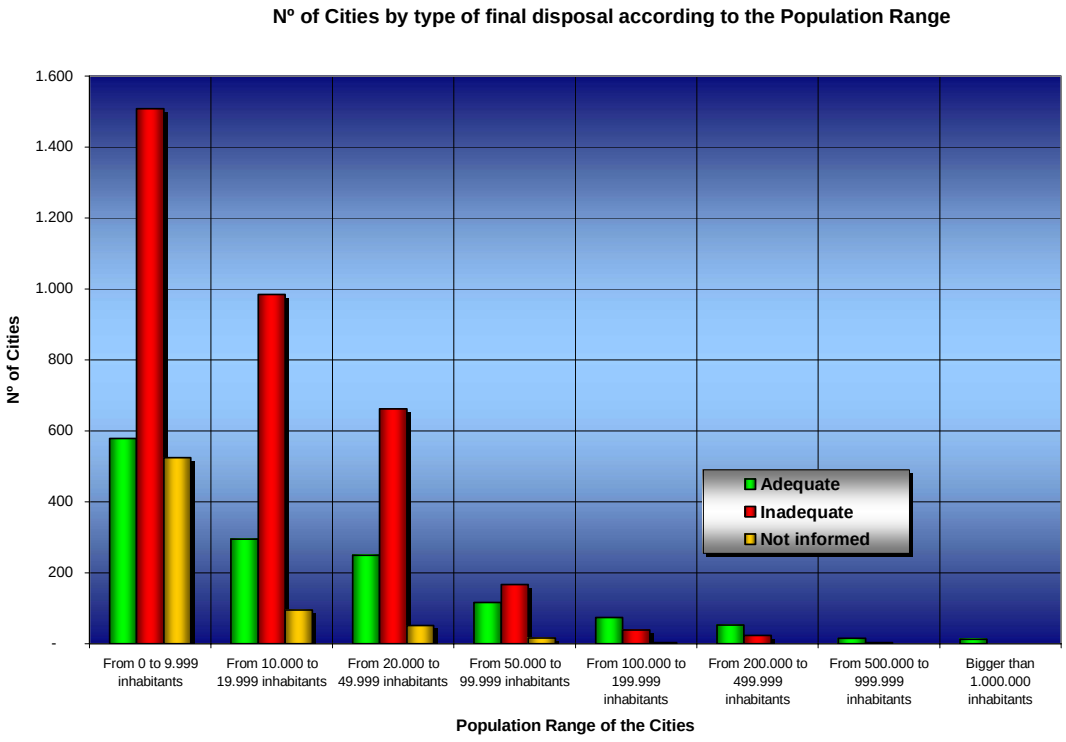


FIGURE 1 No. of Cities by type of Final Disposal according to the Population Range

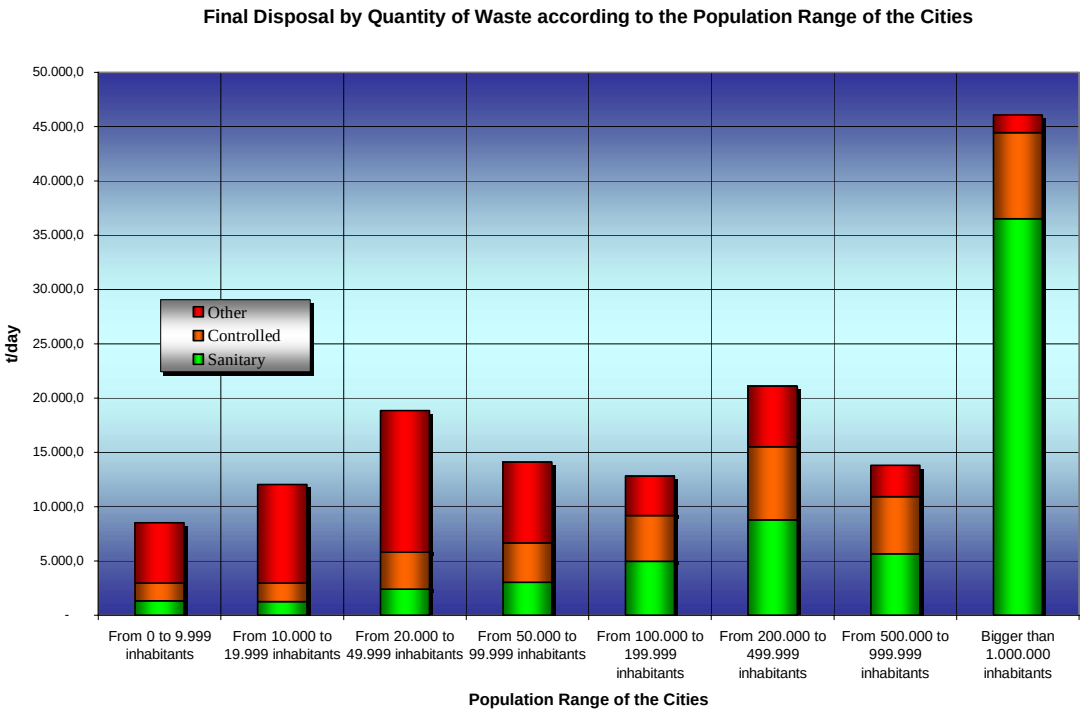


FIGURE 2 Final Disposal by Quantity of Waste according to the Population Range of the Cities

The data indicates a tendency that reflects an improvement in the situation of final disposal of household waste in Brazil in recent years, which can be attributed to many factors: higher awareness of the population regarding the waste management issue (which has a positive and direct influence on councilmen and mayors), the strong action of the State Public Attorney, which has been decisively active, the allocation of resources by the Federal Government to the sector through the National Environmental Fund, and the support of some State Governments. However, the improvement of final disposal sites has not been satisfactory because, as is widely known, this segment is little observed by the population due to the remote location of such sites, usually on the outskirts of the cities, where the pressure of "opinion-formers" is more subtle, being therefore the one that are less favored in the application of resources by the municipal administration.

In all Latin American countries, with the exception of Chile, there have been few attempts to implement the use of landfill gas or LFG, partly because such an initiative represents no economic interest, and also because environmental laws do not require, specifically, the collection and burning of gas to avoid greater impact on the greenhouse effect.

Two significant experiences were implemented in the city of Rio de Janeiro, Brazil, by COMLURB (Municipal Waste Management Company of the City of Rio de Janeiro), a mixed economy company (the municipality of Rio has 99 % of all shares), whose activities are carried out exclusively within the city of Rio de Janeiro. The first of these experiences took place from 1977 to 1985 and consisted in the daily collection of 10,000 cubic meters of gas from a former municipal landfill in Rio and the transportation of that gas through a 3-

km long gas pipeline to the natural gas plant run by the state-owned gas company, in charge of gas distribution in the city. The LFG, without any sort of treatment and with an average heat power of 5,800 kcal/ Nm3, was mixed with the cracked natural gas produced in the plant. The landfill gas at that time represented 1% of all the city gas distributed through the public network. The second experience consisted in a system for collecting, purifying and compressing the LFG generated in the same landfill to use it in the vehicles of the urban cleaning company. Beginning in 1980 and during the next five years, nearly 130 light and heavy vehicles were adapted to run mainly on the treated LFG, with almost 85% of CH4, after CO2 removal by means of a water absorption system within 14 kg/ cm2 pressure tanks.

As recently as only two years ago the use of landfill gas became again an important issue in Brazil, especially because of the possibility of recovering economic resources by awarding carbon emission reduction certifications under the Clean Development Mechanism (CDM).

The subject of this case study is the Nova Gerar project, the only project in Brazil that has received a positive approval from an international finance agency. Operations in the new landfill began in January 2003, that is, five months ago.

This case study will provide all pertinent information and background data since the beginning of the project, i.e., when the municipal administration of Nova Iguaçu decided to change the way the final disposal of waste was carried out in the city through a 15-year concession with a private company.

It will specifically detail all the institutional problems faced by Nova Gerar in order to achieve, through a contract with the municipality, full responsibility to install, operate and recover the landfill gas from a new landfill, and to acquire, by means of an addendum to the contract, the right to exploit the gas as a fuel for power generation and to benefit from the related carbon credits. It is stated in this same contract that Nova Gerar has also the obligation to close the old open dump of the city and environmentally recover the site, as defined in its contract with the Nova Iguaçu municipality.

This case study will also detail the social aspects involved in the implementation of the project. Because there were about 60 scavengers working in the old open dump, Nova Gerar had also to generate alternative jobs for these people.

2.0 BACKGROUND

2.1 GENERAL BACKGROUND

Nova Iguaçu is a municipality, about 30 kilometers from the city of Rio de Janeiro, with 920,000 inhabitants, most of which live in urban areas. Household waste generation is around 800 metric tons/ day; the collection service is operated by a private company and it serves approximately 90 % of the population.

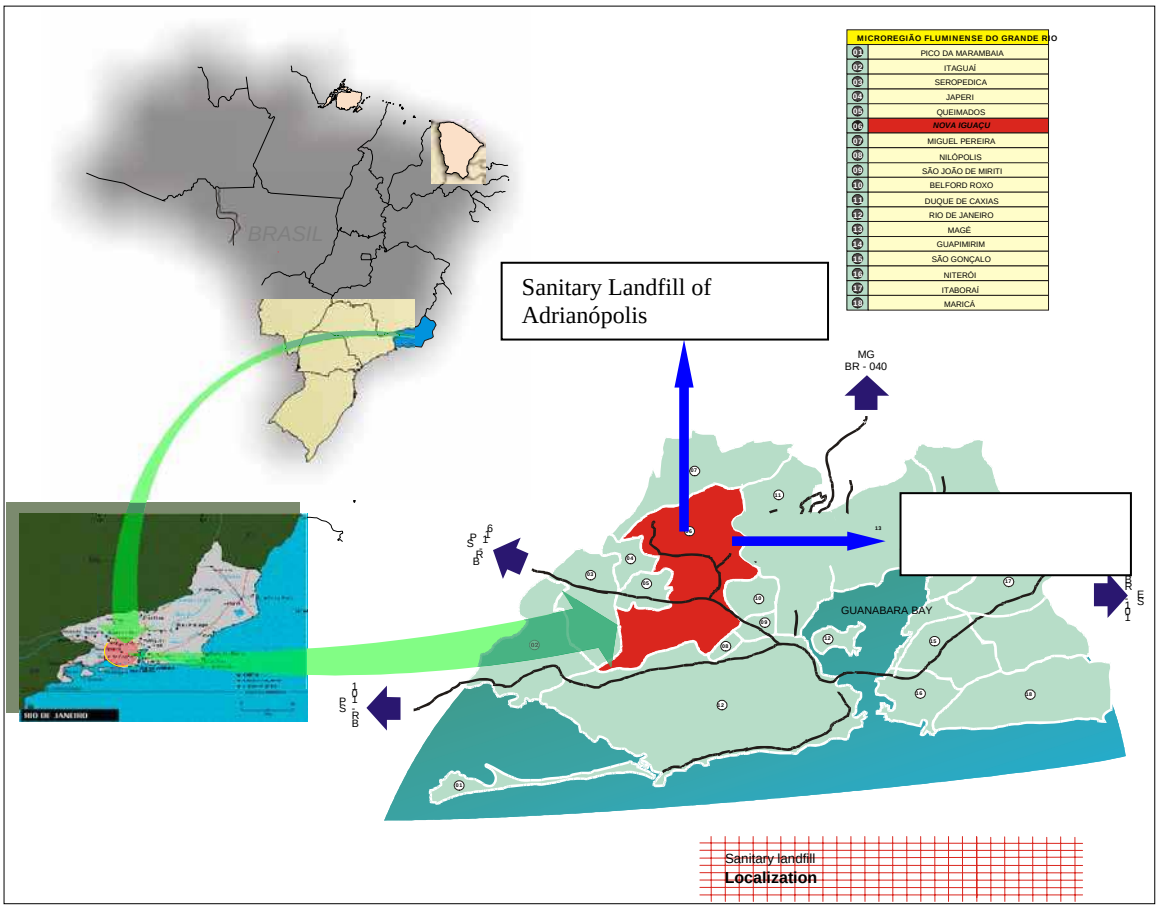


FIGURE 3 LANDFILLS LOCATION PLAN

Until January 2003 all waste collected was dumped in a private open dump, with no care at all concerning compression, daily coverage, and leachate treatment or gas collection. Besides, as we mentioned, there were about 60 scavengers working in the landfill and surviving from the recyclables sales.

S.A. Paulista, a Brazilian civil engineering and construction firm based in the city of São Paulo, Brazil, with branches in several other states and counties, was granted in 2001 a 20-year concessional license by the Empresa Municipal de Limpeza Urbana (EMLURB - Municipal Waste Collection Company, a government agency an mix economy company linked to the Public Works Secretariat of Nova Iguaçu, responsible for waste collection and disposal) to manage the Marambaia and Adrianópolis landfills (officially called 'Lixão de Marambaia' and 'Aterro Sanitário de Adrianópolis') in the state of Rio de Janeiro. In February, 2003, the company started the operation of the new Adrianópolis landfill and the environmental recovery of the former open dump, known as Marambaia landfill.

NovaGerar is a 50:50 joint venture between EcoSecurities, an environmental finance company which specializes in greenhouse gas (GHG) mitigation issues, with offices in the UK, USA, the Netherlands, Australia and Brazil and S.A. Paulista. The exploration of the landfill gas potential of these sites is now catalyzed by carbon finance and subject of this project. As part of this concessional agreement, S.A. Paulista is responsible for the decommissioning and rehabilitation of the Lixão da Marambaia site, which has been operating since 1986, with over 2 million tons of waste already deposited and ceased operation in February 2003, when the new site started receiving the urban waste of the city of Nova Iguaçu. The Adrianopolis site commenced operation in February 2003, receiving at the beginning, 900 tons of municipal waste per day, collected in the municipalities of Nova Iguaçu and Mesquita.

In order to achieve the objectives, NovaGerar will invest in a gas collection system and a modular electricity generation plant (with maximum capacity of 10 MW in Adrianópolis and 2 MW in Marambaia), in order to produce electricity to supply to the grid and reduce emissions of ca. 12 million tons of CO2 (conservative estimate) over the next 21 years. Project life and the emission reductions crediting period is 21 years, starting in the end of 2003.

Site Information

Total Site area:

Old open dump (Marambaia)	20	hectares
New landfill (Adrianópolis)	120	hectares

Area designated for Landfilling:

Old landfill (Marambaia)	20	hectares
New landfill (Adrianópolis)		
1st. phase:	16	hectares
Final:	96	hectares

Estimated Site Capacity at Time of Site Closure:

Marambaia open dump (closed Feb 2003):	1,845	million metric tons
Adranópolis landfill (2022):	9,968	million metric tons

Estimated Capacity of Waste in Place (May 2003):

Marambaia open dump:	1,845	million metric tons
Adranópolis landfill:	91,800	metric tons

Annual Waste Disposal Quantity (2002): 234 thousand metric tons

Note: From now on, all descriptions below will only refer to the new landfill, as the old one (Marambaia), operated as an open dump since its closure, is being recovered to become a park (end of works scheduled for December, 2003).

Site Geology, Stratigraphy and Regional Phisiography for Adrianópolis Landfill

The town of Nova Iguaçu is located in the so-called *Baixada Fluminense* (coastal lowland region in the state of Rio de Janeiro) within the Coastal Plain Unit extending along the coast among the ranges, massifs and escarpments of the Serra do Mar, along the so-called Coastal Mobile Belt.

Along the Coastal Plains of Rio de Janeiro, sedimentary depositions are scattered in different environments. In the indirect area of influence, these depositions are fluvial and marine in origin and contain gravel, sand and unconsolidated silt, with cross-bedding and aggradation to pelitic sedimentation.

Regional Physiography

The diversified and complex environments affected by eustatic and climatic variations have contributed to the area's morphological distribution. Based on the relationship of recent and sub-recent facies and processes, it is possible to distinguish more representative areas, among which the alluvial plains stand out, where the river depositional beds are flat. These facies were formed as a result of the land processes in relation to the changes to and types of stresses and mass movements, as well as solifluction processes, which result in colluvial flows and landslides, which are combined with the hydrologic characteristics of the canals.

The Colinas Unit region is characterized by depressional topography with low elevations. The geographical location of the referred unit was determined by the geological and the climatic and sea level control activities and the sub-recent processes, whereas the erosional patterns comprise concave and convex ranges. The ranges comprise erosional features with fine and moderate drainage density and may present incisions of dozens of meters in depth, covered with colluvial material on the peaks and angular and/ or sub-rounded rock lines, which separate the colluviums from the metamorphic gneissose material. The rock lines and the colluviums indicate the balance of erosion and denudation, which represent the pedogenesis/ morphogenesis sequence. The colluvial material is thicker in the recesses at the base of the slopes.

Hydrogeology – Groundwater and Surface water conditions

The geologic, geomorphologic and climatic features of the region are largely the underlying factors of the hydrographic basin formation and the groundwater aquifers, which are characterized by the lithology of the land and by their hydraulic features.

There are two different aquifers in this area. The first system is crystalline, and the aquifers are related to the fractures, the weathering mantle lines and thickness. The second aquifer is sedimentary, and its permeability is related to the granular porosity.

Hydrology

Iguaçu River Basin

The Iguaçu River Basin affecting both the direct and indirect areas of influence extends over 726 square kilometers and partially comprises the towns of Rio de Janeiro, Nova Iguaçu, Nilópolis, São João de Meriti, Belford Roxo and Duque de Caxias. It is bounded by the Paraíaba do Sul River Basin to the north, by the Inhomirim and Estrela Rivers Basin, to the south, and by the Guandu River Basin and the Sepetiba Bay tributaries, to the west. It rises in the Tinguá mountain range, at a height of nearly 100 m, and flows southeasterly over a total extension of 43 km to the Guanabara Bay. Its main tributaries are the Tinguá, Pati and Capivari rivers to the left, and the Botas and Sarapuí Rivers to the right.

The Biological Reserve of Tinguá is located in the Tinguá mountain range, where the preserved Atlantic Forest is predominant.

In relation to its water volume, the Iguaçu River is classified as Type 2, which, pursuant to Resolution Nr. 20/ 86 of CONAMA (Brazilian National Environmental Council), comprises bodies of water potentially suitable for household supply after being treated, as well as for aquatic communities, primary contact activity, fruit and vegetable crop irrigation, and natural and/ or intensive breeding of species for human consumption.

According to FEEMA (State Engineering and Environment Foundation) (1984), the Iguaçu River shows high pollution levels comparable to open sewage ditches. It's maximum discharge, in a 100 years reference, is 2,148 m^3/ sec.

Paiol Canal Basin

The Paiol Canal, a right tributary of the Iguaçu River, is bounded by the Iguaçu River springs to the north, and by the Velhas River Basin to the south. Its basin extends over 11 square kilometers and is elongate in shape. The river extends over nearly 10 km in length and over an average of 1.1 km in width. Based on the geometry of the basin, it may be concluded that the area is hardly prone to floods. It's maximum discharge, in a 100 years reference, is 32 m^3/ sec.

Depth of Waste (Adrianópolis landfill):	65 m in 5 m depth cells (first phase); 85 m next phases

Meteorology:

The development implementation area is situated between the latitudes 22º 30' and 23ºS and the meridians 043º00'W, in a plain region, where the Sea Mountain Ranges stand out in the North, Tijuca and Jacarepaguá Mountain Ranges in the South, Guanabara Bay in the East and Madureira Mountain Ranges in the West. This way defined, the area has a micro-climate, which is typical of a humid tropical coastal region.

The available data from the pluviometric and climatologic stations of the region show that the seasonal distribution of the average precipitation indicates its maximum value in the summer, which is 208 mm, and its min. value in the winter, which is 63 mm. The annual average is 1,595 mm, and the monthly seasonal variation shows that January is the rainiest month, with 229 mm, and July is the driest month, with 51.4 mm of precipitation.

The monthly variation of the maximum precipitation in a 24-hour period, which corresponds to the greatest amount of rain that has ever occurred in a one-day period, reveals that the maximum value registered in the region was 235 mm, measured at Rio d'Ouro Station on December 26th, 1933. The development area has the influence of a maximum precipitation in a 24-hour period between 150 and 200 mm.

In the development areas, the seasonal distribution of the evaporation average shows its maximum value in the summer, with 64 mm, and the min. value in the autumn, with 50 mm. The annual average is 703 mm, and May has the min. value, which is 49 mm.

The air circulation at surface level, based on the conventional analysis of available data current lines, reveals that, in summer and winter, the predominant outflow in the development area has the south-southeast direction, between 3 and 4 m/ s. In winter, the east wind prevails, at the speed between 4 and 5 m/ s. In spring, the outflow has again the south-southeast direction, at the speed of 4m/ s.

According to the classification of Köppen and Thornthwaite, the development area presents subtropical climate (wa), with dry winter (w) and hot summer (a), to rainy tropical climate of a forest region.

Waste Management System Information

Waste Composition (% by weight):

Domestic (nontoxic industrial, commercial & institutional)	58,7 %
Construction & debris	31,1 %
Street Cleansing	9,4 %
Hospital waste	0,55 %
Curbside collection	0,13 %

A gravimetric analysis of the domestic waste used in the project is presented below, based on an analysis carried out in 1994 in the city of São Paulo:

Gravimetric Waste Composition used in the project Source: PROEMA, 1994 – city of São Paulo	
Material	**% by weight**
Paper and Cardboard	16
Glass	1
Textiles and Leather	3
Metals and Cans	3
Plastics	19
Organic Matter	58

Note: As mentioned above, the new landfill operation and the environmental recovery of the old open dump (from where there will be also the recovery and use of LFG) started in February 2003, but the most difficult steps towards a successful project have been removed. This project is a good example of how to use carbon credits to help making the final disposal of waste an environmentally sound activity; this practice should encourage all countries interested in improve their household waste landfills.

The information presented below are those available at the time this paper has been written (August/ September 2003).

General Site Design & Operations Information

Liner System Description: **technical description of materials of construction and design basis**

BASE LANDFILL - COMPACTED SOIL

In all Sanitary Landfill implementation area, after all the services of cleaning, digging and natural springs draining were done, a layer of compacted soil was placed in order to waterproof the foundation, in accordance with the thickness showed in the project.

The soils to be used in that layer were obtained in the same Sanitary Landfill implementation site, or came from the diggings carried out simultaneously to the foundation waterproofing.

That layer was placed through the pouring of loose material not thicker than 30 cm. The poured material will be spread and leveled in order to obtain a plane surface with uniform thickness.

Next, the soil was compacted through a suitable roller compactor in order to obtain a 95% minimum level of compaction and moisture content from 0 to 2% level of optimum moisture, both related to the Standard Proctor Test - (NBR-7182).

HIGH DENSITY POLYETHYLENE GEOMEMBRANE – HDPE

The geomembrane, a high-density polyethylene liner - HDPE 1,5mm thick, was placed after the area for the Sanitary Landfill foundation was prepared with the base landfill.

It was used a geomembrane with the maximum possible width in order to reduce the quantity of patches.

When there were holes or tears in the geomembrane, a piece of the liner was glued over the damaged parts. Its dimension exceeded the edges of the hole/ tear in about 30 cm at each side.

The geomembrane joint was done through "welding" process as defined by the manufacturer. That welding was done through suitable machines in order to ensure the perfect force transmission. The patches were done at the same geomembrane installation site. The patches transverse to the

geomembrane main dimension, in adjacent straps, were staggered at 2,0 m at least.

In the sloped areas, geomembranes were anchored in trenches dug by the means of drain rings placement. Whenever it was possible, installation started on the one side of the foundation, unwinding the spindles up to its opposite side.

The anchorage trenches were cleaned of mud and fines in water suspension. In the field, the integrity of patches was tested with the compressed air injection.

PROTECTION RECOVERING

After installing geomembrane, it was protected by a soil covering, according to the dimensions defined in the project. The material poured came from the digging done in the landfill area or in the borrowed areas.

The material did not contain organic matter (branches, stem, etc.), gravels, slabs and/ or other material that anyhow might damage the geomembrane during the soil pouring and spreading operations.

The material was poured, spread and compacted by the equipment on the platform and in the sloped areas of the shoulders.

Leachate Collection System: technical description of materials of construction and design basis

LEACHATE DRAINS AND GAS COLLECTION

In order to allow both the dispersion of gases and the collection of the leachate formed in the Sanitary Landfills Cells, drains for leachate and gas collection were installed, as shown in the project.
Those devices were comprised of foundation drains, drain rings, horizontal drains for leachate and vertical drains for leachate and gas. Where there is

change in direction of foundation drains inside the Sanitary Landfill, draw-in boxes were also installed, as shown in the project.

FOUNDATION MAIN DRAIN FOR LEACHATE

The main drain for leachate was installed in the foundation. It is comprised of a system of main concrete piping involved by log parts covered with crushed rock or concrete in trenches dug in the foundation.

The trenches were done according to the dimensions anticipated in the project, with suitable equipment and, when necessary, timbering was erected.

The trenches were dug before the draining system was placed on the geomembrane.

After the digging work, the trench was prepared in order to assure that the bottom presents a uniform aspect, with no depressions and/ or ledges caused by the presence of preexisting stone blocks. That leveling was done with crushed rock and/ or light concrete.

HORIZONTAL DRAINS FOR LEACHATE AND DRAIN RINGS

Both in the foundation and after each waste cell was finished (already covered by the soil layer) the horizontal drains for leachate and the drain ring were installed, in order to connect the cell to the internal draining system of the landfill.

The drain rings were installed at the end side of the digging site and/ or in the berms on the digging, through digging trenches, as shown in the project. Those devices, besides guaranteeing the leachate draining, will act as anchorage element for the waterproofing geomembrane.

Trenches were dug for the leachate horizontal drains, connecting the vertical drains for gas and leachate, until it reaches the top surface of the soil layer of the subjacent cell. Next, log parts were placed, in accordance with the thickness and sections defined in the project. The remaining volume of the trench was recomposed with compacted waste until it had reached the basis of the soil top layer. Finally, it was applied the necessary soil for the recomposition of the cell revetment.

The foundation horizontal drains were installed without the trenches digging, in order to avoid damages to the waterproofing geomembrane.

DRAINAGE DITCH FOR GAS AND LEACHATE

The drainage ditches for gas and leachate were installed according to the dimensions and features shown in the project.
In each cell the drainage ditches are installed before the waste is disposed. Alternatively, the piping may be installed after the cell is finished, through digging work in the drainage ditches, as long as that procedure does not interfere with the landfill embankment process.
During the work all the necessary precautions to protect the operation will be taken, extinguishing the fire in the piping and keeping, in the area, suitable equipment to fight other occasional combustions.
At the piping basis, where there is a geomembrane, suitable protections in order to prevent it from puncturing will be placed.
The drainage ditches were done with reinforced concrete perforated pipes. The minimum diameter for the holes is 1,5 cm, spaced in lines, in every 20 cm. In each line, the spacing between the holes was 20 cm at a maximum. In adjacent lines, the holes should be staggered in half of the spacing.
A layer of log parts with 50 cm in thickness was placed around the pipes, for their protection. In order to protect the log parts, a metal screen was installed.
At the top of the Landfill, when finished, galvanized pipes with 15cm in diameter should be installed. They should have burners at their ends, as shown in the project.

DRAINS FOR SLOPE AREAS LEACHATE

Drains for slope areas leachate will be installed at the landfill final external slope areas.
Those drains aim to drain occasional percolated liquid flows not intercepted by the main draining system, and lead them to the foundation main drain.

The spacing of those drains will be defined during the building work, due to the local particularities and, mainly, due to the potential percolated liquids emerging points.

DRAW-IN BOXS

Concrete draw-in boxes will be done where there is a change in the direction of the drains for leachate, at the external slope areas.

Those draw-in boxes are molded in site or, as an alternative; they will be done with pre-molded parts.

The draw-in boxes should have masonry walls with openings on the sides that contact the drains.

LEACHATE STORAGE TANKS

Tanks to drain and store leachate will be done at the places predefined in the project.

Monitoring Systems: **Brief descriptions of the systems**

LANDFILL MONITORING PLAN

The purpose of Nova Iguaçu Landfill Geotechnical Monitoring is to meet the requirements established by those environmental licensing entities and institutions of the State of Rio de Janeiro, as well as ensure the operational quality in disposing solid waste from the Municipality of Nova Iguaçu.

The basic procedures to be followed shall be implemented in the Landfill Implementation Phase, as well as during the Operation, and after it is concluded.

Monitoring shall include the evaluation of constructive aspects that are necessary to ensure the quality of general cleaning operations in the area where the landfill will be implemented, inspect the exchange of improper earth existing in the foundation, determine the previous indicators of water outflows from springs and local water-table levels, as well as the stability conditions of excavating slopes, the permeability and resistance properties of materials that will be used in the foundation and of soils and materials to be used in foundation water-proofing layer, the water quality existing in local and regional water-tables, besides other aspects.

In the operational phase itself the procedures to be carried out intend to inspect and register the deformities of solid pieces from the residues, the levels of percolates existing in the landfill body, the determination of spring outflows that will be canalized, and the confirmation of landfill water-proofing system efficacy.

LANDFILL IMPLEMENTATION PHASE

During the landfill implementation phase, the following activities shall be monitored:

- Excavation of Landfill Implementation Area
- Implementation of Water Course Canalization
- Refill of Excavated Areas
- Implementation of Foundation Percolate Draining and Waterproofing System
- Installation of Wells for Water-Table Monitoring
- Installation of Referential Planialtimetric Points

LANDFILL OPERATION PHASE

- Execution of Waste Cells
- Draining Systems of the Layers
- Implementation of Provisional and Definitive Draining Systems
- Implementation of Landfill Instrumentation System
- Landfill Final Covering

During monitoring, the following items shall also be checked and registered:

- Check for smoke existing in the gas wells, which at first indicates that the wells are burning waste, provoked by the atmospheric air penetration through landfill cracks.
- Check for the fence integrity along the development areas.
- Prompt analysis of gas concentration expelled by Vertical Wells (PDR) to evaluate the methane concentrations.
- Collection of percolate samples from the Inspection Wells and Accumulation Tanks in the Landfill performed quarterly, for physical-chemical analysis, DBO and DQO concentrations, etc.
- Collection of water samples from the Monitoring Wells performed semi-annually, and execution of tests in specialized laboratories, in order to check possible contamination levels in the water-table.
- Evaluation of the natural vegetation coloring performed semi-annually at the landfill neighboring areas, by means of aerial photos. If coloring is proved to be significantly altered, it may be an indication of gas escaping from the landfill

body through unwanted "percolation", which needs to be conveniently corrected.

Based on such data, monthly and brief inspection reports shall be elaborated, as well as a detailed report, which shall be sent to the Environmental Legislation Institutes (IBAMA, FEEMA, etc).

Stages of Development: **How is filling undertaken and how many cell areas are at final grade.**

The Adrianópolis sanitary landfill started its operation in February, 13, 2003. In June, 3rd, 2003, three cells with a height of 4,5 m have been finished, corresponding to a total weight dumped of 91.800 tons and a volume of 134.465 m^3. These cells have been covered with a 40 cm compacted clay layer and have formed a plain surface of 15,300 m^2.

Until August, 2003, 43,000 m^2 of a high density polyethylene geo-membrane (1,5 mm thickness) has been installed in the landfill as impermeable layer.

The main horizontal and secondary leachate drains system have been installed, connected to the vertical wells. Thirteen vertical gas wells have been installed; three of them are already burning as shown in the figure below.

An average density of 0,68 metric tons/ m^3 has been reached, and a leachate generation of 10 l/ min has been measured.

FIGURE 5 Gas wells already burning at Adrianópolis landfill

Daily Cover type: **Type and thickness**

The waste dumped in the landfill is covered daily with a 30 mm thickness layer of compacted clay, excavated from the landfill site (civil works for the new cells) or brought from deposits nearby.

Final daily cover type: **Type and thickness**

All the surfaces of sloped and flat areas and berms were designed to support one layer of clay soil, minimum of 0,60m in thickness and permeability under 10^{-7} cm/ s.
That layer should be separated from the covering layer, and should be spread and compacted, by specific equipment, in sub-layers of 0,30 m, presenting humidity deviation between 0% and +2% (h-hot), related to the Standard Proctor Test.

After this material application, a layer of vegetal soil with a minimum of 0,40 m in thickness should be placed and the grass should be planted, preferably in pads, with species acclimated to the region, so that they are not deteriorated easily with occasional gases that might emanated by Sanitary Landfill mound.

That vegetal layer should be permanently irrigated until the grass has definitely taken.

Proposed end use of site: **Description of future use of the site**

Both landfills will be probably transformed in public recreational parks. The details of the future use of these areas are being discussed between Nova Gerar (the contractor) and the neighborhood communities. The Marambaia dump will be completely recovered by August of 2004. The Adrianopolis landfill closure is not yet scheduled as there are many uncertanties concerning the total quantity of waste it may receive during its lifetime.

2.1 LANDFILL GAS COLLECTION AND UTILIZATION SYSTEMS

LFG Fuel Resource

A brief outline of the LFG generation estimated as the basis for the design

A technical analysis was conducted in order to quantify the potential volume of emissions reductions that the project can generate. The analyses were conducted based on the projections of carbon emissions for the project and its baseline, using the recommended method by IPCC. It was found that the project has the capacity to generate 17.3 million tonnes of CO_2 credits over its 20-year lifetime.

In order to increase its credibility, and environmental integrity, the project will aim to undertake the following activities:

- Validation of project design by an independent international verification company;
- Self insurance – the project will create an internal reserve of carbon credits which will be set aside to compensate for any reduction in expected carbon credit outputs that may be caused by unexpected events.

LFG Collection System

- A factual outline of the design criteria and constraints that were used to develop the collection system;
- A brief factual description of the construction/ commissioning dates for the system or the phases of the system if commissioned in parts;
- A plan and description of the key elements of the system;
- An outline of the operating and maintenance plan requirements;
- A factual outline of gas quality and quantity collected during the life of the project to date;
- Identification of the intended expansion plans and sequence of LFG system development;

None of these information are known in this phase of the project. The old open dump is being recovered and the beginning of the flaring is scheduled for December, 2003. The installation of the first generator unit in the new landfill is scheduled for January, 2005.

Utilization System

- A factual outline of the design criteria and constraints that were used to develop the projected utilization system;

- A brief factual description of the construction/ commissioning dates for the system or the phases of the system if commissioned in parts;
- A plan and description of the key elements of the utilization system;
- An outline of the operating and maintenance plan requirements;
- A factual summary of the expected performance of the utilization system; and
- Identification of any expansion plans.

None of these points can be informed so far as the final design criteria is not yet defined. Nova Gerar is still discussing and evaluating the best supplier for the flares and generation units to be installed in both landfills. Only the capacities of each of the systems has already been defined (Marambaia open dump will start flaring the gas in a flare with a nominal capacity of 1,500 Nm^3/ hour and generating electricity in a 1,5 MW generator in January 2005)

3.0 PRE-INVESTMENT PHASE

This section presents the development of the project in a chronological sequence.

The City Administration of Nova Iguaçu issued on May 29th, 2000 a public bidding aiming at contracting the construction, implementation, operation and maintenance services for a waste treatment and final processing central plant, consisting of a Sanitary Landfill, one hospital waste treatment unit and one debris treatment plant, as well as the implementation, operation and maintenance services for a transport and collection system for hospital waste.

The schedule for the several phases that followed this initiative is presented below:
a) Delivery of proposals – July 14th, 2000
b) Legal ratification of Bidding process - 001/ CP/ EMLURB/ 2000 – October 24th, 2000
c) Contract signature – December 15th, 2000
d) Signature of Additament nº 1 – March 27th, 2001 (Adjustments due to an agreement with IBAMA, in which an amount of R$ 3,085,555.00 would be destined for the project, being 1 million for the implementation, and the remaining for the operation costs)
e) Signature of Additament º 2 – September 13th, 2002 (Inclusion of S.A. PAULISTA liabilities regarding the Conduct Adjustment Term (signed with the Public Ministry / Rio de Janeiro) in the contract for inspection done by EMLURB of such commitments.)
f) Signature of Additament nº 3 – January 31st, 2003 (Authorization for bio-gas collection that makes the electric power generation viable. "Each and every direct or indirect economic utilization, which may generate income for the concessionaires, is approved as a recovered or recycled sub-product by this additional term...")

g) Signature of Additament – March 27th, 2003 (Price readjustment, according to a new inflation
h) Beginning of ground leveling work in the landfill area – August 12th, 2002
i) Public hearing, one of the phases of the environmental licensing – Dec. 07th, 2001
j) Installation License concession – Nov. 30th, 2001
k) Operation License request – Jan. 28th, 2003
l) Licensing at the Federal Environmental Agency - IBAMA (Instituto Brasileiro de Meio Ambiente), the Brazilian Environmental Institute – Nov. 09th, 2001
m) Operation License concession (FEEMA) – Feb. 06th, 2003
n) The deadline for recovering Marambaia open dump is 18 months, from the initial date of the Waste Treatment Central Station operations, which occurred on February 13th, 2003. It means that on August 13th, 2004 the old landfill shall be totally recovered, from the environmental point of view.
o) Beginning of Marambaia flaring: December, 2003
p) Beginning of Adrianópolis flaring: December, 2003
q) Installation and operation of generators in Adrianópolis: January 2005 and operation in the beginning of 2005

3.1 TECHNICAL PRE-FEASIBILITY WORK

Identification and discussion of the technical pre-feasibility work that was conducted that was necessary to determine the potential for a LFG utilization project.

a) Assessment of characteristics and reliability of urban solid waste stream

The NovaGerar Project includes two operations, which represent the Brazilian waste management reality: (1) the clean up of an existing dump site – Marambaia, and (2) the creation of new a sanitary landfill – Adrianopolis. Both are based in the municipality of Nova Iguaçu in the State of Rio de Janeiro, about 40 kilometers from the city of Rio de Janeiro.

NovaGerar is a 50:50 joint venture between EcoSecurities and S.A. Paulista, a Brazilian civil engineering and construction firm based in the city of São Paulo, Brazil. In 2000, S.A. Paulista was granted a 20-year concessional license by the Empresa Municipal de Limpeza Urbana (EMLURB - Municipal Waste Collection Company, a government mix economy company linked to the Public Works Secretariat of Nova Iguaçu, responsible for waste collection and disposal) to manage the Marambaia and Adrianópolis landfills. As part of this concessional agreement, S.A. Paulista is responsible for the decommissioning and rehabilitation of the Lixão da Marambaia site.

The Adrianopolis landfill commenced its operation in February 2003 and it is receiving around 900 metric tons of household waste per day, collected in the municipalities of Nova Iguaçu and Mesquita. The Executive Plan, prepared by

S.A.Paulista and approved by FEEMA, indicates that waste disposal rate will be some 1,000 metric tons/ day with maximum of 1,500 day/ day. The receiving capacity of the landfill is some 4,000 - 5,000 metric tons/ day. For the project projections, it is envisaged that the project will be able to capture around 2000 metric tons/ day from Nova Iguaçu and other neighbor municipalities. This possibility depends on the Public Ministry permit. Currently, as already said, the landfill is allowed to receive the waste from the cities of Nova Iguaçu and Mesquita, only. A sanitary emergency in other Municipalities could force a change in the Public Ministry position. This could leads the Adrianópolis landfill to receive waste from Queimados (50 metric tons/ day) and São João do Merití (260 metric tons/ day), which are now dumping in Gramacho, the Rio de Janeiro city's landfill, whose closure is expected to occur in middle 2005. This scenario is very likely to happen due to the precarious waste disposal situation in and around Rio de Janeiro. A separate study on the waste disposal market provided by S.A. Paulista shows that the Rio de Janeiro metropolitan area lacks of adequate waste disposal areas, and most of the current sites will be closed by 2005. Adrianópolis could likely be the only legal and clean option for the metropolitan area, if no further landfills were approved by the local public administration. Besides that, the environmental permits allow this site to receive waste also from the so-called big-generators, that is, those commercial stores or institutions that produce more than 100 l/ day. Private companies collect this waste and this will help to increase the total quantity of waste dumped in this site in the near future.

b) Understanding the LFG fuel resource potential and any risk factors

The new landfill will be managed according to the latest technology, which is being sought from specialist waste management companies. The bottom of the landfill will be coated with an impermeable high-density polyethylene membrane and the water residues will be channelled and treated in a wastewater treatment plant. Landfill gas will be collected by a gas collection system, and channelled to the electricity generation units. Excess gas will be flared. The project has already secured all the necessary environmental permits required by the Brazilian law.

QUANTIFICATION OF EMISSION REDUCTIONS FOR THE PROJECT

The Adrianópolis and Marambaia sites are adjacent to each other, and located adjacent to a densely populated section of the municipality of Nova Iguaçú, State of Rio de Janeiro, with more than 800,000 inhabitants. Because of their location

close to the city of Rio de Janeiro, many manufacturing companies are either relocating existing facilities or establishing new plants in Nova Iguaçú. The municipality today hosts more than 600 industries and 2,400 commercial establishments. The site is located 10 km from the centre of Nova Iguaçú city. Electric power transmission lines are located at less than 1 km from the site. Figure 1 shows a map of the location of the NovaGerar landfills.

The gas collection system for Marambaia and Adrianópolis will use state-of-the-art technology, and will be designed by specialist landfill gas engineers. Current plans includes landfill cells coated with an impermeable high-density polyethylene membrane, leachate channeled and treated in a state-of-the-art wastewater treatment plant, vertical wells used to extract gas, optimal well spacing for maximum gas collection whilst minimizing costs and condensate extraction and storage systems designed at strategic low points throughout the gas system. All efforts will be made to minimize condensate management. A schematic of the gas collection system and details of gas wells are shown below.

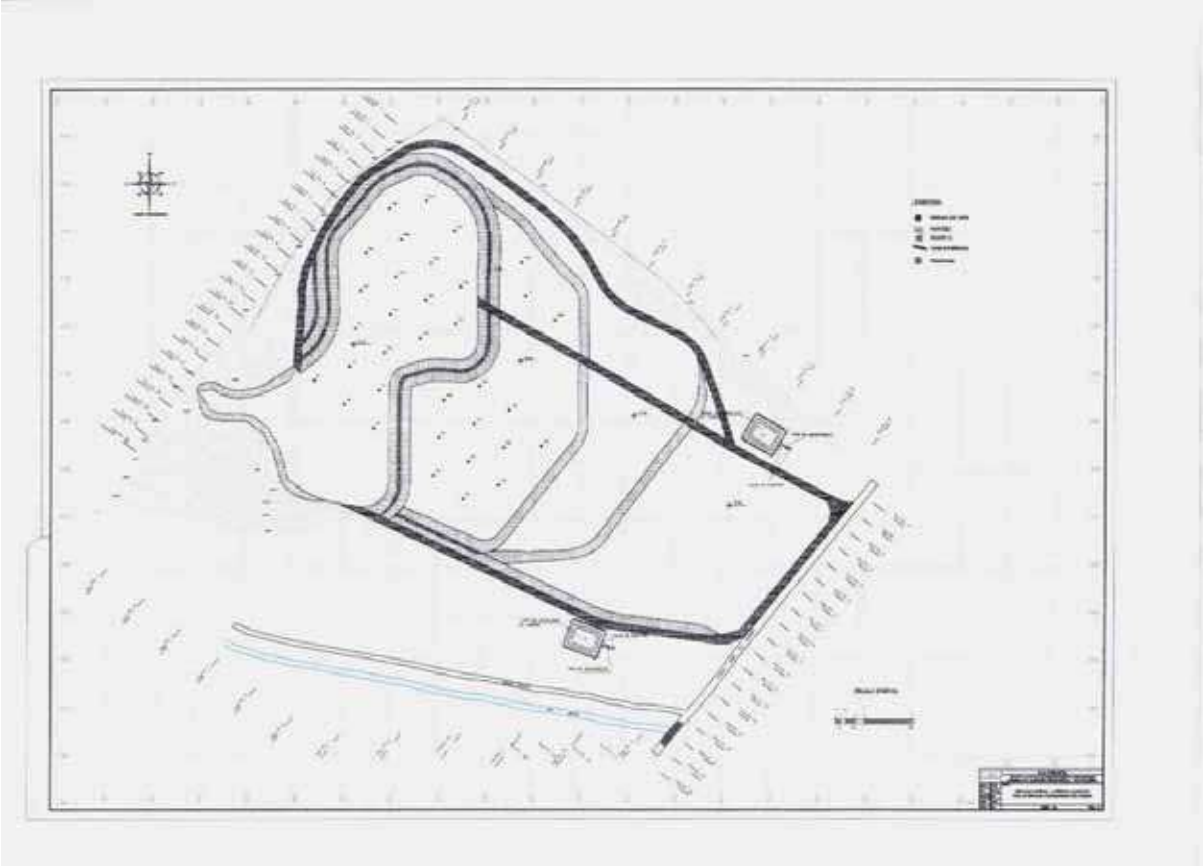


FIGURE 6 Schematic gas collection network

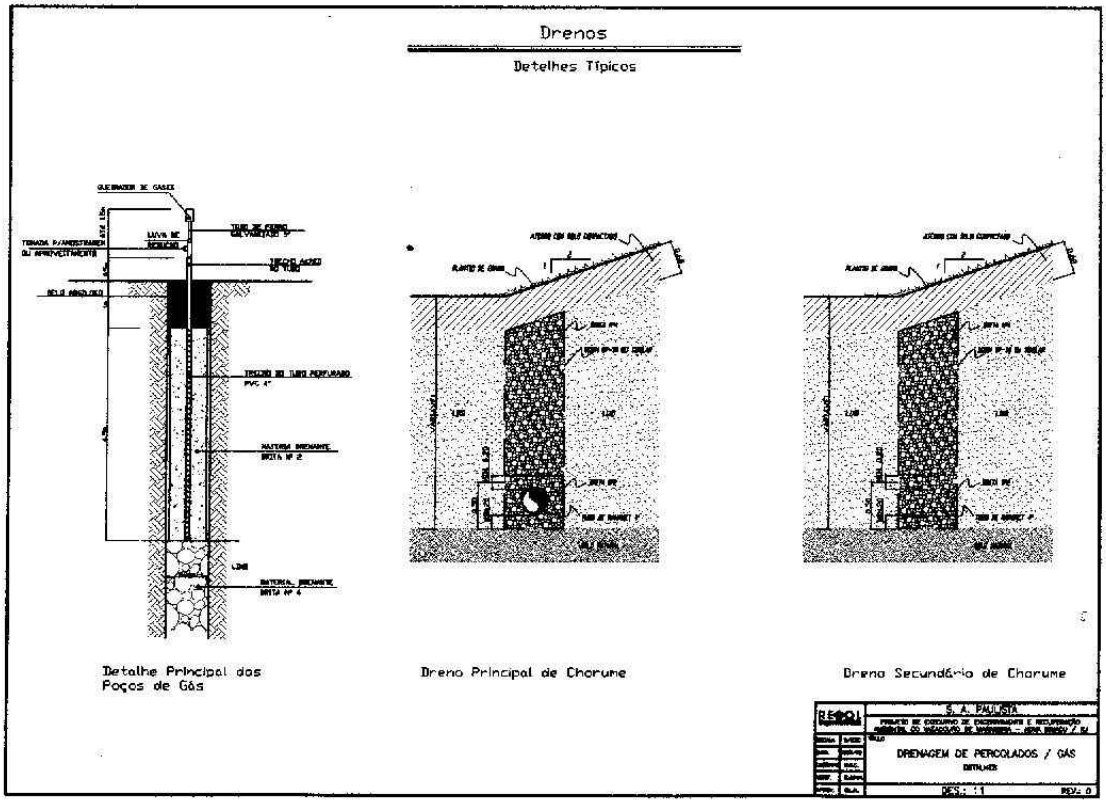


FIGURE 7 Construction details of a typical gas well

The technical aspect of the analysis focuses on the carbon reductions of the project and therefore its potential to produce net carbon reductions. As part of this, it is necessary to consider the different levels of carbon emissions associated with the 'with' and 'without' project environments. The methodologies and results of this analysis are presented below.

DATA ASSUMPTIONS

Wherever possible the data used were based on project specific measurements. In the case where data was not provided by the project, it was sourced from other literature data, and full references are given. This calculation and estimate have been made at the beginning of the project and have to be updated

- The baseline scenario

The baseline scenario is based on what would have happened in the absence of the project activities. In this case the baseline scenario is the continued uncontrolled release of landfill gas to the atmosphere, similarly to most landfills in Brazil (see Section 1.3.2 for more discussion).

The most accurate method for determining landfill gas quantity, short of installing a full collection system, is to sink test wells in representative locations and measure the gas collected from these wells. An added benefit of this method is that the collected gas can be tested for quality as well as quantity. The gas can also be analysed for Btu content as well as hydrocarbon, sulphur, particulate and nitrogen content. This will help in the design of the processing and energy recovery system. This detailed analysis will be undertaken in the initial stages of implementation of the NovaGerar project, after adequate financing is secured.

In the absence of this detailed analysis, a preliminary assessment of the landfill gas generation of the Marambaia and Adrianopolis landfill sites has been carried out using a first order decay model from the US EPA manual 'Turning a Liability into an Asset: A Landfill Gas to Energy Handbook for Landfill Owners and Operators' (December 1994). The US EPA first order decay model equation is as follows:

$$LFG=2LoR(e-kc-e-kt)$$

Where

LFG = total landfill gas generated in current year (cf)

Lo = theoretical potential amount of landfill gas generated per mass of waste (cf/ lb)

R = waste disposal rate (lb/ year)

t = time since landfill opened (years)

c = time since landfill closed (years)

k = rate of landfill gas generation (cf/ lb/ year)

The waste disposal volumes (R) are based on historical data for the Marambaia site, while the projected values for the Adrianopolis site are based on waste disposal tonnages from the Marambaia site plus projected growth in waste

disposal from the surrounding municipalities. These data forms the foundation of the gas volume projection and is subject to change over the active lifetime of the landfill as refuse acceptance volumes vary. This implies that the gas volume projection will vary accordingly. Therefore, even though gas volumes may fluctuate over a period of time because of varying disposal rates, the ultimate total volume of gas projected for the site should remain constant.

Lo is a variable dependent on the type of waste deposited and its organic content. The other variable, k, is dependent on factors affecting the decomposition of waste, i.e., temperature and humidity. The US EPA has developed a range of values for Lo and k, which were used for this analysis (see Appendix 2 for values used for the various variables). Because of the uncertainty in estimating k and Lo, however, gas flow estimates derived from the first order decay model have a high inherent error. For this reason, the project aims at selling only 75% of the total amount of credits estimated at this stage.

The results of the preliminary landfill gas generation analysis are presented in Figure 3 below, and the full details are shown in Appendix 3. According to the analysis, the Adrianopolis site has the capacity to generate approximately 1.4 billion cubic metres of landfill gas over the next 10 years, and 3.7 billion cubic metres over the next 20 years. This dramatic rise is due to an exponential increase in landfill gas production once a core volume of waste has been placed. Conversely, the Marambaia site will only generate approximately 184 million cubic metres of landfill gas over the next 10 years. Landfill gas at this site will decrease exponentially once waste placement has ceased, this is highlighted by the fact that over the next 20 years the landfill gas generated only increases to 199 million cubic metres. (Note that these values could be higher or lower, due to the uncertainty inherent to the evaluation method).

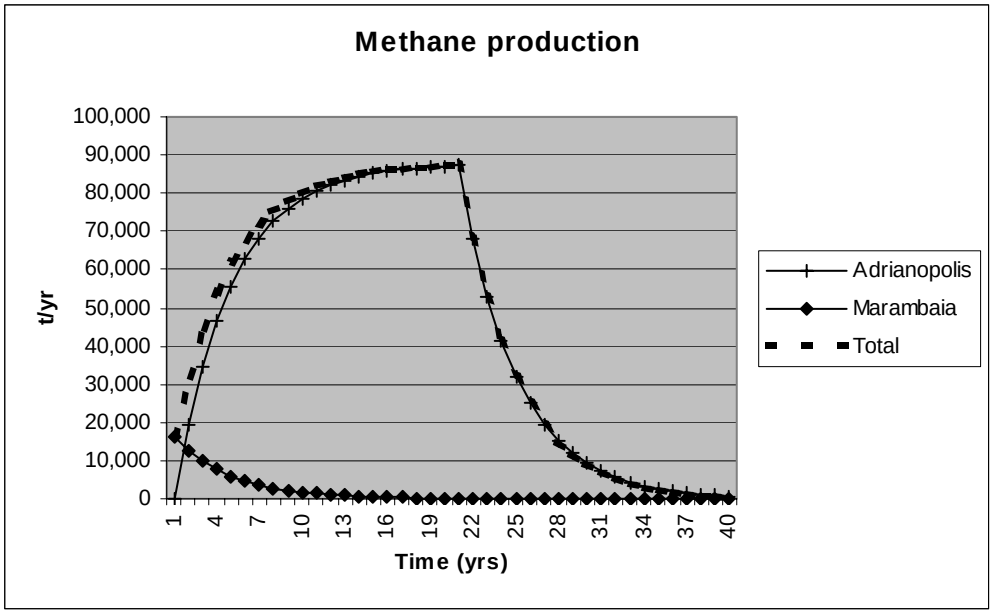


Figure 8: Methane gas generation volumes at Marambaia and Adrianopolis landfill sites based on the US EPA first order decay model.

The actual gas volume collected depends on the performance of the gas extraction system and liquids present within the waste. According to the US EPA publication 'Turning a Liability into an Asset: A Landfill Gas to Energy Handbook for Landfill Owners and Operators', the efficiency of collection systems varies from about fifty percent to over ninety percent because some of the landfill gas generated in a landfill will escape through the cover of even the most tightly constructed and controlled collection system. For this project an average landfill gas collection efficiency of 70% has been chosen. In addition, these estimates are consistent with previous estimates for similar sites within the city of São Paulo, as determined by engineers of the Environment and Waste department of EarthTech, an environmental engineering company from Oak Brook, USA.

In the project scenario, all these landfill gases will be emitted to the atmosphere. Methane, the main energy component of landfill gas, is a particularly potent "greenhouse" gas, having roughly 21 times the global warming effects of carbon dioxide. Please note the IPCC is currently revising the Global Warming Potential (GWP) of all 6 GHGs and it is anticipated that the GWP for methane will be revised to 23. Estimates of emission reductions for the NovaGerar project will be revised accordingly once the IPCC officially endorses the new GWP factors.

Measurements conducted on behalf of NovaGerar by consultant engineers from the Environment and Waste department of EarthTech, an environmental engineering company from Oak Brook, USA, determined that the landfill gas of a similar site located in São Paulo is typically comprised of 54% methane (see Table 2). Because of the similarities in waste composition and climate, which are the main factors in determining landfill gas generation, it was assumed that the methane content of landfill gas produced at the Marambaia and Adrianopolis sites would be similar.

Typical Landfill Gas Analysis	
Methane	40% to 60%
Carbon Dioxide	25% to 40%
Oxygen	<1%
Nitrogen	5%
Hydrogen	<0.1%
Carbon Monoxide	<0.01%
Ethane/Propane/Butane	<0.01%
Halogenated Compounds	Trace
Hydrogen Sulphide	Trace
Organosulphers	Trace

Typical landfill gas analysis of a similar site in Brazil.

In a business-as-usual scenario, without any gas collection or utilisation schemes in place, the site would be responsible for the release of approximately 80,000 tonnes of methane every year during this period. Using a Global Warming Potential (GWP) of 21 this is equivalent to carbon dioxide emissions of approximately 1.7 million tonnes per year. If the IPCC officially endorses an increase in the GWP for methane to 23 these numbers will be revised accordingly. Cumulative CO2-e emissions without the project over the baseline period are conservatively estimated at more than 24.1 million tonnes.

- The project scenario

  - Methane Mitigation

The NovaGerar project scenario is based on the collection and utilisation of landfill gas for the generation of electricity. 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. As previously discussed, the methane content of the landfill gas from the NovaGerar landfills is approximately 54%. Only 7.5 million tonnes of CO2e will be emitted in the project scenario during the period 2002-2022. Extracts from these calculations appear in Appendix 3.

- Grid Electricity Displacement

The project scenario also displaces grid electricity from the southern Brazilian grid. The Brazilian electricity grid is low to moderately carbon intensive being largely comprised of hydropower, however there are small but increasing elements of diesel, gas and coke usage. Therefore electricity generated from the NovaGerar landfills will effectively reduce emissions by displacing electricity from the grid which has a higher carbon intensity than electricity from a renewable resource, i.e. landfill gas. Based on the estimations of landfill gas generation, it is expected that these sites will produce levels of gas suitable for sustained electricity generation from 2002-2022.

To calculate the emissions displaced the amount of electricity exported to the grid is multiplied by a carbon emission factor (CEF) for that year. A CEF indicates the amount of CO2 or carbon emitted for each unit of fuel consumed, energy produced, or electricity output. CEFs are thus a measure of the 'carbon intensity' of different activities, and for electricity generation are usually expressed in units of tCO2/ MWh or tCO2/ GJ. CEFs can also be expressed in terms of CO2 equivalents, which means that emissions of other greenhouse gases such as CH4 or N2O are included in the measure of carbon intensity, by calculating the equivalent amount of CO2.

A table of the CEFs elaborated in the beginning of the project appears below. Also included in the table are the expected volumes of electricity to be exported to the grid, and the subsequent emission reductions. This table will be updated as soon as all the next steps of the project are defined

Year	CEF (kgCO2/MWh)	MWh per year output	Grid Electricity Displacement Emission Reductions (tCO2/year)	Cumulative Emission Reductions
2002	281.11	0	0	0
2003	321.92	34,952	11,252	11,252
2004	344.43	58,254	20,065	31,316
2005	333.86	81,556	27,228	58,544
2006	334.36	104,857	35,060	93,605
2007	331.15	116,508	38,582	132,186
2008	334.48	116,508	38,970	171,156
2009	332.73	116,508	38,766	209,922
2010	332.73	116,508	38,766	248,688
2011	332.73	116,508	38,766	287,454
2012	332.73	116,508	38,766	326,219
2013	332.73	116,508	38,766	364,985
2014	332.73	116,508	38,766	403,751
2015	332.73	116,508	38,766	442,517
2016	332.73	116,508	38,766	481,282
2017	332.73	116,508	38,766	520,048
2018	332.73	116,508	38,766	558,814
2019	332.73	116,508	38,766	597,580
2020	332.73	116,508	38,766	636,345
2021	332.73	116,508	38,766	675,111
2022	332.73	116,508	38,766	713,877
TOTAL		**2,143,747**	**713,877**	

Grid electricity displacement emission reductions and CEFs

ESTIMATION OF EMISSION REDUCTIONS

The GHG emissions of the baseline are shown in Figure 4 below. Capture and combustion of the landfill gas to generate electricity will effectively result in the avoidance of approximately 800,000 tonnes of CO2 emissions each year, and grid electricity displacement will result in emission reductions of 38,800 tCO2 each year, therefore cumulative GHG emission reductions of 17.3 million tonnes will accrue during the period 2002-2022.

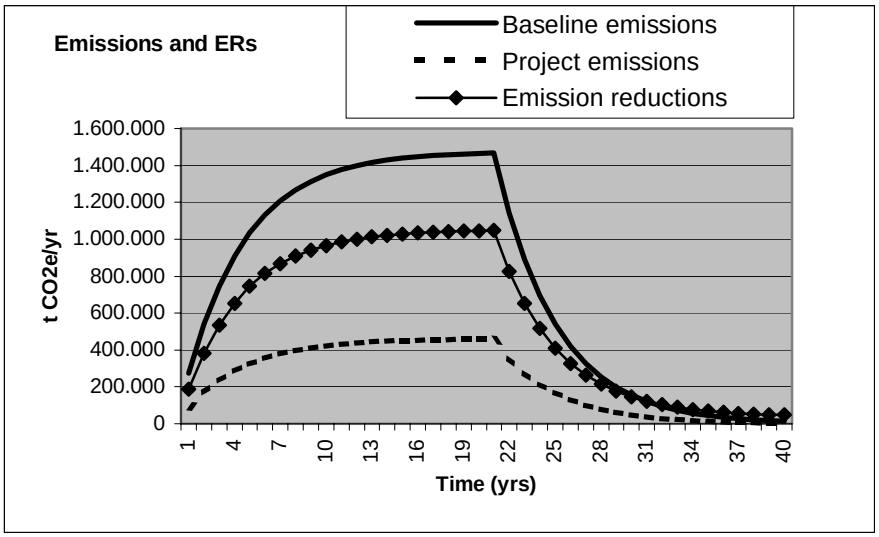


Figure 9: Baseline and project greenhouse gas emissions, and emission reductions estimated for the NovaGerar Landfill site (tCO2e/ year).

c) Assessment of technical options for use of the LFG fuel

The consultants contracted by Nova Gerar proposed that a modular power plant design would be the most appropriate. Although gas volumes are sufficient to support a turbine generator power system, the higher capital costs and parasitic losses meant this option was discounted. A modular reciprocating engine facility requires considerably less initial capital expenditure, but does incur higher maintenance costs. Given the inherent uncertainty of gas supply, the smaller modular reciprocating engine generator units may offer a significant advantage to adapt the equipment to the site-specific gas volumes. This is because it allows for a small pilot plant to be established at a relatively low cost and then, if economics and gas volumes support it, a plant expansion can be accomplished with minimal difficulty. Furthermore, as the gas volumes decrease over time, the modules can be relocated to other sites.

d) Approvals and permitting requirements.

The environmental permit for energy generation has already been applied to the State Environmental Agency (FEEMA) and to The National Electric Energy Agency (ANEEL). The first one is expected to issue the installation permit in the month of August; the second one was issued in February, 12, 2003.

3.2 MARKET ASSESSMENTS UNDERTAKEN

a) Identification of all projected revenue streams

Note: All the figures presented in the table below are projections, as none of them has been realized, so far.

NovaGerar landfill - Financial results and data inputs

PHASE I- FLARING --Data Inputs	
Price of carbon (€/tCO2)	3,35
Exchange rate US$/€	1,15
Exchange rate RS/US$	3,00
Net price of carbon (U$/tCO2) (deducting 2% adapt.levy)	3,78
% of Carbon Sales due to Municipalities	10%
Gas Plant & Flaring O&M/ Month (U$)	6.800

PHASE 1: Financial results	21 years	Until 2012
Gross Carbon Sales (U$)	37.058.196	9.515.492
% of Net Sales due to Municipalities	(3.705.820)	(951.549)
Net Carbon Sales (U$)	33.352.376	8.563.943
Gas Plant & Flaring O&M + Capital Costs	(3.619.349)	(2.803.349)
Land Rent	(160.000)	(160.000)
Administrative Expenses (U$/y)	0	0
World Bank Costs (US$)	**(160.000)**	**(160.000)**
CARBON CREDITS CASH FLOW	29.413.027	5.440.594
Present Value @ 15% (AT)	**4.152.428**	**1.782.082**
Total CERs sold to PCF (tCO2)		**2.520.360**

PHASE II- POWER GENERATION -- Data Inputs	
Tariff (Rs$/MWh)	130
Rate of increase (%) and evolution of tariff	0%
Tariff (Us$/MWh)	43,33
Taxes (PIS+COFINS)	18,65%
Land owner Royalty	10%
% of Energy due to Municipalities	10%
Land Rent (US$/y)	16.000
Power Plant O&M + Capital Costs	38,40

PHASE 2: Financial results	21 years	Until 2012
Gross Electricity Sales	**59.103.720**	**18.448.560**
Taxes (PIS+COFINS)	(11.022.844)	(3.440.656)
% of Net Sales due to Municipalities	(4.808.088)	(1.500.790)
Land owner Royalty	(125.066)	(125.066)
Net Electricity Sales	**43.147.723**	**13.382.047**
Power Plant O&M + Capital Costs	(52.374.989)	(16.348.262)
Eletricity Operating Margin (US$)	**(9.227.266)**	**(2.966.215)**
POWER GENERATION CASH FLOW	**(9.227.266)**	**(2.966.215)**
Present Value @ 15% (AT)	**(1.691.014)**	**(1.019.761)**

PROJECT CASH FLOW- -Data Inputs	
Pre-operational costs (US$)	150.000
Project Administrative Expenses	6.850
World Bank yearly administration costs (US$)	20.000
Discount rate	15,0%
Income tax 15%+9%	24%

INTEGRATED PROJECT CASH FLOW- With Carbon	21 years	Until 2012
Phase 1 + 2 Cash Flow	**20.185.763**	**2.474.381**
Pre-operational costs	**(150.000)**	**(150.000)**
Project Administrative Expenses	**(1.644.000)**	**(822.000)**
Income tax	**(4.482.577)**	**(429.126)**
Project Cash Flow AT	**13.909.186**	**1.073.255**
Present Value @ 15% (AT)	**1.732.954**	**325.448**
IRR	**36,19%**	**23,46%**

b) Legal and technical requirements

Energy Generation

Considering that it is a low-impact energy generation undertaking, it can be classified in the provision of CONAMA Resolution (Conselho Nacional do Meio Ambiente - National Environmental Agency) #279/ 01, which establishes procedures and dates for the simplified environmental permit for electric undertakings with low potential for environmental impact. That Resolution defines the Simplified Environmental Assessment (Relatório Ambiental Simplificado – RAS) as an evaluation tool.

Regarding the emission standards for combustion engines in stationary sources, the CONAMA Resolution 08, 12/ 06/ 1990 should be followed.

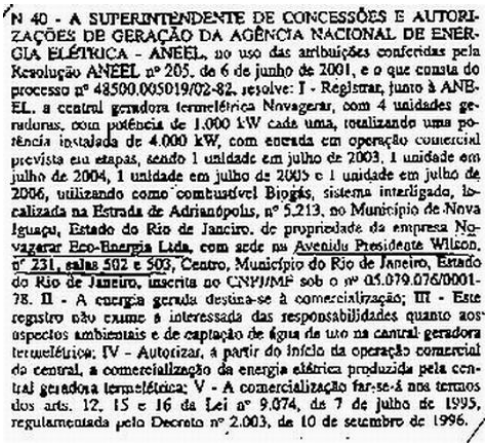
Concerning the air quality standards and the atmospheric pollutant concentrations that, when exceeded, might affect health, safety and wellbeing of the population, the CONAMA Resolution 03, 06/ 28/ 1990 should be followed.

In terms of State, the Technical Guideline of FEEMA (State Environmental Protection Agency) DZ-041- R13, 1997, quotes limits and types of studies for electric energy generation activities permit.

The DZ-545.R-5,1986 – Guideline to Implement the Program for Controlling Emissions into the Atmosphere (Autocontrole de Emissões para a atmosfera - Procon Ar) aims to establish the general guideline to implement a program named Program for Controlling Emissions into the Atmosphere (Programa De Autocontrole de Emissões para a Atmosfera - Procon Ar).

In terms of City, consultation relative to the undertaking location is needed, and it should follow the provisions of its Urban Master Plan, in accordance with the Complementary Law No 006, December 12th, 1997 and to the Law No 2.882 from December 30th ,1997, which defines the Use and Occupation of Land in the City of Nova Iguaçu.

The ANEEL - National Electric Energy Agency permit has been issued in February, 12, 2003 and published in The Official Federal Journal as shown below:



Nº 40 - A SUPERINTENDENTE DE CONCESSÕES E AUTORIZAÇÕES DE GERAÇÃO DA AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA - ANEEL, no uso das atribuições conferidas pela Resolução ANEEL nº 205, de 6 de junho de 2001, e o que consta do processo nº 48500.005019/02-82, resolve: I - Registrar, junto à ANEEL, a central geradora termelétrica Novagerar, com 4 unidades geradoras, com potência de 1.000 kW cada uma, totalizando uma potência instalada de 4.000 kW, com entrada em operação comercial prevista em etapas, sendo 1 unidade em julho de 2003, 1 unidade em julho de 2004, 1 unidade em julho de 2005 e 1 unidade em julho de 2006, utilizando como combustível Biogás, sistema interligado, localizada na Estrada de Adrianópolis, nº 5.213, no Município de Nova Iguaçu, Estado do Rio de Janeiro, de propriedade da empresa Novagerar Eco-Energia Ltda, com sede na Avenida Presidente Wilson, nº 231, salas 502 e 503, Centro, Município do Rio de Janeiro, Estado do Rio de Janeiro, inscrita no CNPJ/MF sob o nº 05.079.076/0001-78. II - A energia gerada destina-se à comercialização; III - Este registro não exime o interessada das responsabilidades quanto aos aspectos ambientais e de captação de água de uso na central geradora termelétrica; IV - Autorizar, a partir do início da operação comercial da central, a comercialização da energia elétrica produzida pela central geradora termelétrica; V - A comercialização far-se-á nos termos dos arts. 12, 15 e 16 da Lei nº 9.074, de 7 de julho de 1995, regulamentada pelo Decreto nº 2.003, de 10 de setembro de 1996.

FIGURE 10 - Operation Permit issued by ANEEL

c) Energy markets and the potential for "green" power pricing;

The only program in Brazil concerning special conditions for “green” energy sales is called PROINFA. It was created by Decree N° 4541 of 23/ 12/ 2002 and its regulation scheduled for end October 2003. It’s purpose is the diversification of the Brazilian energetic matrix and the search for solutions in a regional basis with the utilization of the renewable energy sources, through the economic use of the available combustibles, aiming the increase of the participation of the amount of

energy produced by the eolic systems, small hydroelectric power plants and biomass, within the National Integrated Electric System – SIN. In its first phase, the program will promote the implementation of the capacity of the system up to 3,300 MW, in installations scheduled to begin operations in December 30, 2006. MME assures the purchase of the produced energy for a period of 15 years, from the date of the beginning of operation defined in the contract. The regulatory Decree # 4,541, published in December 24, 2002, established the first phase of PROINFA. The Program implementation needs actions that are been held by the MME, specially the calculation of the economic value of the eolic energy, biomass and PCH, along with the customization of the said decree to the new directives of the new National Energetic Policy. The Ministry presents the conclusion of this hard work, performed by specialists and consultants specialized in alternative sources of energy and risks analysis for electric generation projects and publicize it for the discussion of interested people and institutions of the sector:

ECONOMIC PARAMETERS

The economic parameters resulted from the applied methodology and that will be preliminarily considered by PROINFA – 1st Phase are the following:

Unit: R$/MWh

Sources	**Sector**	**Area 1(I)**	**Area 2 (II)**
Biomass	Biogas	166,31	170,12
	Rice Sector	108,17	112,67
	Wood Sector	116,05	121,85
	Sugar-alcohol Sector	119,61	89,59
Eolic	FCB < 34%	221,81	231,68
	34% < FCB < 44%	Function (III)	Function (III)
	FCB > 44%	181,46	191,70
PCH (small hydroelectric power plant)		114,74	125,09

(I) Regions covered by the former SUDAM (Superintendência de Desenvolvimento da Amazônia) and SUDENE (Superintendência de Desenvolvimento do Nordeste)

(II) All other areas of the Country

(III) A factor found in a specific table

FCB = Gross Capacity Factor (it doesn't consider the unavailability of winds)

Also, ANEEL, the National Electric Energy Agency, regulations for free consumers are still pending.

d) Fuel pricing and other chemical product options;

Not applicable in this case study.

e) Specific contractual requirements and/ or limitations (e.g., power sales contract, gas sales contract, waste supply contract);

The following procedures are been forecasted by Nova Gerar concerning the futures agreements for energy sales:

Commercial Terms for the Sale of Energy

- Energy is going to be traded through 5 years PPAs
- Potential clients are Eletrobras (PROINFA) , free consumers (banks, shopping centers etc) and Municipalities.
- As mentioned above, PROINFA was created by Decree N° 4541 of 23/ 12/ 2002 and its regulamentation is expected to happen very soon. Also, ANEEL regulations for free consumers are still pending. Expected prices for next 5 years are comprised between R$ 95,00 and R$ 110,00/ MWh

f) Timing and contract term issues. How long will take to get contracts approved.

Not applicable, as no contract has been signed so far.

3.3 ANALYSIS OF PROJECT ECONOMICS

The summary of all economics projected for the project is shown in the table presented in item 3.2.a above.

3.4 PROJECT STRUCTURE AND PRELIMINARY BUSINESS PLAN

a) Assessment of ownership and O&M options

NovaGerar is a 50:50 joint venture between EcoSecurities, an environmental finance company which specializes in greenhouse gas (GHG) mitigation issues, with offices in the UK, USA, the Netherlands, Australia and Brazil, and S.A. Paulista a Brazilian civil engineering and construction firm based in the city of São Paulo, Brazil, with branches in several other states. S.A. Paulista's core business is in traditional heavy construction sectors such as highways, railways, airports, ports, industries and sanitation. S.A. Paulista also manages the largest domestic

waste transfer station in South America (Transbordo de Ponte Pequena) responsible for 60% of all domestic waste from São Paulo, a city with a population of more than 10 million people.

In 2000, S.A. Paulista was granted a 20-year concessional licence by the Empresa Municipal de Limpeza Urbana (EMLURB - Municipal Waste Collection Company, an mixt economy company vinculated to the Civil Works Secretariat of Nova Iguaçu Municipality government agency responsible for waste collection and disposal) to manage the Marambaia and Adrianopolis landfills (officially called 'Lixão de Marambaia' and 'Aterro Sanitário de Adrianópolis') in the state of Rio de Janeiro. A contractual side agreement has been negotiated with the Nova Iguaçu Municipality to allow Nova Gerar to explore the biogas in Adrianópolis landfill and a negotiation with the owner of the land of Marambaia open dump has been held with the same purpose.

Whereas, S.A. Paulista is in charge for landfill operations, the joint venture NovaGerar will explore all business related to the use of the GHG and is the legal contractual partner of the NCDF (Netherlands Clean Development Facility).

b) Specific contractual requirements (source: Project Concept Document – The World Bank)

The project was selected on basis of NCDF's eligibility criteria. The NCDF funds projects in the framework of Article 12 (CDM) of the Kyoto Protocol. As per the terms of the Agreement, NCDF projects should be located in Non-Annex I Countries (as listed in the UN Climate Convention) which have (i) signed and ratified, accepted, approved or acceded to the Kyoto Protocol, or (ii) signed the Kyoto Protocol and demonstrated a clear interest in becoming a party thereto in due time, for example those that have already started or are on the verge of starting their national ratification, acceptance or approval process or (iii) already started or are at the verge of starting the national accession process. Brazil meets the criteria under (i) as it is a non-Annex I Country as per the UN Climate Convention and has ratified the Kyoto Protocol.

Cost-effectiveness and sustainability will play a major role in selection and approval of NCDF projects. Projects are drawn from a broad range of technologies and processes in energy, industry, and transport, which provide various vehicles for generating ERs, which contribute to sustainable development and achieve

transfer of cleaner and more efficient technology to Host Countries. VROM ranks technologies in the following descending order: (i) renewable energy technology, such as geothermal, wind, solar, and small-scale hydro-power; (ii) clean, sustainably grown biomass (no waste); (iii) energy efficiency improvement; (iv) fossil fuel switch and methane recovery; (v) sequestration. Brazil NovaGerar project has been approved by VROM and is part of the NCDF Business Plan for the period up to December 2002.

The most important Kyoto Protocol requirement for CDM projects is that "reductions in emissions are additional to any that would occur in the absence of the certified project activity." This "environmental additionality" of the project is assessed against a baseline, which describes what would happen without the proposed project.

The Landfill Gas Projects are based on the collection and utilization of landfill gas, which is currently released in an uncontrolled manner. This will lead to reductions of landfill gases rich in methane, a highly potent greenhouse gas, and potential reductions of GHG emissions associated with the use of fossil fuels used for generation of electricity. The collection and reduction of landfill gases would not occur without the project involvement.

The Landfill Gas Project clearly exceeds the requirements of Brazilian regulations, since they will ensure that landfills are managed according to the latest environmental standards, aiming at collecting the highest amount of landfill gases. This represents an unprecedented investment in this type of activity in Brazil. There is not policy and regulatory framework which would indicate a certain quantity of methane to be flared or combusted and used for power generation. National and State regulations will be checked periodically, as a part of the Monitoring Plan for the project, to guarantee that the project maintains the "additionality" as indicated as necessary under the Kyoto Protocol.

In the case of power generation, it demonstrates that the current situation for small scale power producer is very risky due to low energy sales prices to be achieved on the market. This would prevent private investors to go ahead with using methane gas for energy generation, once it is not the most economic way to produce energy. In parallel to the risks related to power sales, there are further entrepreneurial risks, such as the uncertainty of the exact amount of landfill gas available over the years and the performance of the plant. Given that there is not a single landfill site in Brazil generating electricity, this is seen as 'unproven' technology by local investors.

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.

The NovaGerar baseline study confirmed the eligibility and viability of the proposed project. Particularly, the study (i) confirmed the environmental additionality of the project, and (ii) estimated the quantity of ERs that the project is expected to generate by reducing methane emissions and fossil fuel replacement on the energy market.

The baseline approach adopted for the NovaGerar project is in accordance with the CDM rules the scenario that represents "emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment". The NovaGerar project circumstances permit the use of a simplified financial analysis to determine the baseline scenario. The proposed project involves a significant investment in 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. The methodology involves an 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. The only other plausible scenario is continued non-utilization of landfill gas. 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.

3.5 SOCIAL AND ENVIRONMENTAL IMPACT

Socio-Economic Benefits: (source: Project Concept Document – The World Bank)

- The project will have a positive impact on amenity and the communities in the local area. Contaminated leachate and surface run-off from landfills can affect down-gradient ground and surface water quality, and have secondary impacts on the health of the local environment and the local population. The uncontrolled release of landfill gas can also lead to risks of explosions in the local surroundings.

By managing the Marambaia and Adrianopolis landfill sites properly the health risks and the potential for explosions is greatly reduced.

- The project will also have a small, but positive impact on employment in the local area as a number of staff will need to be recruited to manage the landfill gas sites. Appropriate management of the landfill sites will also decrease the risk of landslide on the sites, reduces risks to employees and surrounding population.
- The project aims to promote capacity building seminars demonstrating best practices in waste management and contract – so far illegal workers – legally.

The project was subject to an environmental license process mandated by federal and state laws. One of the stages consisted in the development of an Environmental Impact Assessment, where all of the environmental and social issues were analyzed. Also, the mitigating initiatives to be implemented by the entrepreneurs for each of the project implantation stages were described. This assessment was subject to a public hearing coordinated by the state environmental agency (FEEMA). All of the relevant issues involving environmental or social interfaces proposed by any of the hearing attendants were registered, and the entrepreneur should review the Environmental Impact Assessment to address any registered issues that may arise.

Another stage in the license process consisted in an opinion poll with the participation of the different stakeholders who were in any way involved in or affected by the business implementation. A summary of the poll results is presented in Appendix C. The conclusive comments are presented below, according to the civil society segments considered as "opinion makers" concerning to the Open Dump Remediation and Implementation of Nova Iguaçu Sanitary Landfill, with Methane Gas Energetic Use.

PUBLIC SECTOR DEPARTMENTS

The project beneficiaries will be, in the majority, the population and the society and the greatest contribution of the project will be the global effort to fight against the climatic change.

The qualification/ generation of knowledge aiming the quality of life/ environment improvement will be the most important environmental social-economical factor.

NON GOVERNAMENTAL ORGANIZATION

The population will be the project's greatest beneficiary and the best contribution will be the promotion of green energy generation.

The most important environmental social-economical factor will be the qualification/ generation of knowledge aiming the quality of life/ environment improvement.

The compensation to the environmental reliability for greenhouse effects in Brazil, the incentive for production systems that generate environmental services to the global society, the qualification/ generation of knowledge aiming the quality of life/ environment improvement and the awareness of a sustainable model are the most likely effects to occur.

SCAVENGERS ASSOCIATION

The local community will be the greatest beneficiary with the implementation of the project, due to the increase in jobs.

The Public Power positioning will happen with the increase in jobs, the increase in the quality of life and the conversion of the environmental liability for the greenhouse effect to investing countries.

PRIVATE ENTERPRISE

The beneficiaries of the project will be in the majority the population, the City government and the entrepreneurs. The greatest contributions of the project will be the global effort to fight against the climatic change and the improvement of the company's image in Brazil.

The most important environmental social-economical factor will be the qualification/ generation of knowledge aiming the improvement of quality of life/ environment.

INTERNATIONAL ENTITIES

The population will be the project's greatest beneficiary and the major contribution will be the global effort to fight against the climatic change.

The increase of income of workers/ producers directly involved will be the most important environmental social-economical factor.

The incentive for production systems that generate environmental services to the global society, the qualification/ generation of knowledge aiming the improvement of quality of life/ environment and a sustainable model awareness are the most likely effects that will probably occur.

* Wastepickers or scavengers – Called "Catadores" in Portuguese, they are the people who pick up recyclable material in the landfills or in the streets.

Environmental Benefits: (source: Project Concept Document – The World Bank)

Regarding the current precarious waste management situation in Brazil, specially in the final disposal sector, as showed in the introduction of this study, the project will generate many additional environmental benefits:

- By collecting and combusting landfill gas, the projected 'sanitary' landfill will reduce both global and local environmental effects of uncontrolled releases.
- Although the majority of landfill gas emissions are quickly diluted by 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 and/ or improved management of the sites, landfill gas will be captured and combusted, removing the risks of toxic effects on the local community and local environment.
- In most cases the waste disposal situation is precarious. Leachate is directly going into the groundwater and small rivers heading to the Baia de Guanabara (NovaGerar). By providing appropriate management on the site, these potential problems should be avoided.
- Other potential hazards and amenity impacts minimized by appropriate management of the landfill sites 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.
- Where landfill gas utilization schemes, such as the NovaGerar 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.

4.0 PROJECT DEVELOPMENT PHASE:

4.1 PARTNERSHIP ARRANGEMENTS AND BUSINESS PLAN

a) Ownership of waste, landfill gas and emission reduction credits

According to the Brazilian legislation, the municipality is responsible for the waste management services. The public administration has the authority to grant other institutions the right to exploit services of the waste management, partially or totally, such as the operation of sanitary landfills. According to this regulation, the City of Nova Iguaçu started a public bidding process in 2000 aiming at the implementation of a new sanitary landfill to be constructed in a property owned by the City Administration, including in the contract the old open dump closing down. In December, 2000, the concession contract was signed with S.A Paulista. Such contract foresaw the gas draining, but not its exploitation by the concessionaire. In January, 2003, one Additional Term to the contract was signed, granting the concessionaire the rights to exploit the landfill bio-gas (authorization for the bio-gas collection that makes the electric power generation viable: "Each and every direct or indirect economic utilization, which may generate income for the concessionaires, is herein approved as a recovered or recycled sub-product by this additional term..."). The City Administration will receive from S. A. Paulista, as royalties, 10% over any extra income obtained with the landfill operation (carbon credits, electric power generation, waste brought from other cities other than Nova Iguaçu, of greater generators, among others).

b) How the costs, risks and financial returns will be shared

The concession contract specifies a payment by the municipality to the operator, in national currency, corresponding to U$ 4,36 per metric metric tons of waste dumped in the landfill.

c) Description of the institutions responsible for design, installation, and O&M;

The institutions involved in the concession, construction and operation of the landfill have been already described and detailed in this study. In September 2003, a British company, ENER-G, has been contracted to implement the gas recovery system, the flaring and the generation units. In spite the contract is still in a confidential basis, it is known that Nova Gerar will reimburse ENER-G based on a certain percentage of the net income derived from the energy sales and from emissions reduction certificates value in the international market.

d) Who decides how large the O&M expenditures are going to be?

Nova Gerar is the owner of the project and will decide all necessary expenditures (investments, operation and maintenance costs) according to the contract signed with de City of Nova Iguaçu and the environmental and sanitary requirements established in the Brazilian legislation.

4.2 PROJECT APPRAISAL AND FINAL DUE DILIGENCE ASSESSMENTS

As the gas project has not yet been implemented, this item will be written lately.

4.3 FINAL ENERGY SALES CONTRACT AND ANY OTHER FINANCIAL INCENTIVES

ENER-G, the English company contracted by Nova Gerar in September, 2003, to be responsible of the complete gas recovering system, flaring and energy generation and Nova Gerar, will start looking for a PPA – Power Purchase Agreement for the plant. This item will be detailed lately.

4.4 SECURING PERMITS AND APPROVALS

As the gas project has not yet been implemented, this item will be written lately.

4.5 CONTRACTING FOR ENGINEERING, PROCUREMENT & CONSTRUCTION, AND O&M SERVICES

The steps to carry out the contracts for engineering, procurement & construction, and O&M services will be discussed according to the following items:

a) Preparation of detailed engineering design, site preparation, plant construction: expected to be concluded on December 2005.

b) Developed construction strategy and issue bid documents: expected to be ready in October 2003

c) Selection of contractor(s): signature of contract expected to happen at the end of September 2003

d) Process for negotiation and execution of contract(s): expected to happen during the end of 2003 and first quarter of 2004.

e) Agreements between contractor and developer for commissioning, start-up and long-term operations and maintenance: expected to happen in January 2005.

The detailed engineering design, site preparation, plant construction and all items related to these actions are expected to finish in January 2005.

4.6 PROJECT IMPLEMENTATION

a) Plant commissioning and start up commercial operations: expected to be concluded in December 2003.

b) Steps taken to ensure future good O&M practices: expected to start November 2003 until June 2004.

c) Actions aimed at maintaining good public relations: these actions began when the concession contract was signed and will last until the end of the concession, as the maintenance of the public relations is a *sine qua* condition to keep the project in operation, considering the natural reaction that a landfill provokes in the neighboring population. A big effort was developed during the licensing period, which happened during 2002/ 2003, due to the reaction of some political groups. The last related event occurred in September, 9, when the project received an important nomination related to the Local Agenda 21, which was granted by the Federal Legislative Group, formed by senators and federal deputies. Nova Gerar took this chance and organized an important event on the site, in which many senators, deputies, the Vice Governor and State Secretary of Environment, mayors, stakeholders and people from the nearby community have participated. The event consisted in a Seminar followed by a visit to the landfill. It has been covered by the press and it had an important regional repercussion.

These items will be detailed latter as the implementation of the gas recovery and utilization project has not yet commenced.

4.7 MONITORING AND EVALUATION OF CONTRACT PERFORMANCE AND PROJECT IMPACTS

a) The monitoring indicators and procedures designed for the project have not yet been implemented and this is expected to happen at the end of 2003.

LANDFILL GAS MONITORING PLAN

The gas is captured from the landfill by a pump that simultaneously feeds both consumption devices, that is, the atmospheric burner (flare stack) and the engine-generators.

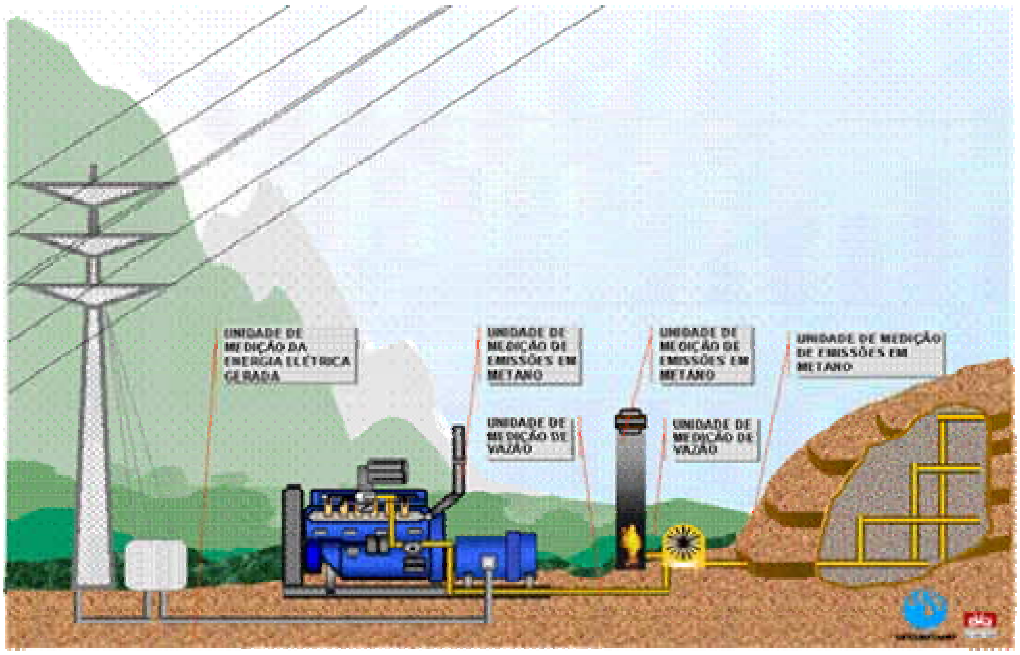


FIGURE 11 Schematic figure for the monitoring system

The system is fitted with monitoring devices to control biogas leaks, CH4 emissions and generated power.

Both types of units operate continuously and provide data that are logged and stored by means of specific software applications.

This enables permanent queries as well as the generation of virtually real-time reports due to the traceability allowed by such measurements.

The specific software will directly convert the values obtained into carbon credits while the electricity measuring unit reads and records the amount of energy generated.

This allows the prompt management of data and the readily availability of outputs obtained over a certain period.

These data are available by means of a supervisory control center connected to the software application in order to transmit the data through the INTERNET and thus enable remote queries.

Additionally, the engine-generators may also be remotely operated by the same process, in accordance to the most relevant operating standards. At the same time,

the operator will be permanently connected to issue reports and detect preventive, overall and corrective maintenance needs.

In order to provide real time images of the facilities, also through the Internet, the plant is fitted with strategically located cameras.

This set of data high-speed transmission and accuracy tools not only adds enhanced operating reliability to the systems but also ensures full reliability to the acquirers of carbon credits related to the supplied electricity, making the related activity solid, serious and unquestionable.

b) The indicators projected to be used to ensure for good operational and financial management;

Not applicable at this phase of the project.

c) A discussion on the entire subject of warrantees and performance guarantees.

Not applicable at this phase of the project.

5.0 SUMMARY OF CASE STUDY EXPERIENCE

5.1 IMPORTANT LESSONS LEARNED

The most important lesson we have learned, up to the current phase of the project, is that, since the very beginning, in any undertaking that involves a close relation to the public service and to the community, the undertakers should be willing to show the general public, transparence and credibility regarding the project's objectives. Any action that involves waste landfills has as a result the reaction of the community from the surroundings. Therefore, the previous contact to the population next to the installation, clearly showing the project details and the compensatory measures predicted, is an essential initiative to contribute to the undertaking implementation process feasibility. It is also crucial the strict compliance with all applicable laws, specially regarding the environmental aspects, in order to avoid non-governmental organizations, Prosecuting Counsel and environmental control institutions antagonistic actions.

5.2 SUMMARY CRITIQUE OF PROJECT DEVELOPMENT EXPERIENCES

Up to the current phase of the project, the undertakers have led the whole process successfully; from the moment they won the bid for Adrianópolis Sanitary Landfill concession, it was necessary the articulation among the different institutions involved in the permit process, and in special, of the Adrianópolis community, where the new landfill was implemented. It's interesting to realize that the reaction to the implementation of a new landfill is always very strong, even when it results into closing a highly pollutant open dump, as it was the Marambaia landfill, where

there was no protection against the leachate infiltration into the soil, the waste was not covered, there were permanent fires, and there was constant emission of particles and bad odors. During the whole implementation process there were many lawsuits trying to obstruct the continuity of the work, but finally the environmental control agency (FEEMA) granted the permit for installation and operation. Then it began the work for the old landfill environmental recovery and the waste final disposal, in a suitable environmental way in the new landfill of Adrianópolis.

The implementation of the recovery system and use of gas and the beginning of the process for carbon credit sale (resulted from the reduction of carbon emissions to the atmosphere, through PCF-Prototype Carbon Fund, managed by The World Bank), also demanded a great articulation capability by the undertakers together with Nova Iguaçu City Administration, once it wasn't a initiative anticipated at the time of the landfill concession contract. Finally, it should be observed that the negotiations with the World Bank for any project that aims the carbon credit sale is lengthy and demands the compliance with a series of phases until the final agreement is executed. The carbon credit sale is not an easy task to execute successfully and it is necessary, mainly, to be able to provide a guarantee of operational continuity within the parameters established in the beginning of the project. Hardly the City public administration is able to guarantee the operational conditions of the project in a period longer than 10 years. Besides other factors, that's due to the fact that, in Brazil, there are election processes for mayors every 4 years, and the changes in the public administration might alter the city's waste management guidelines. So that, hardly a project for the recovery and use of gas and the consequently carbon credit sale would be successful without a long-term concession contract, where all the guarantees for the compliance of the agreement would be provided by a private group. That is the case of the Nova Gerar project, which is, at this moment, beginning the first phase of the project implementation, the burnt and generation of energy from the gas generated in the Marambaia landfill, which environmental recovery has been developed. It is expected for this phase to start in January 2004. It is also expected for 2004 the beginning of the gas exploitation in Adrianópolis new landfill.

APPENDIX A

1. Environmental permit issued by the State Environment Agency – FEEMA:

Operation Permit

LICENÇA DE OPERAÇÃO

LO Nº FE002793

Conforme Deliberação nº 003, de 28/12/77, da Comissão Estadual de Controle Ambiental - CECA, a Fundação Estadual (e Engenharia do Meio Ambiente - FEEMA, no uso das atribuições que lhe são conferidas pelo Decreto-Lei nº 134, de 16 de junho de 1975, Artigo 8 e de acordo com o Sistema de Licenciamento de Atividades Poluidoras, instituído através do Decreto nº 1633, de 21 de dezembro de 1977, expede a presente Licença de Operação, que autoriza a

Empresa: S.A. PAULISTA DE CONSTRUÇÕES E COMÉRCIO
CNPJ/CPF: 60.332.319/0002-27
Endereço: AV. MONTE CASTELO, 1760 - JARDIM GRAMACHO
Reg. Adm./Distrito: 1º DISTRITO - DUQUE DE CAXIAS
Município do(a) DUQUE DE CAXIAS no Estado do(a) RIO DE JANEIRO, registrada na FEEMA sob código UN002681/35.51.50 a operar a instalação relativa à(s) atividade(s) de aterro sanitário de resíduos urbanos. - - - - - - -

localizada em:
ESTRADA DE ADRIANÓPOLIS, 5213 - SANTA RITA, município - NOVA IGUAÇU

com as seguintes restrições:

1- Atender, no prazo de 30 (trinta) dias a contar da data de emissão desta Licença, à NA-052 - Regulamentação para Publicação das Licenças Obrigatórias e Estudo de Impacto Ambiental do Sistema de Licenciamento das Atividades Poluidoras, aprovada pela Deliberação CECA Nº 2536 de 12/11/91 (D.O.R.J. de 06/12/91), arcando com as publicações à FEEMA, no mesmo prazo;

2- Esta Licença não respeita aos aspectos ambientais e não exime o empreendedor do atendimento as demais exigências por lei;

3- Esta Licença não poderá sofrer qualquer alteração, nem ser cancelada, sob pena de perder sua validade;

Esta LO é válida até 06 de fevereiro de 2008, a contar da presente data, conforme Processo FEEMA nº E-07/200.153/03, observadas as condições deste documento e seus anexos, que embora não transcritos, são partes integrantes do mesmo.

Rio de Janeiro, 06 de fevereiro de 2003

ISAURA FRAGA
Presidente da FEEMA

Pag. 1 de 3

LICENÇA DE OPERAÇÃO
CONTINUAÇÃO DA LO Nº FE002793

Empresa: S.A. PAULISTA DE CONSTRUÇÕES E COMERCIO
Endereço: ESTRADA DE ADRIANÓPOLIS, 5213 - SANTA RITA, município - DUQUE DE CAXIAS

RESTRIÇÕES DESTA LO

26- Evitar todas as formas de acúmulo de água que possam propiciar a proliferação do mosquito "Aedes aegypti", transmissor da Dengue;
27- Eliminar métodos de trabalho e ambientes propícios à proliferação de vetores (insetos e roedores nocivos);
28- Manter atualizados, junto à FEEMA, os dados cadastrais relativos à atividade ora licenciada;
29- Submeter previamente à FEEMA, para análise e parecer, qualquer alteração na atividade;
30- A FEEMA exigirá novas medidas de controle, sempre que julgar necessário; - - - - - - - - - -
31- Qualquer atraso na implantação dos sistemas de tratamento previstos implicará na paralisação imediata das atividades de reaterramento de lixo, tornando sem efeito esta licença.

Rio de Janeiro, 06 de fevereiro de 2003

ISAURA FRAGA
Presidente da FEEMA

Pag. 2 de 3

2. Description and specification of the equipment for biogas burning (flares) and for the use as combustible (generators) – all these information are subject to change because the final contracts with suppliers have not been signed so far.

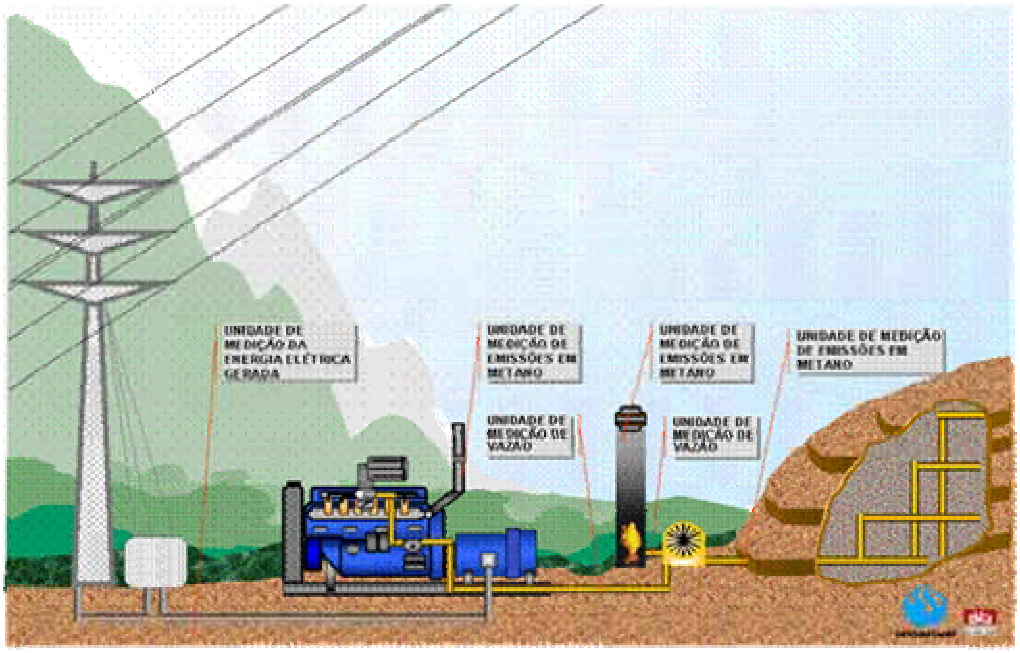
2.1 Burning and power generation equipment

Two integrated biogas burning systems will be implemented, one of which will be destined to the landfill at Marambaia, which is to be recovered, and the other, to the landfill at Adrianópolis, which is has recently begun operating.
In the first case, the integrated system is fitted with a burning unit (flare stack) with a capacity of 1500 cu. m/ h and a power generator of 1 MW/ h.
In the case of the Adrianópolis landfill, the integrated system is fitted with a burning unit (flare stack) with a capacity of 2000 cu. m/ h and a power generator of 1 MW/ h.
All of the fittings and services necessary for the implementation described below (item 7) are included in each system.

2.1.1- OPERATING CHARACTERISTICS OF THE PROPOSED SYSTEMS

The operating characteristics of the system are basically the same in both cases: the gas is captured from the landfill by a pump that simultaneously feeds both

consumption devices, that is, the atmospheric burner (flare stack) and the engine-generators.



The system is fitted with monitoring devices to control biogas leaks, CH4 emissions and generated power. Both types of units operate continuously and provide data that are logged and stored by means of specific software applications. This enables permanent queries as well as the generation of virtually real-time reports due to the traceability allowed by such measurements.

The specific software will directly convert the values obtained into carbon credits while the electricity measuring unit reads and records the amount of energy generated. This allows the prompt management of data and the readily availability of outputs obtained over a certain period.

These data are available by means of a supervisory control center connected to the software application in order to transmit the data through the INTERNET and thus enable remote queries.

Additionally, the engine-generators may also be remotely operated by the same process, in accordance to the most relevant operating standards. At the same time, the operator will be permanently connected to issue reports and detect preventive, overall and corrective maintenance needs.

In order to provide real time images of the facilities, also through the Internet, the plant is fitted with strategically located cameras.

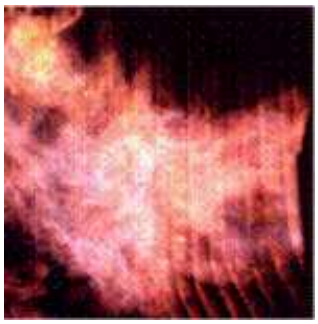
This set of data high-speed transmission and accuracy tools not only adds enhanced operating reliability to the systems but also ensures full reliability to the acquirers of carbon credits related to the supplied electricity, making the related activity solid, serious and unquestionable.

2.2. EQUIPMENT AND SERVICE SPECIFICATIONS

2.2.1 MARAMBAIA LANDFILL

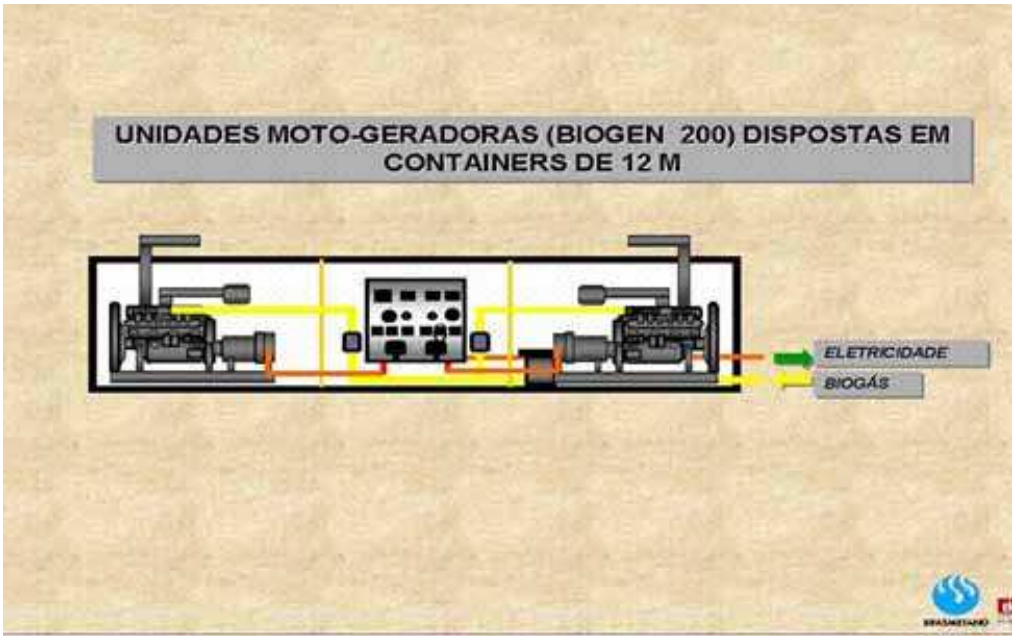
2.2.1.1. Equipment

2.2.1.1.1 Biogas burning unit



- Open monoblock frame to support the parts
- Stainless steel burner tips
- Carbon steel fan
- Flame arrester
- Valve boss
- Knock-out pot
- Twelve-meter high flare stack, fitted with fans, burner tips, thermal insulation, lockout and safety valves, etc.
- Blower to feed the flare stack, designed to simultaneously feed the power generators
- Analog electric control panel
- Built-in pneumatic electric network run on biogas and LPG
- Compressed air supply unit
- Fully automatic LPG pilot burner with an output of up to 60,000 Kcal/ h
- Subunits for leak control and detection, and for biogas methane content qualitative analysis
- CH methane emission monitoring units for separate, intermittent and non-integrated readings
- Integrated leak monitoring unit

2.2.1.1.2 1 MW/ H Power Generator.



- 5 engine-generators with a regular capacity of 200 kW/ h.
- 5 switchboards for engine and generator operation and control.
- 1 booster to feed the engines.
- 1 Subunit for working in parallel with network,
- 1 Subunit for biogas dewatering
- 1 Subunit for control and safety.
- 3 12-meter long containers, plus fittings (remanufactured), to hold engine-generators
- 1 set of basic spare parts for maintenance tasks.
- Transformer

2.2.1.1.3 Auxiliary Subunits (GENERATORS)

- 1 container measuring 12 meter in length (remanufactured):
- Maintenance center,
- Operating office.
- Operating control room
- 2 restrooms (Men' and women's).
- 1 recreational room.
- Built-in electric network interconnecting all of the sections within the integrated system
- Hydraulic network interconnecting all of the sections within the integrated system.
- Biogas network interconnecting all of the sections within the integrated system. It is fitted with control, lockout and flare arresting valves.

2.2.1.1.3.1 Remote control auxiliary subunits – Burning Unit and Generator (Optional)

- Supervisory control center for monitoring and controlling tasks, fitted with external connections for data transmission.
- Integrating hardware,
- Software for compatibility and operation of sections and external communication,
- Remote monitoring of strategic sections.
- Remote monitoring by strategic real time images of the sections within the integrated system during operation.
- Fire prevention.
- Main transformer
- 1 central synoptic panel to monitor the entire integrated system.
- Central monitoring unit with data analysis and on-line transmission functions for the entire integration system (burning unit and generator)

2.2.1.2 Marambaia landfill services.

2.2.1.2.1 Biogas burning unit

- Design and supply of the integrated system basic project, as built drawings upon completion of installation.
- Design and supply of electric, hydraulic, biogas, LPG, and compressed air facilities, as built drawings upon completion of installation.
- Development of the specific application project for all of the units comprised in the system,
- Mounting of burning unit and generator, and pre-operating testing of generators at our plant,
- Installation of all of the parts comprised in the integrated system as described above,
- Pre-operating tests of all of the system's components subsequent to the installation on site.

2.2.1.2.2 1 MW/ H Power Generator

- Design and supply of the integrated system basic project, as built drawings upon completion of installation.
- Design and supply of electric, hydraulic, biogas, LPG, and compressed air facilities, as built drawings upon completion of installation.
- Development of the specific application project for all of the units comprised in the system,
- Mounting of burning unit and generator, and pre-operating testing of generators at our plant,
- Installation of all of the parts comprised in the integrated system as described above,
- Pre-operating tests of all of the system's components subsequent to the installation on site.

2.2.2 ADRIANÓPOLIS LANDFILL

2.2.2.1 Equipment

2.2.2.1.1 Biogas burning unit.

- Open monoblock frame to support the parts,
- Stainless steel burner tips
- Carbon steel fan
- Flame arrester
- Valve boss
- Knock-out pot,
- Twelve-meter high flare stack, fitted with fans, burner tips, thermal insulation, lockout and safety valves, etc.
- Blower to feed the flare stack, designed to simultaneously feed the power generators.
- Analog electric control panel,
- Built-in pneumatic electric network run on biogas and LPG.
- Compressed air supply unit.
- Fully automatic LPG pilot burner with an output of up to 60,000 Kcal/ h
- Subunits for leak control and detection, and for biogas methane content qualitative analysis.
- CH methane emission monitoring units for separate, intermittent and non-integrated readings.
- Integrated leak monitoring unit.

2.2.2.1.2. 1 MW/ H Power Generator

- 5 engine-generators with a regular capacity of 200 kW/ h.
- 5 switchboards for engine and generator operation and control.
- 1 booster to feed the engines.
- 1 subunit for working in parallel with network,
- 1 subunit for biogas dewatering
- 1 subunit for control and safety.
- 3 12-meter long containers, plus fittings (remanufactured), to hold engine-generators
- 1 set of basic spare parts for maintenance tasks.

2.2.2.1.3 Auxiliary Subunits (GENERATORS)

- 1 container measuring 12 meter in length (remanufactured):
- Maintenance center,
- Operating office.
- Operating control room
- 2 restrooms (Men' and women's).

- 1 recreational room.
- Built-in electric network interconnecting all of the sections within the integrated system
- Hydraulic network interconnecting all of the sections within the integrated system.
- Biogas network interconnecting all of the sections within the integrated system. It is fitted with control, lockout and flame arresting valves.

2.2.2.1.3.1 Remote control auxiliary subunits – Burning Unit and Generator (Optional)

- Supervisory control center for monitoring and controlling tasks, fitted with external connections for data transmission.
- Integrating hardware,
- Software for compatibility and operation of sections and external communication,
- Remote monitoring of strategic sections.
- Remote monitoring by strategic real time images of the sections within the integrated system during operation.
- Fire prevention.
- Main transformer
- 1 central synoptic panel to monitor the entire integrated system.
- Central monitoring unit with data analysis and on-line transmission functions for the entire integration system (burning unit and generator)

2.2.2.2 ADRIANÓPOLIS Landfill services

2.2.2.2.1 Biogas burning unit

- Design and supply of the integrated system basic project, as built drawings upon completion of installation.
- Design and supply of electric, hydraulic, biogas, LPG, and compressed air facilities, as built drawings upon completion of installation.
- Development of the specific application project for all of the units comprised in the system,
- Mounting of burning unit and generator, and pre-operating testing of generators at our plant,
- Installation of all of the parts comprised in the integrated system as described above,
- Pre-operating tests of all of the system's components subsequent to the installation on site.

2.2.2.2.2. 1 MW/ H Power Generator

- Design and supply of the integrated system basic project, as built drawings upon completion of installation.
- Design and supply of electric, hydraulic, biogas, LPG, and compressed air facilities, as built drawings upon completion of installation.
- Development of the specific application project for all of the units comprised in the system,
- Mounting of burning unit and generator, and pre-operating testing of generators at our plant,
- Installation of all of the parts comprised in the integrated system as described above,
- Pre-operating tests of all of the system's components subsequent to the installation on site.

2.3- Civil works infrastructure

- Flooring (asphalted or cemented 250-sq-m area to support a maximum load of 1 kg/ sq. cm, and high voltage box to install the transformer, whose dimensions will be furnished within the basic project.
- Lighting of this area.
- Drinking water for restrooms.
- Telephone line.
- LPG supply station (lease for use),
- Maximum electricity output of 112 kW on 220/ 380 V.
- Equipment transportation.
- Winches to unload and assemble the equipment.
- Lightning arrester to protect the entire area.
- Biogas pipeline to be connected to the main blower of the integrated system.
- External electricity network interconnecting all of the sections.
- Capturing network with valve seats, with biogas sampling points.

2.4- GAS EMISSIONS AND CHARACTERISTICS OF GENERATED POWER

The gases emitted from biogas burning will be released directly into the atmosphere, at a height of 12 meters in the burning unit and of 3 meters in the generator.

13.6 or 25.0 kW, 60 Hz high voltage electricity system will be implemented in a suitable box, fitted to the integrated system.

APPENDIX B

Pictures of the new landfill – Adrianópolis

1. Pictures taken in April, 2003

2. Pictures taken in May, 2003

3. Pictures taken in April and September, 2003 – gas drainage system

Pictures of the old open dump – Marambaia

1. Pictures taken in May, 2000 and April, 2003

2. Pictures taken in August, 2003, during recovery works

APPENDIX C

OPINION SURVEY ON THE OPEN DUMP REMEDIATION AND THE IMPLEMENTATION OF THE NEW NOVA IGUAÇU SANITARY LANDFILL WITH ENERGETIC USE OF METHANE GAS
FEBRUARY/ 2003

1 PRESENTATION

The Brazilian Association of Environmental and Sanitary Engineering (Associação Brasileira de Engenharia Sanitária e Ambiental), Rio de Janeiro Section – ABES-Rio, was contracted by Novagerar Ecoenergia Ltda. to implement an Opinion Survey on the Open Dump Remediation and Implementation of the new Nova Iguaçu Sanitary Landfill, both projects including an Energetic Use of Methane Gas.

The Opinion Survey used specific questionnaires as investigation tool. These questionnaires aim different target-population which are: public segment departments, non-governmental organizations and associations, private enterprises and international entities connected to the solid waste issue, aiming to obtain an homogenous opinion about the energetic use of methane gas from the biodegradation organic matter present in the solid waste mass disposed as Open Dump and/ or Landfills.

2 OBJECTIVE

The survey aimed to analyze the opinion of the scientific-technical community, together with non-governmental organizations from "Baixada Fluminense" (coastal lowland region of the State of Rio de Janeiro) that work in the Environmental Sector, society organizations from the landfill surroundings and also the private and public segments related to that sector, on the issue of energy generation from the energetic use of methane gas that comes from the biodegradation of organic

matter present in the solid waste mass disposed at Adrianópolis Sanitary Landfill and at Marambaia Open Dump.

3 METHODOLOGY

The adopted methodology was comprised of three stages, as it follows:

Stage 1 covered the identification of different groups, entities and/ or individuals that formed the survey's target population.
At first, it was identified sub-groups that would cover the institutions that take part in the survey. They are:

- Public Sector;
- Non-Governmental Organizations;
- Private Sector of the Solid Waste, Energy or Gas area;
- International Entities;
- Wastepickers (scavengers) Associations*.

Then, the institutions that formed each sub-group were identified, according to the following criteria:

- Groups that directly or indirectly, might affect or be affected by the Project;
- Groups with a role to play in the Project and their capacity to play it;
- Groups, which occasionally negative responses to the project, might strongly influence it.

The city, state and national institutions with the headquarter in Rio de Janeiro Metropolitan Region, besides the international institutions with the headquarter in Brazil were defined as the sample universe of the survey.
The quantity of entities that took part in the analysis might be different from the quantity initially forecasted at the Survey planning. The addition of new entities is due to the lack of responses by some entities questioned, or to the interest that the question raised during the process.

During the planning stage of this Survey, 34 entities were identified and contacted:

Stage 2 was the definition of the strategy to contact the entities. Then, it was decided for the personal and separate interviews for each entity that formed the target-population, using standardized questionnaires, especially elaborated for each one of the five sub-groups.

Before the questionnaires were applied, there was always a speech about the enterprise, explaining the Adrianópolis Landfill, the Marambaia open dump recovery and the project of biogas energetic use and the reduction of greenhouse gases.

The personal contact has been used to clarify occasional doubts expressed by the interviewees, assuring a more effective result.

In order to elaborate the questionnaires, it was considered:

- The expectation of the entity concerning the project;
- The identification of the benefits that the entities might receive from the project;
- The identification of the entity's interests that might conflict with the project;
- The resources (physical or financial) that the entities should use to execute the project;
- The entity's knowledge about environmental and sustainable development issues involved in the project;
- The interest of the entity in setting partnerships or cooperation agreements with other entities;
- The attitude changes that the project might demand from the entity

Stage 3 was the interviews tabulation and the elaboration of the sub-sectorial charts and demonstrative graphics.

From the 34 entities initially contacted, one preferred not to make declarations about the issue and 14 did not respond to the several requests for appointment or for filling in the suitable questionnaire. After adding new entities, which were representative of the Public Sector and of the scavengers associations, the final number of interviewees was 25, distributed as it follows:

- Public Sector - 11
- Non-Governmental Organizations - 3
- Private Sector in Energy and Gas area - 2
- International Entities - 2
- Scavengers Representatives - 7

The Survey Application

The survey was executed thought the application of specific questionnaires in each sector defined as target population, totalizing 25 (twenty five) interviews, as it follows: public sector-11 (eleven); NGO 3 (three); scavengers associations 7 (seven);

international entities 2 (two) and private sector 2 (two); during a 03 (three) week period, with one researcher responsible for each segment to be analyzed, totalizing 05 (five) researchers.
In appendix 5, it is presented the example of questionnaires applied in each civil society segment.
When the field work was concluded, the tabulation stage was carried out, resulting into a data bank, by types of responses to the subjects that comprised the questionnaire, according to the five segments of the organized civil society, defined as target population.

After that, in February 2003, it was researched 79% of the total universe of scavengers from Marambaia Open Dump, totalizing 70 people from the 89 previously registered.

The results obtained were:

All of them declared to keep that activity due to the lack of alternatives in the formal job market and/ or to complement the family income.

It was verified that 100% of them live in the Open Dump surroundings and all of them believe that there will be an environmental improvement with the closing of "Marambaia" and the operation of Adrianópolis Treatment Center.

Nevertheless, the fear of the scavengers community is to lose the financial gain.

During the explanation about the undertaking, we tried to highlight the use of biogas for electric energy generation and the reduction of greenhouse gases. The population of scavengers is not opposed to the project, but point out that the project, as a whole, has to generate jobs and income.

All the scavengers point out a possible way to implement a Cooperative.

Below, the graphic shows the percentage of scavengers who think that there will be improvement in working conditions (88%) and those ones who do not believe in that improvement (12%).

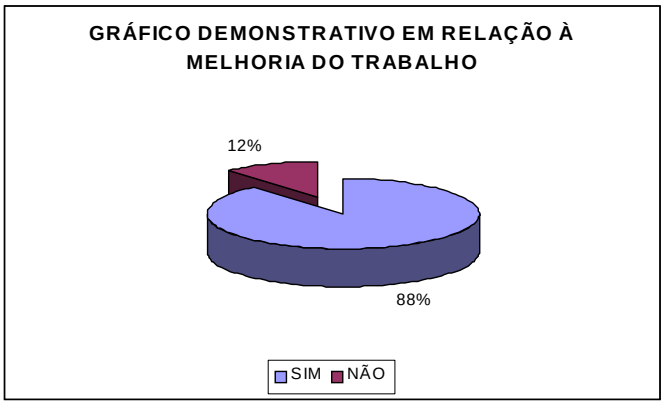


FIGURE 12 Public Opinion – Results about better job quality due to the project

The segment reported hopes the undertaking to be another job creator, besides searching for the environmental conditions improvement.

6 CONCLUSION

The conclusive comments are presented below, according to the civil society segments considered as "opinion makers" concerning to the Open Dump Remediation and Implementation of Nova Iguaçu Sanitary Landfill, with Methane Gas Energetic Use.

PUBLIC SECTOR DEPARTMENTS

The project beneficiaries will be, in the majority, the population and the society and the greatest contribution of the project will be the global effort to fight against the climatic change.

The qualification/ generation of knowledge aiming the quality of life/ environment improvement will be the most important environmental social-economical factor.

The most likely effects to occur are the compensation for the environmental liability for greenhouse gases emissions in Brazil and the incentive for the production systems that generate environmental services to the global society.

The criteria of carbon sequestration that are most suitable for a definition of sustainable development are the reforestation and the use of alternative fuel.

The actors should be informed before the implementation. Most of these actors have little knowledge about the project, so that the pedagogical awareness is the best methodology for the local community to get to know the project.

The possibility of regional integration and articulation to other segments will be higher with the creation of a model of energy recycling and its expansion to other regions.

The community will be an active partner and the contribution to this community will imply exchange. Job-generation is the activity proposed by the executers that most generates income and most of them think that no action or influence will dissatisfy the community in the surroundings.

NON GOVERNAMENTAL ORGANIZATION

The population will be the project's greatest beneficiary and the best contribution will be the promotion of green energy generation.

The most important environmental social-economical factor will be the qualification/ generation of knowledge aiming the quality of life/ environment improvement.

The compensation to the environmental reliability for greenhouse effects in Brazil, the incentive for production systems that generate environmental services to the global society, the qualification/ generation of knowledge aiming the quality of life/ environment improvement and the awareness of a sustainable model are the most likely effects to occur.

The actors who need to be informed are the residents´ association and the local Public Power. The best methodology for the local community to get to know the project will be through the project presentation in the media and communitary centers.

The possibility of regional integration and the articulation to other segments will be higher with the development of environmental awareness.

The community will be an active partner and the contribution of the project to the local needs will be through the solid waste separation, checking the interests of the

community and the awareness about a single sustainable model. The last one will always require some kind of exchange.

The environmental credibility for the city will be the greatest advantage for the local/ environmental infrastructure. When implementing the project and in the opinion of the majority, no action or influence will dissatisfy the community in the surroundings.

SCAVENGERS ASSOCIATION

The local community will be the greatest beneficiary with the implementation of the project, due to the increase in jobs.

The Public Power positioning will happen with the increase in jobs, the increase in the quality of life and the conversion of the environmental liability for the greenhouse effect to investing countries.

The reduction of methane gas emission to the atmosphere and the introduction of renewable energy are the criteria of projects for carbon sequestration that are most suitable for a sustainable development definition.

The regional integration and the articulation with other sectors in the implementation of the project will happen with the development of the environmental awareness and the creation of a model of energy recycling and its expansion to other regions.

The relative increase in jobs will be the greatest advantage for the environmental infrastructure resulting from the implementation of a project of that dimension.

PRIVATE ENTERPRISE

The beneficiaries of the project will be in the majority the population, the City government and the entrepreneurs. The greatest contributions of the project will be the global effort to fight against the climatic change and the improvement of the company's image in Brazil.

The most important environmental social-economical factor will be the qualification/ generation of knowledge aiming the improvement of quality of life/ environment.

The captivation of investments and currency for the region, the qualification/ generation of knowledge aiming the improvement of quality of life/ environment and the quantity of jobs generated will probably be the most likely effects to occur.

The criteria of carbon sequestration that are most suitable for a definition of sustainable development are those, which are environmentally, correct, socially fair and e economically feasible.

The public organs, as well the society, have to be informed before the implementation, and the best methodology for the local community to get to know the project will be through speeches, presentations, information dissemination and democratization.

The creation of an energy recycling model and its expansion to other regions increase the possibility of regional integration and the articulation to other segments.

The community will be an active partner, mainly if it gets to know the project well, and in the opinion of half of the interviewees, problems with odor and risks of accidents and explosions might dissatisfy the community in the surroundings.

The participation of the private sector will be extremely important, together with the State and the tax benefits for the companies.

INTERNATIONAL ENTITIES

The population will be the project's greatest beneficiary and the major contribution will be the global effort to fight against the climatic change.

The increase of income of workers/ producers directly involved will be the most important environmental social-economical factor.

The incentive for production systems that generate environmental services to the global society, the qualification/ generation of knowledge aiming the improvement

of quality of life/ environment and a sustainable model awareness are the most likely effects that will probably occur.

The actors that have to be informed are the residents´ association, the local Public Power, the scavengers association and the community. The environmental education is the best methodology for the local community to perceive the project.

The search for partnerships in order to promote dynamism in the sector, as well the shared management to generate energy and the development of environmental awareness, will be the most important factors to enable the regional integration and the articulation to other segments.

The community might be an active partner, depending on the leadership.
The project contribution to the local needs will be selective collection, workshops and courses. That contribution will always be connected to clear and perceptible exchanges.

The greatest advantages for the local/ environmental infrastructure resulting from the project implementation will be the increase in local jobs and the contribution in reducing the greenhouse effect.

There will not be actions intrinsic to the project that might dissatisfy the local community. The perception of non-appropriate actions might emerge from the community distrust in the clearness of actions, due to the level of its member's unknowingness. On the other hand, even when knowing the project's actions, if those actions are not well executed, the local community might be dissatisfied.

* Wastepickers or scavengers – Called "Catadores" in Portuguese, they are the people who pick up recyclable material in the landfills or in the streets.