CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>> AESA Misiones (Proactiva Group) Sanitary Landfill Gas capture and flaring project- version 0, February 2007.

A.2. Description of the project activity:

>> The purposes of this project are the landfill gas (LFG) capture and flaring **at the Fachinal sanitary landfill**, located in the Province of **Misiones**, Argentina, which is to be performed **within the scope of a CDM procedure** conducted in the manner prescribed by the Kyoto Protocol, and certifying the reduction of CO_2 emissions. Such rights, once marketed, will render income that will serve to promote other Sustainable Development projects in the same Province.

The Sanitary landfill began to operate in 2001 as a part of the comprehensive waste management plan launched by the Province of Misiones, and has disposed of about 375,000 tonnes of waste to date. The sanitary landfill is used for the safe and controlled final disposal of urban solid waste from 12 Transfer Stations located throughout the Center-South area of the Province, comprising 21 townships and a population of about 437,000.

The sanitary landfill operation is performed by disposing, compacting and covering solid waste in cells with a liner system. The latter comply with all the design standards as necessary to ensure proper management of the generated waste, gases and leachate. The sanitary landfill is also provided with all the infrastructure, machinery and manpower necessary to achieve optimum results in the management of waste and its derivatives.

Figure 1: View of Fachinal Sanitary landfill

This project will be developed **between** the Ecology Ministry of Misiones on behalf of **the Government of the Province of Misiones**, and the operator of the sanitary landfill concession, **AESA Misiones S.A.**, a subsidiary of Proactiva Medio Ambiente, a company specialized in comprehensive water and waste management. Proactiva Medio Ambiente, in turn, is the result of a joint effort between two global groups specialised in environmental services: Fomento de Construcciones y Contratas (FCC, Spain, www.fcc.es) and Véolia Environnement (France, www.veoliaenvironnement.com/), and has delegations and local companies in various countries in Latin America: Mexico, Venezuela, Colombia, Brazil, Chile and Argentina

Proactiva provides waste management services to 7,100 industrial clients and 90 municipalities that account for 26 million people. To offer integrated solutions to its clients, Proactiva has developed advanced know-how covering the full spectrum of waste management activities: municipal solid waste collection, industrial waste recycling, sanitary landfill construction and operation, waste final disposal, urban cleaning, hospital waste collection and treatment and operation of waste transfer plants.

Present in 6 countries in South America, Proactiva operates 13 sanitary landfills that treated 5.5 million tonnes of waste in 2005. All of these sanitary landfills are equipped with safe and modern systems for treatment and final disposal of solid waste: liner systems, stormwater drainage, leachate collection and treatment, best practices for passive landfill gas venting, monitoring of surface and groundwater.

AESA Misiones will be responsible for all the investments and operating costs necessary to perform the project within the Clean Development Mechanism. Any net revenue from the sale of

CERs will be shared with the Province, so the latter can implement **Sustainable Development projects** within the province such as sewage system extensions and increased paved-street areas. The completion of the project will **contribute** to **Sustainable Development** by improving environmental and operating management of the sanitary landfill beyond current legislation requirements, and at the same time will reduce emissions of Greenhouse Gases (GHGs) and their associated global warming effect.

The **technology** used by the project activity includes the installation of enhanced landfill gas extraction and flaring equipment for the destruction of the landfill methane that will be collected from the existing and future disposal areas instead of releasing it to the atmosphere.

The extraction system will consist of a network of HDPE gas wells connected to a main collector. The gas will be driven to the flare thanks to a blower and then flared. The flare will be enclosed allowing the full combustion of methane at high temperature.

This kind of projects entails a large number of benefits to consider in the project evaluation, like:

Environmental Benefits:

Capturing and flaring landfill gas is an effective way of preventing the emission of methane into the atmosphere, thus reducing the release of gases having a potential greenhouse effect, and therefore minimizing contribution to global warming. Besides, this technology permits extracting and channeling the gases generated within the sanitary landfill, accordingly increasing the sanitary landfill stability.

In addition, flaring of the collected LFG does not only destroy methane, but will also destroy compounds in the LFG such as volatile organic compounds and ammonia. This gas management technique will decrease the emission of gases to the atmosphere, thus improving air quality in the surrounding area.

Social Benefits:

Recovering and flaring landfill gas with an active system will not only contribute to the mitigation of climate change, but also to the improvement of health and quality of life in the neighbouring area. Beyond environmental benefits, this project will also support the local economic development by reason of technology transfer and local employment creation.

In addition, the sale of CERs earned by implementing the project will generate a substantial flow in foreign currency to the Province of Misiones. This income will be shared with the Government of the Province to promote new sustainable-development projects.

Technology transfer:

The project will be a vehicle for technological development in the Province, and will permit the engagement and formation of specialists and new projects referred to the capture and use of the landfill gas, so as to disseminate this type of technology. This project will promote new projects within the Clean Development Mechanism at the national and provincial level.

Taking into account the improvements in social, economic, environmental and technological well-being that the project activity is potentially able to offer, the project participants AESA Misiones SA, the Government of the province of Misiones, Proactiva Medio Ambiente and Veolia Propreté are convinced of the positive and long-term contribution of the CDM to sustainable development in Province of Misiones and, more widely, in Argentina.

This Project is an important example of public and private collaboration for the promotion and contribution to the Sustainable Development of the Province of Misiones.

A.3. Project participants:

>>The project participants are named and described below. For more detailed contact information please refer to Annex I in this document.

Name of Party Involved(*) ((host) indicates the host party)	Private and/or public entity(ies) participating in the Project (*) (as applicable)	Kindly indicate if the party involved wishes to be considered as a Project participant (Yes/No)
Argentina (Host Country)	-AESA Misiones (private entity) -Proactiva Medio Ambiente Argentina (private entity), as the parent company of AESA Misiones.	No
	Ministerio de Ecología, Recursos Naturales Renovables y Turismo del Gobierno de la Provincia de Misiones (public entity)	
Spain	Proactiva Medio Ambiente (private entity)	No
France	Veolia Propreté (private entity)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

>>

A.4.1.1. Host Party(ies):

>> Argentina

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

>> Province of Misiones

A.4.1.3. City/Town/Community etc:

>> Fachinal

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

>> The Fachinal Sanitary landfill associated to the project activity is located in the Municipality of Fachinal, Province of Misiones (Argentina), 37 kilometres by road from Posadas, the capital city of the Province. The entrance is on the so-called *Acceso Fachinal* access on provincial route 205, 2,500 meters from the intersection with national route 105.

The sanitary landfill facilities are located on an available area of 100 hectares and are bounded on the north by provincial route No 205, on the west by the creek *Arroyo Naranjo*, on the east by a 15 meter-wide public street and on the south by adjacent properties.

Figure 2 Aerial View of the Fachinal Sanitary landfill

The following map illustrates the location of the Sanitary landfill within Argentina

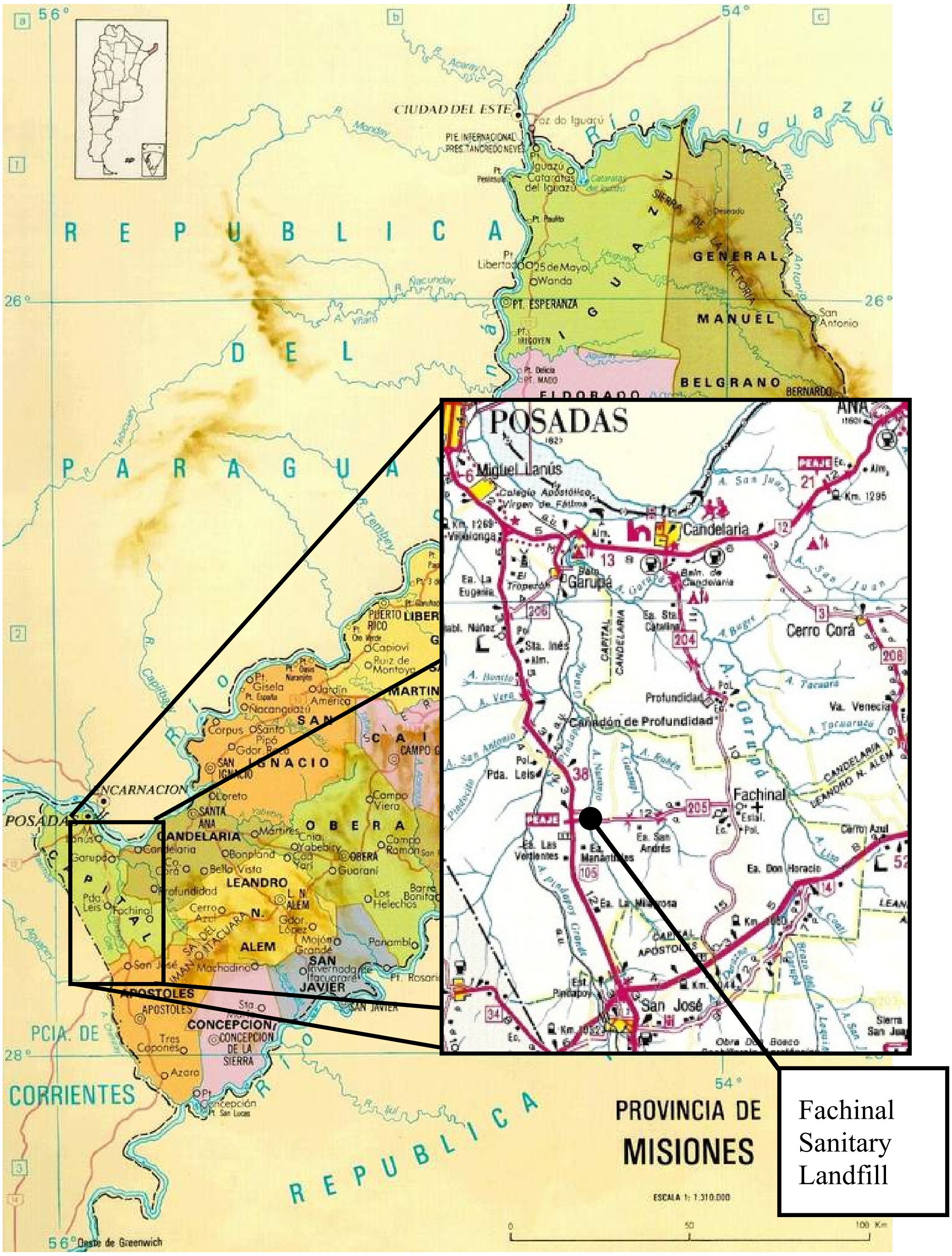


Figure 3: Location of the Fachinal Sanitary landfill.

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

>> Waste Handling and Disposal

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

>> The Fachinal Sanitary landfill constitutes a secure and controlled disposal site for the urban solid waste produced and collected in the centre and the south area of the Province of Misiones. To achieve a better quality of service, the sanitary landfill is composed of several operative units, called cells. Each cell is 220 meters long, 55 meters wide and with a net height between 4 and 11 meters. These dimensions allow each cell to receive approximately 70 000 tonnes of waste.

The cells have a liner system that prevents leachate from migrating outside, as a containing barrier. The liner system of the base and the interior slope was improved as provided under the contract requirements. Such a cell liner system is currently composed of a triple protection barrier with, from the bottom to the top:

- 50 cm of natural clay compacted up to $k=10^{-7}$ m/s.
- A 6 mm-thick "sandwich" of geotextile - bentonite
- A 1500 µm-thick HDPE geomembrane

The final cover will combine a layer of compacted clay 40 cm thick, 20 cm of soil from the site and reinforced with a continuous sheet of 800 µm-thick PE between the layers mentioned above .

Figure 4: Geomembrane installation on cell 3

The landfill gas capture and flaring project will improve the operation of the gas collection system. The **technology** to be used is based on a system that includes vacuum collection and conveyance, measurement, analysis and flaring of the resulting landfill gas.

Initially, the project will be implemented so as to permit the extraction of the generated landfill gas from three cells that are currently closed with a final cover in place, Then, it is expected that, as new cells are closed in the Sanitary landfill operation, they will also be included in the system. **The system comprises four subsystems**:

Collection subsystem: consisting of a group of wells, distributed over the closed cells, which are used to extract the landfill gas from within the sanitary landfill.

Vacuum extraction and conveyance subsystem: formed by a piping network and a blower, permitting the flow of landfill gas from the collection wells to the flaring subsystem. The circuit includes condensate traps designed to remove water vapour that might be contained within the landfill gas.

Measurement/analysis subsystem: installed between the vacuum extraction/ conveyance subsystem and the flaring subsystem, in order to give accurate and valid readings of the volumes of methane to be flared. It consists of a fixed and approved flow meter, which integrate landfill gas pressure and temperature, in order to provide a direct reading of the normalised landfill gas flow fed to the combustion subsystem. The value is expressed in Nm^3 under Normal Conditions (NTP). In addition, there is a continuous gas analyzer that, used under the specific monitoring plan, will permit determining the proportion of methane, carbon dioxide and oxygen in the landfill gas to be flared and the proportion of methane and oxygen in the exhaust gases of the flare. These measurements will be used according the monitoring plan in order to determine the exact quantity of methane passing through the flare and combusted.

Flaring subsystem: including equipment appropriate for the combustion of landfill gas, with an enclosed flare, specifically designed to fulfil the project requirements, which will ensure a burning efficiency above 97% at all times. The flare will be provided with automatic monitoring and control equipment.

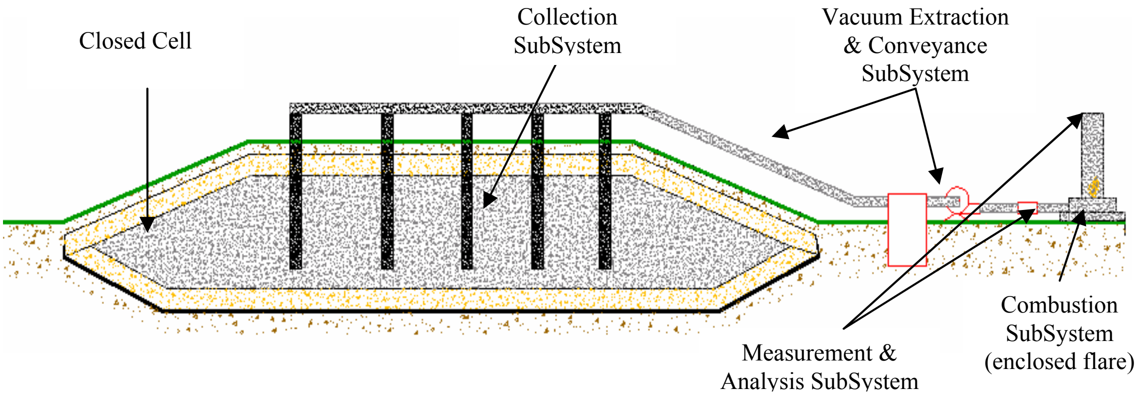


Figure 5: Diagram of the landfill gas Capture and Flaring System

By implementing these improvements at Fachinal Sanitary landfill, AESA Misiones SA, Proactiva Medio Ambiente and Veolia Propreté will transfer their know-how and experience with these systems to the local team. Numerous training programs have been and will be provided in the future to our local staff. Technical support will be provided to help resolve any difficulties.

The following is a layout of the Fachinal Sanitary landfill with the vacuum extraction, flaring and measurement/analysis subsystem planned location:.

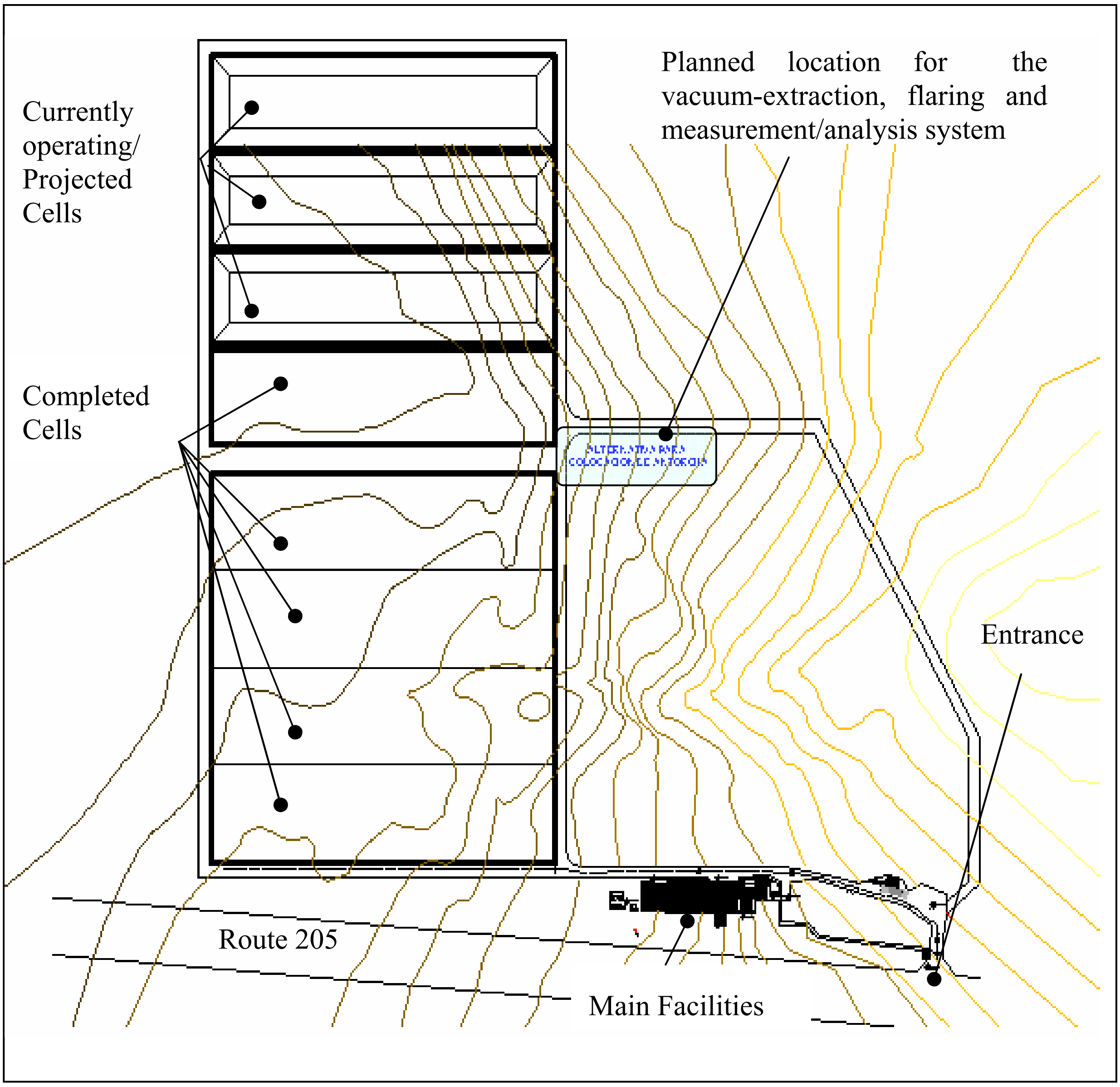


Figure 6: Location of the flaring Subsystem within the Sanitary landfill.

The following graph is a scheme of the landfill gas collection subsystem showing the well distribution in closed cells 1 to 3. This distribution could be modified in the future in order to improve the capture efficiency.

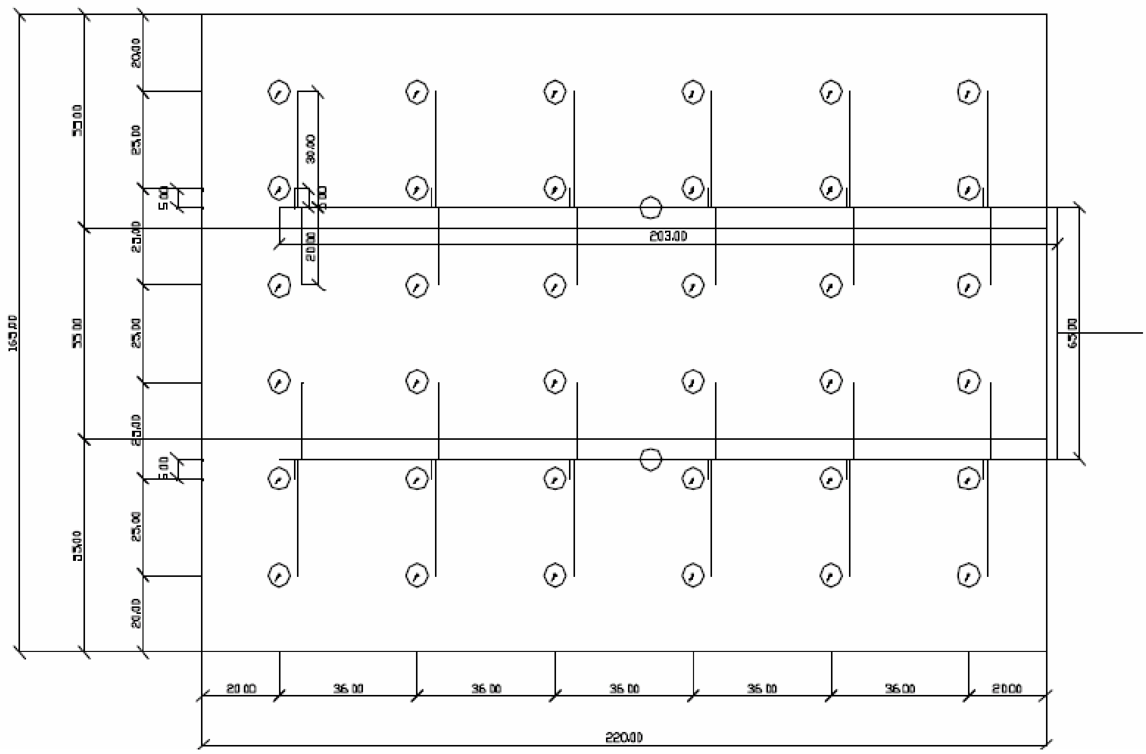


Figure 7: Conceptual landfill gas collection subsystem in closed cells.

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

>> Emission reduction estimations have been made in accordance with the ACM0001/ Version 05 methodology, and by considering a waste degrading model designated as First Order Decay (FOD), taken from the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse gas Inventories (year 2000). This methodology will be described in further detail in section B.6 of this document.

Below is a summary schedule of emission reduction estimations from September 2007 to the scheduled end date of the project crediting period (August 2017).

Year		Annual estimation of emission reductions in tonne of CO_{2e}
2007	4 months	6858
2008	12 months	24020
2009	12 months	27356
2010	12 months	30602
2011	12 months	33776
2012	12 months	36892
2013	12 months	39967
2014	12 months	43015
2015	12 months	46048
2016	12 months	49079
2017	8 months	34747
Total estimated reductions (tonnes of CO_{2e})		372361
Total number of crediting years		10 years
Annual average over the crediting period of estimated reductions (tonnes of CO_2)		37236

A.4.5. Public funding of the project activity:

>>None

SECTION B. Application of a baseline and monitoring methodology

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

>>“Consolidated baseline methodology for landfill gas project activities” – ACM0001 / Version 05 will be used in conjunction with the “Consolidated monitoring methodology for landfill gas project activities” – ACM0001 / Version 05.

According to the recommendation of this methodology, the Version 2 of the “Tool for the demonstration and assessment of additionality” and the Version 1 of the “Tool to determine project emissions from flaring gases containing methane” will be used.

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

>> This methodology is applicable to LFG capture project activities, where the baseline scenario is the atmospheric release of the landfill gas and the project activity includes the following situations:

- The gas is captured and flared.
- There is no legal or contractual requirement to burn landfill gas.

The approved monitoring methodology ACM0001 / Version 05 (“consolidated monitoring methodology for landfill gas project activities”) will be used in conjunction with this baseline methodology.

Since the project aims to install and operate a gas collection and flaring unit on a landfill, located in Argentina, a non-Annex 1 country, that has ratified the Kyoto protocol on the 28th of September 2001, and where there is no legal or contractual requirements to do so, the conditions for use of the methodology ACM0001 / Version 05 are met.

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

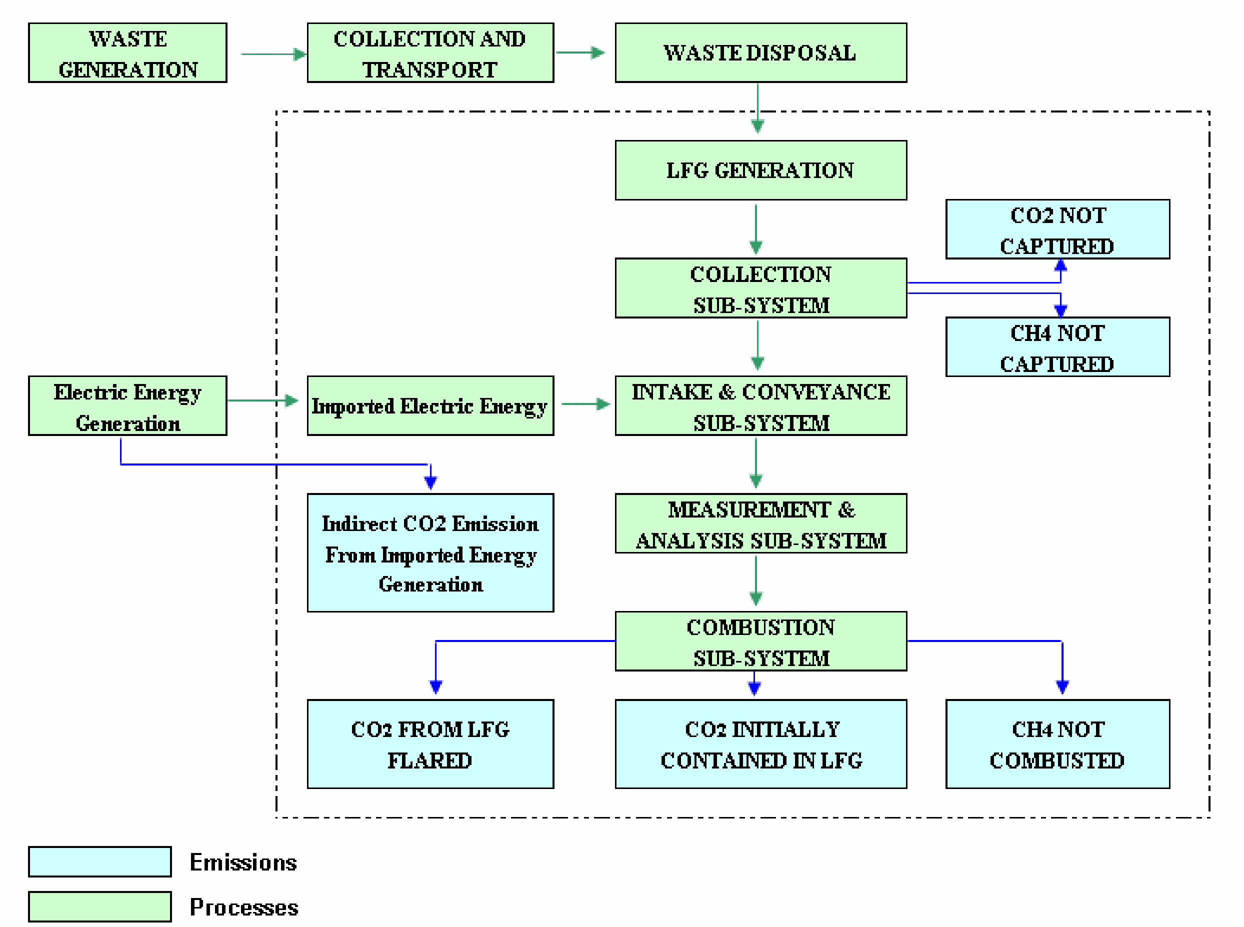
>> Landfill gas is generated by the anaerobic decomposition of disposed solid waste. It is mainly composed of two GHG: Carbon Dioxide “CO_2“ and Methane “CH_4”.

	Source	Gas	Included?	Justification / Explanation
Baseline	Landfill	CO_2	No	The emissions of CO_2 are neutral per convention since they are coming from the degradation of organic waste
		CH_4	Yes	
		N_2O	No	
	Existing extraction system	CO_2	No	No active extraction system is in place to date
		CH_4	No	
		N_2O	No	
Project Activity	Landfill	CO_2	No	The emissions of CO_2 are neutral per convention since they are coming from the degradation of organic waste
		CH_4	Yes	Remaining fugitive emissions from methane
		N_2O	No	
	Extraction system (energy blower)	CO_2	Yes	From displaced emission due to electricity consumption from the grid.
		CH_4	No	
		N_2O	No	
	Flare emissions	CO_2	No	Emissions of CO_2 generated by the waste fermentation are not taken into account
		CH_4	Yes	Unburnt methane, if any
		N_2O	No	

Under the selected ACM0001 / Version 05 methodology, the estimation will not take into account the carbon dioxide generated by the anaerobic decomposition of solid wastes disposed of at the sanitary landfill and released directly into the atmosphere, because it is part of the natural carbon balance. This also applies to the carbon dioxide resulting from the combustion of the generated methane.. Although these two gas sources are not taken into account for the calculation of emission reductions, they are considered to be within the scope of the project, as they are involved as a part of the managed landfill gas.

Although the carbon dioxide resulting from the generation of electricity used to supply the system will be negligible, as compared to the total reduction in tonnes of carbon that is expected to be achieved from the project (about 0.2 % of the total quantity), the value will be included in the project boundary and accounted in the related calculations.

Below is a flowchart indicating the different currents of greenhouse gases and the tasks involved in the normal operation of the sanitary landfill, once the landfill gas capture and flare system is installed. The scope of the project is indicated by the dotted line.



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

>> The baseline scenario has been defined as the atmospheric release of the landfill gas produced by waste in anaerobic conditions after reviewing:

- Other alternatives
- Legal and contractual obligation (existing and forthcoming)
- Current practice of waste management sector in Argentina
- Current practice on site

Identification of alternative scenarios

-Alternative 1: Current situation on site

Landfill gas within the sanitary landfill is vented into the atmosphere. Landfill gas is not flared or combusted. Landfill gas is not recovered for energy production onsite, or externally.

-Alternative 2: Implementation of landfill gas collection flaring system, without the CDM revenue

The second option is to install an active gas collection and flaring system to burn the landfill gas without considering the CDM revenue. This alternative is unlikely to happen since the system represents a significant investment and no revenue will be generated. The site has no incentive to modify its operational methods since there is no contractual or legal requirement to do so.

-Alternative 3: Production and sale of electricity or heat from landfill gas

This alternative consists of the recovery of the landfill gas energy to produce either thermal energy or electricity and sale this energy to a customer.

The alternative scenario consisting of producing electricity from landfill gas is not a plausible solution for reasons linked to the lack of maturity of this technology in Argentina and insufficient financial incentive. It is common practice to first install an active LFG capture and flaring system, to ensure that the quality, the stability and the quantity of landfill gas are compatible with the electricity generation[1.]

In addition to this we should emphasize that the landfill gas generation potential will not be high enough to support an energy development system, because of the small size of the Fachinal Sanitary landfill, and the consequently high relative investment required per MWh of energy produced. This situation could worsen due to very low prices in the Argentine energy market, and long distances to the public distribution grid or to any prospective consumers. For all these reasons, this alternative to our project is not feasible even if we consider the benefits resulting from the Clean Development Mechanism.

-Alternative 4: Collecting and selling landfill gas to final customers

This alternative consists of investing into a gas collection system and selling the gas collected to nearby final users.

[1] Similar findings and statements can be found in the *'The Landfill Gas-to-Energy Initiative for Latin America and the Caribbean'*, published by the World Bank

No final users have been identified close to the site, consequently this alternative will not be economically feasible.

Consequently, alternative 1, the continuation of current practice on site, is the only remaining plausible alternative as baseline scenario.

Legal and contractual obligations (existing or future)

The current concession contract states that AESA Misiones is responsible for the management of derivatives of the disposed wastes, including the gases generated by the anaerobic decomposition. The contract does not specify any restriction whatsoever to the way of performing such management. There is no indication that this might change in the future.

Current practice of waste management sector in Argentina

Today, the urban waste disposal sites in Argentina can be classified in two groups[2]:

- Uncontrolled tipping sites: This type of disposal site is predominant in Argentina. The lack of technical and environmental work and controls causes a significant damage to the Environment and Human Health. These sites do not have any system whatsoever for the management of waste decomposition gases.

- Sanitary landfill sites: They are found in strategic locations and represent a minority of the total number of final disposal sites in Argentina for Urban Solid Wastes. These sites do all the necessary work to provide a final and sanitary safe solution for the deposited wastes. These sanitary landfills most usually have passive venting systems where landfill gas is conveyed and released into the atmosphere. The low cost, the simplicity, the lack of regulation enforcing another practice, and the acquired experience using this landfill gas management system, has made it common practice in sanitary landfill sites in Argentina. There are, however, a few projects involving the capture and flare of landfill gas under development, mostly situated in the province of Buenos Aires. All of these projects are being considered under the context of the Clean Development Mechanism.

Without the revenue generated by the sale of the CER´s, the situation will not change since there is no expected commercial usage of landfill gas nor any forthcoming new laws or regulations on the subject.

[2] Similar findings and statements can be found in the document "*Estrategia Nacional para la Gestión Integral de Residuos Sólidos Urbanos*" (ENGIRSU) published by the SAyDS (September 2005)

www.ambiente.gov.ar/archivos/web/**ENGIRSU**/File/Resmen%20Ejecutivo%20de%20la%20**ENGIRSU**.pdf

Current practice on site

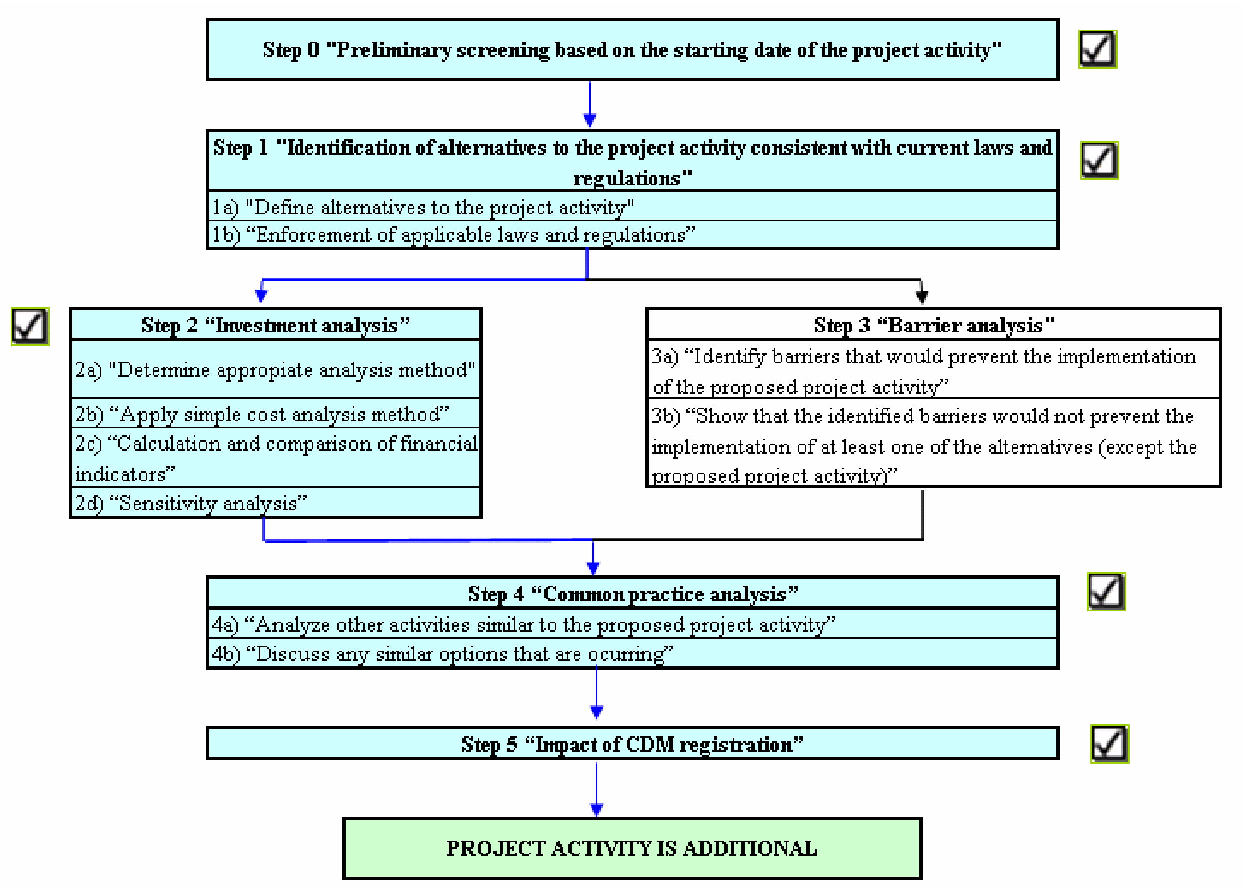
Currently there are two sanitary landfills installed in the province of Misiones: the south sanitary landfill located in the Fachinal municipality (foreseen for the waste disposal of about 200 ton/day) and the north sanitary landfill located in the Aguas Blancas locality (foreseen for the waste disposal of about 100 ton/day).

The two sanitary landfills installed in the province of Misiones, at present, have a gas management and control system that uses a passive venting system. No flaring is practised.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality): >>

A landfill gas capture and flaring system as foreseen by the project requires a large initial investment without any type of economic income during its operating phase. Approval and registration of the project within the Clean Development Mechanism (CDM), and the related certification and sale of the resulting emission reductions, will make it possible to obtain a economic reward that will facilitate the development and installation of the project for the benefit of its participants.

In order to demonstrate the additionality of the proposed project, the methodology recommended under ACM0001 / Version 05, "Tool for the demonstration and assessment of additionality" / Version 2 is described in further detail below. This methodology proposes the following review structure:



To demonstrate the additionality we start with the Step 0 "Preliminary screening based on the starting date of the project activity", followed by Step 1 "Identification of alternatives to the project activity consistent with current laws and regulations", then Step 2 "Investment analysis". Step 3 is not necessary since this tool states that the project participant must chose between the investment or the barrier analysis to demonstrate additionality. Then, the demonstration is pursued with Step 4 "Common practice analysis" and finally Step 5 "Impact of CDM registration".

Below is the analysis of each step considered by this methodology:

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

This step does not apply to our project, because its participants do not intend to commence the crediting period prior to registration of the project.

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

Sub-Step 1a) "Define alternatives to the project activity"

The four alternatives described within the section B.4 are also applicable for the demonstration of the additionality.

As demonstrated in section B.4, alternative 1 "Current Situation" referred to the passive venting of landfill gas generated, without any capture or flaring, is the only plausible alternative.

Sub-Step 1b) "Enforcement of applicable laws and regulations"

Argentine national and provincial legislation does not provide any legal requirement with respect to the capture and flaring of generated landfill gas. Neither is there any indication that regulations on the matter will be enacted in the next decade.

There are no regulations referring to landfill gas flaring and/or combustion and no regulations are expected to be enacted over the next decade.

There is no legal requirement in Argentina which compels the operator to implement any other alternatives or which will make them unlawful

Considering this, the four proposed alternatives above and the project activity comply with all applicable provincial and national legislation and regulations and contract provisions.

Step 2 "Investment analysis"

Sub-Step 2a) "Determine appropriate analysis method"

The project will not render any financial income apart from the income derived from the Clean Development Mechanism, as the proposed technology is implemented for environmental purposes only. For this reason, the selected method will be as described below (Sub-Step 2b)

Sub Step 2b) "Apply simple Cost Analysis" (option I)

The analysis method selected for this Sub-step is the simple cost analysis because, as will be seen later on, the project does not render any financial benefit in addition to the income associated to registration under the Clean Development Mechanism.

In order to implement and register the project under the Clean Development Mechanism (CDM), it will be the responsibility of AESA Misiones S.A. to invest the necessary capital for the full development of the system. The description of the system to be used is shown in section A.4.3 of this document. The table below summarizes approximate values relating to the project:

INVESTMENT	
Gas Collection System (for 10 years)	US$ 450,000
Landfill Gas conducting, suction and analysis system	US$ 500,000
DEVELOPMENT	
CDM Development	US$ 200,000
TOTAL	US$ 1,150,000
ANNUAL OPERATION, MONITORING AND VERIFICATION	
7 % of the total investment	US$ 80,500 /year

The only financial benefit from the project is associated to the Clean Development Mechanism and results from the sale of emission reduction certificates obtained by the project.

The result of this analysis indicates that the implementation of the project is not the most attractive option from the financial viewpoint, and that it can only be performed due to the benefits associated to the registration of the project under the Clean Development Mechanism.

Sub Step 2c) "Calculation and comparison of financial indicator"

Not applicable, due to the selection of the simple cost analysis method (Option I).

Sub Step 2d) "Sensitivity analysis"

Not applicable, due to the selection of the simple cost analysis method (Option I).

Step 3 "Barrier analysis"

This step will not be necessary because the selected tool for the demonstration and assessment of additionality of the project determines that the demonstration may refer to the fulfilment of the guidelines in Step 2 "Investment Analysis" or those in Step 3 "Barrier Analysis".

The project reviewed herein has already shown that it complies with the requirements in Step 2 "Investment Analysis".

Step 4 “Common practice analysis”

Sub Step 4a) “Analyze other activities similar to the proposed project activity”

Landfill gas generation and emission is a very peculiar activity that cannot be compared to an activity in another line of business. Specific features of this type of project include the following:

- Production of a large amount of greenhouse gases
- Emissions are not concentrated at a specific point, but rather result from a large area.
- Emissions are not directly associated to the economic activity at the location. In fact, if such activity ceased completely, the emissions would continue to be generated, as the degrading of organic matter continues to occur over long periods of time.

As a consequence of the above, it is concluded that there is no project activity comparable to the capture and flaring of the gas generated at a sanitary landfill.

Sub Step 4 b) “Discuss any similar options that are occurring”

As said above, neither the national or provincial legislation or the contract requirements determine any restrictions or obligations with respect to the management of the landfill gas generated. It is for this reason that the release of gases through a passive venting system into the atmosphere is the most usual practice. There are, however, certain projects associated to the capture and flaring of landfill gas that are being constructed in Argentina, which are located mostly in the province of Buenos Aires. All of them have been submitted under the Clean Development Mechanism process.

Step 5 “Impact of registration as a CDM project”

The registration of the project activity will make possible to finance the implementation of the landfill gas collection and flaring system to reduce GhG emissions. As demonstrated above, the project will not generate any revenue. Consequently, the sale of the CER’s will permit to finance the implementation of the project activity. The project will be a forerunner in its class at the provincial level and will promote, by the income flow generated, the development of new sustainable-development projects,

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

>> As was already mentioned above, the Approved and Consolidated Methodology ACM0001 / Version 05 has been developed in order to provide a method to estimate reductions of Greenhouse Gas (GHG) emissions, achieved with respect to the baseline in a project of this type, where the baseline scenario (i.e. the scenario occurring in the absence of the project) is the emission of all or a part thereof into the atmosphere. The project will not produce electricity for commercial purpose nor for internal use. Consequently, only the emission reductions due to the destruction of methane are claimed for. The paragraphs below describe how the methodology ACM0001 / Version 05 and its equations will be applied to the project activity.

In this methodology, the following equation will be used to estimate the emission reductions:

$$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + EL_y * CEF_{electricity,y} - ETy * CEF_{thermal,y}$$

wherein:

ER_y	Estimated emission reductions for the year "y", in tonnes of CO_2 equivalent [tCO_{2eq}].
$MD_{project,y}$	Estimated amount of methane to be destroyed during the year “y”, in tonnes of methane [tCH_4]
$MD_{reg,y}$	Amount of methane that would have been destroyed during the year “y” in the absence of the project, in tonnes of methane [tCH4]
GWP_{CH4}	Methane Global Warming Potential value = 21 [tCO_{2e}/tCH_4]
EL_y	net quantity of electricity imported/exported during year “y”, in megawatt hours [MWh].
$CEF_{electricity,y}$	CO_2 emissions resulting from electric energy generation consumed by the system in [tCO_2/MWh]. Estimated according to AMS.I.D methodology, section 9-b.
ET_y	CO_2 emissions in the year "y" due to the increase in consumption of fossil fuels during the project, with respect to the baseline, in [TJ].
$CEF_{thermal,y}$	CO2 emissions arising from each unit of thermal or mechanical energy produced consumption of fossil fuels, in [tCO2e/TJ]

General comments:

1) The value of the reductions that would have been achieved in the absence of the project ($MD_{reg,y}$), can be estimated by the following equation, as defined in ACM0001 / Version 05:

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

In this equation "AF" is the Adjustment Factor and, as was explained in section B.4, because the baseline selected for the project consists of a situation where all the generated landfill gas is released to the atmosphere by a passive venting system, the value to be given to the "AF" factor is zero. Accordingly, the reduction of emissions that would have been achieved in the absence of the project ($MD_{reg,y}$) is nil.

2) Following the guidelines provided in the methodology used to calculate the selected baseline, the destruction of methane achieved in one a year "y" ($MD_{project,y}$) will be determined by the following equation:

$$MD_{project,y} = MD_{flare,y} = \left(LFG_{flare,y} * w_{CH4,y} * D_{CH4}\right) - \left(PE_{flare,y} / GWP_{CH4}\right)$$

wherein:

$LFG_{flare,y}$	Quantity of landfill gas fed to the combustion subsystem during the year "y" in normal cubic meters (Nm3)
$MD_{flare,y}$	Quantity of methane destroyed by flaring in year y in tCH_4
$W_{CH4,,y}$	Average methane content in the landfill gas (fraction) in year "y"
D_{CH4}	Methane density expressed in tCH_4/Nm^3CH_4
GWP_{CH4}	Methane Global Warming Potential
$PE_{flare,y}$	Project emissions due to unburnt methane in the combustion Subsystem. In [tCO_{2eq}] determined by using the "*tool to determine Project emissions from flaring gases containing methane*" in year "y"

3) Taking into account that the electricity balance of the project is negative, as electricity is imported to operate the air turbine and the blowers extracting landfill gas, the value EL_y will be equal to the quantity of electricity imported to operate the system.

EL_y= - EL_{IMP}

4) Considering that the project does not involve the use of fossil fuels to obtain thermal or mechanical energy, its value (ETy) is determined to be equal to zero.

In this way we can determine the formula for the ex-ante estimate of emission reductions achieved each project year, by including them in the proposed formula by the selected calculating methodology, which then leaves:

$$ER_y = \left(LFG_{flare,y} * w_{CH4,y} * D_{CH4}\right) * \left[\left(1 - AF\right) * GWP_{CH4}\right] - PE_{flare,y} - EL_{IMP} * CEF_{electricity,y}$$

During the project operation $PE_{flare,y}$ will be calculated according "the tool to determine project emissions from flaring gases containing methane".

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} * (1 - \eta_{flare,h}) * \frac{GWP_{CH4}}{1000}$$

Where

Variable	SI Unit	Description
$PE_{flare,y}$	tCO_{2e}	Project emissions from flaring of the residual gas stream in year y
$TM_{RG,h}$	Kg/h	Mass flow rate of methane in the residual gas in the hour h
GWP_{CH4}	tCO_{2e}/tCH_4	Global Warning Potential

$\eta_{flare,h}$ is the hourly efficiency of the flare. Since the project activity will use an enclosed flare and continuous monitoring the flare efficiency will be calculated as follows :

- 0% if the temperature of the exhaust gas of the flare (T_{flare}) is below 500 °C during more than 20 minutes during the hour *h*.
- determined as follows in cases where the temperature of the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h* :

$$\eta_{flare,h} = 1 - \frac{TM_{FG,h}}{TM_{RG,h}}$$

Where:

Variable	SI Unit	Description
$\eta_{flare,h}$	-	Flare efficiency in the hour *h*
$TM_{FG,h}$	kg/h	Methane mass flow rate in exhaust gas averaged in a period of time t (hour, two months or year)
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*

In case of the continuous system is unavailable for maintenance, or failure, the following methods will be used:

- 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour *h* .
- 50%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h,* but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour *h*.
- 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h* and the manufacturer's specifications on proper operation of the flare are met continuously during the hour *h*.

$TM_{FG,h}$ and $TM_{RG,h}$ will be calculated applying the equations below:

$$TM_{FG,h} = \frac{TV_{n,FG,h} * fv_{CH_4,FG,h}}{1000000}$$

$$TM_{RG,h} = FV_{RG,h} * fv_{CH_4,RG,h} * \rho_{CH_4,n}$$

Variable	SI Unit	Description
$TM_{FG,h}$	kg/h	Mass flow rate of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h*
$TV_{n,FG,h}$	m^3/h exhaust gas	Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour *h*
$fv_{CH4,FG,h}$	mg/m^3	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h*
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*
$FV_{RG,h}$	m^3/h	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*
$fv_{CH4,RG,h}$	-	Volumetric fraction of methane in the residual gas on dry basis in hour *h* (NB: this corresponds to fvi,RG,h where *i* refers to methane).
$\rho_{CH4,n}$	kg/m^3	Density of methane at normal conditions (0.716)

Considering that the mass fraction of carbon, hydrogen, oxygen and nitrogen of the residual gas ($fm_{j,h}$) can be calculated as follows:

$$fm_{j,h} = \frac{\sum_i fv_{i,h} * AM_j * NA_{j,i}}{MM_{RG,h}}$$

Where:

Variable	SI Unit	Description
$fm_{j,h}$	-	Mass fraction of element *j* in the residual gas in hour *h*
$fv_{i,h}$	-	Volumetric fraction of component *i* in the residual gas in the hour *h*
AM_j	kg/kmol	Atomic mass of element *j*
$NA_{j,i}$	-	Number of atoms of element *j* in component *i*
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour *h*
j	The elements carbon, hydrogen, oxygen and nitrogen	
i	The components CH_4, CO_2, O_2, N_2	

$TV_{n,FG,h}$ is calculated as follows:

$$TV_{n,FG,h} = V_{n,FG,h} * FM_{RG,h}$$

Where:

Variable	SI Unit	Description
$TV_{n,FG,h}$	m^3/h	Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour *h*
$V_{n,FG,h}$	m^3/kg residual gas	Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in hour *h*
$FM_{RG,h}$	kg residual gas/h	Mass flow rate of the residual gas in the hour *h*

$$V_{n,FG,h} = V_{n,CO_2,h} + V_{n,O_2,h} + V_{n,N_2,h}$$

Where:

Variable	SI Unit	Description
$V_{n,FG,h}$	m^3/kg residual gas	Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in the hour *h*
$V_{n,CO2,h}$	m^3/kg residual gas	Quantity of CO_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
$V_{n,N2,h}$	m^3/kg residual gas	Quantity of N_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
$V_{n,O2,h}$	m^3/kg residual gas	Quantity of O_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour h

$$V_{n,0_2,h} = n_{0_2,h} * MV_n$$

Where:

Variable	SI Unit	Description
$V_{n,O2,h}$	m^3/kg residual gas	Quantity of O_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
$n_{O2,h}$	kmol/kg residual gas	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*
MV_n	m^3/kmol	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 L/mol)

$$V_{n,N2,h} = MV_n * \left\{ \frac{fm_{N,h}}{200AM_N} + \left(\frac{1-MF_{O_2}}{MF_{O_2}} \right) * \left[F_h + n_{O_2,h} \right] \right\}$$

Where:

Variable	SI Unit	Description
$V_{n,N2,h}$	m^3/kg residual gas	Quantity of N_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
MV_n	m^3/kmol	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 m^3/Kmol)
$fm_{N,h}$	-	Mass fraction of nitrogen in the residual gas in the hour *h*
AM_n	kg/kmol	Atomic mass of nitrogen
MF_{O2}	-	O_2 volumetric fraction of air
Fh	kmol/kg residual gas	Stoichiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h*
$n_{O2,h}$	kmol/kg residual gas	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*

$$V_{nCO2,h} = \frac{fm_{C,h}}{AM_c} * MV$$

Where:

Variable	SI Unit	Description
$V_{n,CO2,h}$	m^3/kg residual gas	Quantity of CO_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
$fm_{C,h}$	-	Mass fraction of carbon in the residual gas in the hour *h*
AM_C	kg/kmol	Atomic mass of carbon
MV_n	m^3/kmol	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 m^3/Kmol)

$$n_{0_2,h} = \frac{t_{O_2,h}}{\left(1-(t_{O_2,h}/MF_{O_2})\right)} * \left[\frac{fm_{C,h}}{AM_C} + \frac{fm_{N,h}}{2AM_N} + \left(\frac{1-MF_{O_2}}{MF_{O_2}}\right) * F_h \right]$$

Where :

Variable	**SI Unit**	**Description**
$n_{O2,h}$	kmol/kg residual gas	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*
$t_{O2,h}$	-	Volumetric fraction of O_2 in the exhaust gas in the hour *h*
MF_{O2}	-	Volumetric fraction of O_2 in the air (0.21)
Fh	kmol/kg residual gas	Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h*
$fm_{j,h}$	-	Mass fraction of element *j* in the residual gas in hour *h*
AM_j	kg/kmol	Atomic mass of element *j*
j		The elements carbon (index C) and nitrogen (index N)

$$F_h = \frac{fm_{C,h}}{AM_C} + \frac{fm_{H,h}}{4AM_H} - \frac{fm_{O,h}}{2AM_O}$$

Where:

Variable	**SI Unit**	**Description**
F_h	kmol O_2/kg residual gas	Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h*
$fm_{j,h}$	-	Mass fraction of element *j* in the residual gas in hour *h*
AM_j	kg/kmol	Atomic mass of element *j*
i		The elements carbon (index C), hydrogen (index H) and oxygen (index O)

And $FM_{RG,h}$ will be calculated as follows:

$$FM_{RG,h} = \rho_{RG,n,h} * FV_{RG,h}$$

Where:

Variable	**SI Unit**	**Description**
$FM_{RG,h}$	kg/h	Mass flow rate of the residual gas in hour *h*
$\rho_{RG,n,h}$	kg/m^3	Density of the residual gas at normal conditions in hour *h*
$FV_{RG,h}$	m^3/h	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*

$$\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} * T_n}$$

Where:

Variable	SI Unit	Description
$\rho_{RG,n,h}$	kg/m^3	Density of the residual gas at normal conditions in hour *h*
P_n	Pa	Atmospheric pressure at normal conditions (101 325)
R_u	$Pa.m^3/kmol.K$	Universal ideal gas constant (8 314)
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour *h*
T_n	K	Temperature at normal conditions (273.15)

$$MM_{RG,h} = \sum \left(fv_{i,h} * MM_i \right)$$

Where:

Variable	SI Unit	Description
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour *h*
$fv_{i,h}$	-	Volumetric fraction of component *i* in the residual gas in the hour *h*
MM_i	kg/kmol	Molecular mass of residual gas component *i*
i	The components CH_4, CO_2, O_2, N_2	

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

Data / Parameter:	Methane Global Warming Potential
Data unit:	tCO_{2eq}/tCH_4
Description:	Factor used for converting tons of Methaneinto Carbon Dioxide Equivalents
Source of data used:	Revised 1996 IPCC Guideline for National Greenhouse Gas Inventories
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	Parameter defined within the methodology ACM0001 / Version 05
Any comment:	

Data / Parameter:	Methane density
Data unit:	tCH_4/Nm^3CH_4
Description:	Conversion factor
Source of data used:	ACM0001 / Version 05
Value applied:	0.0007168
Justification of the choice of data or description of measurement methods and procedures actually applied :	Parameter defined in the methodology ACM0001/ Version 05. The value is given under Normal Temperature and Pressure Conditions (0ºC and 1 atm)
Any comment:	

Data / Parameter:	Pn: Atmospheric pressure at normal conditions
Data unit:	Pa
Description:	Atmospheric pressure at normal conditions
Source of data used:	"tool to determine project emissions from flaring gases containing methane"
Value applied:	101325 Pa
Justification of the choice of data or description of measurement methods and procedures actually applied:	Physical constant
Any comment:	

Data / Parameter:	Ru: Universal ideal gas constant
Data unit:	Pa.m³/kmol.K
Description:	Universal ideal gas constant
Source of data used:	"tool to determine project emissions from flaring gases containing methane"
Value applied:	8314.472 Pa.m³/kmol.K
Justification of the choice of data or description of measurement methods and procedures actually applied:	Physical constant
Any comment:	

Data / Parameter:	T_n: Temperature at normal conditions
Data unit:	K
Description:	Temperature at normal conditions
Source of data used:	"tool to determine project emissions from flaring gases containing methane"
Value applied:	273.15 K
Justification of the choice of data or description of measurement methods and procedures actually applied:	Physical constant
Any comment:	

Data / Parameter:	AM_j: Atomic Waste of element j
Data unit:	kg/mol
Description:	Atomic Waste of element j (j= Carbon or hydrogen, oxygen and nitrogen)
Source of data used:	Mendeleïev table
Value applied:	AM_C = 12.00 kg/mol AM_O = 16.00 kg/mol AM_H = 1.01 kg/mol AM_N = 14.01 kg/mol
Justification of the choice of data or description of measurement methods and procedures actually applied:	Physical constant
Any comment:	

Data / Parameter:	MV_n: Volume of one mol of any ideal gas at normal conditions
Data unit:	m^3/kmol
Description:	Volume of one mol of any ideal gas at normal conditions
Source of data used:	"tool to determine project emissions from flaring gases containing methane"
Value applied:	22.414 m^3/kmol
Justification of the choice of data or description of measurement methods and procedures actually applied:	Physical constant
Any comment:	

Data / Parameter:	MM_i: Molecular mass of component i
Data unit:	Kg/kmol
Description:	Molecular mass of component i (i = methane, carbon dioxide, Oxygen, hydrogen or nitrogen)
Source of data used:	"tool to determine project emissions from flaring gases containing methane"
Value applied:	MM_{CH4} = 16.04 kg/kmol MM_{CO2} = 44.01 kg/kmol MM_{O2} = 32 kg/kmol MM_{N2} = 28.02 kg/kmol
Justification of the choice of data or description of measurement methods and procedures actually applied:	Physical constant
Any comment:	

Data / Parameter:	MF_{O2}: Oxygen volumetric fraction of air
Data unit:	Dimensionless
Description:	Oxygen volumetric fraction of air
Source of data used:	"tool to determine project emissions from flaring gases containing methane"
Value applied:	MF_{O2} = 0.21
Justification of the choice of data or description of measurement methods and procedures actually applied:	Physical constant
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

>> Calculating Method:

Initially, quantities of methane generated within the sanitary landfill by anaerobic degrading of wastes will be estimated in accordance with the First Order Decay (FOD) Model described in the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse gas Inventories issued in year 2000. Subsequently, the values obtained will be converted into quantities of methane captured and conveyed by the system, by using the capture factor. Finally, the methodology proposed in ACM0001 / Version 05 will be used as described in section B.6.1 above, in order to estimate the reductions achieved by the project in comparison with the selected baseline, in tonnes of carbon dioxide equivalent. Then, the procedure continues with each step in the calculation method, as follows:

- Estimation of Methane generated at the Sanitary landfill
- Estimated quantity of methane captured by the system
- Estimated emission reductions

1) EX-ANTE ESTIMATION OF METHANE GENERATED AT THE SANITARY LANDFILL.

In order to estimate the quantities of methane that will be produced by the disposed wastes, the First Order Decay Model has been followed as described in the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse gas Inventories (year 2000). This model considers a first order decay kinetic reaction, for the degrading of wastes and resulting generation of landfill gas, and has the advantage of having been used in most studies estimating landfill gas emissions.

The model uses the following equation to perform the estimations:

$$CH_{4,y} = \sum_{X} \left[\left(A * k * MSW_T(x) * L_0 * e^{-k(y-x)} \right) \right]$$

wherein:

$CH_{4,y}$	Total methane generated in year “y” [tonCH4/year]
A	Normalization factor $\frac{1-e^{-k}}{k}$
y	Year of inventory
x	Year for which input data should be added
k	Methane generation rate [$year^{-1}$]
$MSW_T(x)$	Total municipal waste disposed at the sanitary landfill in year “x” [ton MSW/year]
L_0	Methane generation potential [ton CH_4/ton MSW]

- Value of k:

The estimation of the quantity of methane released from a sanitary landfill, is highly sensitive to the value “k” assumed for the methane generation rate. This constant depends on the humidity content of the wastes in the sanitary landfill, the temperature in the anaerobic degrading zone, the pH of the environment and the presence of nutrients. In order to obtain a realistic value, the selected calculate method will be the proposed by the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse gas Inventories issued in the year 2000, which considers the time taken for the DOC in the waste to decay to half its initial mass ("half life time"), wherein:

$$k = \frac{\ln 2}{t_{1/2}}$$

wherein $t_{1/2}$ is the half life time of the waste.

It is assumed that the half life time of the waste will be seven (7) years, due to the high rainfall values at Fachinal, exceeding 1000 mm per year, and the high content of degradable organic matter (almost 60%). With this values, the Methane Generation Rate to be used will be 0.1 $year^{-1}$. This result is within the range recommended by the IPCC (between 0.03 and 0.2)

- Value of L_0

The methodology proposed by the IPCC (year 2000) to estimate the value of the potential methane generation is based on the following equation:

$$L_0 = MCF * DOC * DOC_F * F * \frac{16}{12}$$

wherein:

MCF	Methane Correction Factor (fraction)
DOC	Degradable Organic Carbon [ton C/ton MSW]
DOC_F	Fraction of Degradable Organic Carbon dissimilated
F	Fraction by volume of CH4 in landfill gas
16/12	Molecular Weight relation between methane and carbon [tonCH_4/ton C]

Upon replacing each variable as described, the values of which are given below, the Methane Generation Potential value is estimated at **0.07 tonCH_4/ton MSW**.

$$L_0 = 1 * 0.1372 * 0.77 * 0.50 * \frac{16}{12} = 0.07 \frac{tonCH_4}{tonMSW}$$

Dividing this value by the density of methane at 0ºC and 1 atm (0.0007168 Nm^3/ton) we obtain **97.6 Nm^3 CH_4/ton MSW**. This result is within the acceptable range recommended by the IPCC (between 100 and 200 Nm^3CH_4/ton MSW)

- *Value of the MCF*

The methane correction factor (MCF) has been estimated in accordance with the table published in the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse gas Inventories (year 2000), which is shown below:

Type of site	Methane Correction Factor (MCF) default values
Managed	1.0
Unmanaged-deep (≥5m waste)	0.8
Unmanaged-shallow (<5 m waste)	0.4
Default Value-uncategorised SWDSs	0.6

The Fachinal sanitary landfill may be classified as a Managed site, as the wastes are disposed of in a controlled manner by implementing modules and cells and, additionally, the disposed wastes are compacted with heavy machinery and finally covered; the Methane Correction Factor is given a value of 1. Fachinal Sanitary landfill satisfies these criteria for the following reasons:

- The disposal of waste is planned and performed in cells specifically designed for the purpose. The cells are well lined.
- Access to the sanitary landfill is controlled; no scavenging activities are allowed inside the sanitary landfill.
- After the disposal of each layer of waste (>5 m), the waste is covered with 30 to 40 cm of soil in order to prevent any self-ignition risk and the entrance of rainwater into the cell.

- *Value of DOC*

The value of Degradable Organic Carbon (DOC) is calculated by the formula proposed in the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse gas Inventories (year 2000). This formula assumes different DOC percentages for the different types of wastes, and so permits estimating one percentage of degradable organic carbon for the total waste. The formula is the following:

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

wherein

Variable	Type of Waste	Percentage of waste disposed of at Fachinal
A	Fraction of waste that is paper and textiles	14.1
B	Fraction of waste that is garden park waste and other non food organic putrescibles	
C	Fraction of waste that is food waste	53.1
D	Fraction of waste coming from wood or agriculture	0.4

The percentage values of disposed wastes have been taken from a research on the composition of urban solid wastes disposed at the Fachinal Sanitary landfill, performed by the Department of Engineering of the Universidad Nacional de Misiones (UNAM). Substituting such values into such equation gives a Degradable Organic Carbon value of 0.1372 ton C / ton MSW.

- *Value of* DOC_F

The assumed value of the dissimilated Fraction of Degradable Organic Carbon (DOC_F) is 0.77 (this is the default value taken from the revision to the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse gas Inventories (year 2000).

- *Value of F*

The methane fraction in the landfill gas (F) ranges between 0.4 and 0.6. For practical purposes of our calculation the average value of such range, i.e. 0.50 will be considered.

- Evolution of waste quantities to be disposed of ($MSW_{T(x)}$)

As commented above, the Fachinal Sanitary landfill commenced its operations in 2001. Since such time, the quantities of wastes entering the disposal site have been weighed, recorded and compared to the forecasted projections, with very good results. Beyond 2006 waste income forecasts have been estimated with an annual growth rate of 4% Recorded and forecasted amounts are shown in the following table:

YEAR	DISPOSED WASTE (TONS)
2001	51481
2002	45458
2003	56510
2004	69117
2005	76959
2006	76000
2007	80000
2008	83200

YEAR	DISPOSED WASTE (TONS)
2009	86528
2010	89989
2011	93588
2012	97332
2013	101225
2014	105274
2015	109484
2016	113864

As the conclusion of this estimating phase, the following matrix shows the results of methane generation in [ton CH_4 / year] obtained for the reviewed period with the formula:

$$CH_{4,y} = \sum_{X} \left[\left(A * k * MSW_T(x) * L_0 * e^{-k(y-x)} \right) \right]$$

In this matrix, each row shows the quantity of methane generated from the wastes disposed in such year "x", and each column shows the total methane generated in the inventory year "y" from the total waste disposed up to such date.

		YEAR FOR WHICH THE INVENTORY "y" IS MADE										
	months	4	12	12	12	12	12	12	12	12	12	8
	YEAR	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
YEAR FOR WICH INPUT DATA SHOULD BE ADDED "x"	2001	63	171	155	140	127	115	104	94	85	77	47
	2002	61	167	151	137	124	112	102	92	83	75	46
	2003	84	229	207	188	170	154	139	126	114	104	63
	2004	114	309	280	253	230	208	188	171	154	140	84
	2005	140	380	344	312	282	256	231	210	190	172	104
	2006	152	414	375	340	308	279	252	229	207	188	113
	2007	0	481	436	395	358	324	293	266	241	218	132
	2008	0	0	501	453	411	372	337	305	276	250	151
	2009	0	0	0	521	471	427	387	350	317	287	174
	2010	0	0	0	0	541	490	444	402	364	330	199
	2011	0	0	0	0	0	563	510	462	418	379	229
	2012	0	0	0	0	0	0	586	530	480	435	263
	2013	0	0	0	0	0	0	0	609	552	500	302
	2014	0	0	0	0	0	0	0	0	633	574	346
	2015	0	0	0	0	0	0	0	0	0	659	398
	2016	0	0	0	0	0	0	0	0	0	0	457
Total	[ton/year]	614	2151	2448	2738	3021	3300	3574	3846	4117	4387	3106
								Total (10 years)			33302	

2) ESTIMATED EX-ANTE QUANTITY OF METHANE CAPTURED BY THE SYSTEM.

In order to have an estimation of methane captured and subsequently flared by the system, as realistic as practicable, it has been assumed that only a fraction of the landfill gas –and therefore of the methane- will be captured. This situation can be simulated by including the "landfill gas capture factor" (FC) in the calculation, which is the same both for the landfill gas and for the methane because one is a component of the other.

This capture factor (FC) primarily depends on the design and operating features of the sanitary landfill itself. In the case of the Fachinal sanitary landfill, the final disposal cells for the waste have the particularity of being quite shallow in relation to the volume occupied by the waste, which implies a large emission area with respect to the volume of each cell. This factor also considers a small possible imbalance, due to the operating plan, which will not be significant because the site fills and covers about one cell per year, and the capture system will be installed at the beginning of the following year. For all these reasons, the capture factor will be conservatively assumed to be 55 %.

The quantities of methane captured by the installed capture and conveyance subsystem, will be then given by the product between the estimated methane to be produced ($CH_{4,y}$) at the sanitary landfill and the selected capture factor (FC). This new calculated value will be equal to the quantity of methane fed to the combustion subsystem during each year of operation, and will be used in the final step of the calculation method in order to obtain the reductions in Carbon Dioxide Equivalent values (only for ex-ante calculations). The following is a table summarizing the quantities of methane generated and captured in [ton CH_4 / year] throughout the years scheduled for the operation of the system.

Year	CH_4 generated [ton CH_4/year]	CH_4 captured [ton CH_4/year]
2007 (4 months)	614	338
2008	2151	1183
2009	2448	1347
2010	2738	1506
2011	3021	1662
2012	3300	1815
2013	3574	1966
2014	3846	2115
2015	4117	2264
2016	4387	2413
2017 (8 months)	3106	1708
TOTAL (10years)	33302	18316

3) ESTIMATED EX-ANTE EMISSION REDUCTIONS.

Upon calculating the quantities of Methane captured and fed to the combustion subsystem it is possible to estimate the emission reductions, in carbon dioxide - equivalent values, that will occur by flaring such gas. In order to perform this calculation, the formula used will be derived from the formula in the ACM0001 / Version 05 methodology, which is described and explained in section B.6.1. hereof, as shown below:

$$ER_y = \left(LFG_{flare,y} * w_{CH4,y} * D_{CH4}\right) * \left[\left(1 - AF\right) * GWP_{CH4}\right] - PE_{flare,y} - EL_{IMP} * CEF_{electricity,y}$$

where AF is nil, as explained in paragraph "General comments" from B.6.1

- Project Emissions Calculated for the year "y" ($PE_{flare,y}$)

The value of project emissions ($PE_{flare,y}$) considered in this equation will be obtained, under the methodology ACM0001 / Version 05, by the "tool to determine Project emissions from flaring gases containing methane". This tool provides the following formula for the value determination:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \left(1 - \eta_{flare,h}\right) \times \left(\frac{GWP_{CH4}}{1000}\right)$$

Wherein:

$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year "y"
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour "h"
$\eta_{flare,h}$	Flare efficiency in hour "h"
GWP_{CH4}	Global Warming Potential of methane, valid for the commitment period

The flare to be used in the system will be an enclosed flare, and the hourly efficiency achieved will be monitored continuously according to the "tool to determine Project emissions from flaring gases containing methane".

In order to perform the ex-ante estimation of the project emissions resulting from the combustion of landfill gas, it will be necessary to assume a value of burning efficiency at the flare, such value being 97 % pursuant to the technical specifications provided by the supplier. The mass flow of methane can be obtained as:

$$TM_{RG,h} = LFG_{flare,h} \times w_{CH4,h} \times D_{CH4,h}$$

If we take into account this efficiency and the value obtained for the mass flow, the ex-ante estimation of annual project emissions, due to the methane not flared, will be the following:

Year	$PE_{flare,y}$ [$tonCO_{2eq}$]
2007 (4 months)	213
2008	745
2009	848
2010	949
2011	1047
2012	1143
2013	1238
2014	1333
2015	1426
2016	1520
2017 (8 months)	1076
TOTAL (10years)	11539

- Estimated decrease in emission reductions due to imported electricity

The $CEF_{electricity,y}$ value used has been calculated by the AMS.I.D method together with the information in the *"Balance Energético Nacional"* Sheet published by the *"Secretaría de Energía Argentina"* . The emission factors of each fuel have been taken from the latest tables published by the IPCC.

For the estimation, the kWh generated with the relevant fuel have been multiplied by the emission factor (in kg CO_{2eq}/kWh) related to such fuel, which gives the value of the emissions in CO_{2eq} generated by each source per type of fuel consumed. The sum of the latter values is divided by the total electricity produced, so as to finally obtain the value of $CEF_{electricity,y}$.. Below is a summary of the calculations:

SOURCES OF ELECTRICITY	CEF [kg CO2/TJ]	Produced Energy [TJ]	Ton CO2 [ton CO2]
Anthracite (Mineral Coal)	98,267	15,701	1,542,910
Crude Oil	73,333	0	0
Gas/Diesel Oil	74,067	5,527	409,355
Residual Fuel Oil	77,367	52,631	4,071,853
Natural Gas Dry	56,100	444,241	24,921,903
Sugar Canes	99,990	3,978	397,725
Wood	111,980	6,281	703,290
Coking Coles	94,600	0	0
Petroleum Coke	97,533	4,941	481,879
Refinery Gas	57,567	3,140	180,774
Coke oven/Gas coke	107,067	0	0
Other Primary Fuel	111,980	7,160	801,751
Other Secundary Fuel	107,067	5,401	578,292
TOTAL		548,999	34,089,732

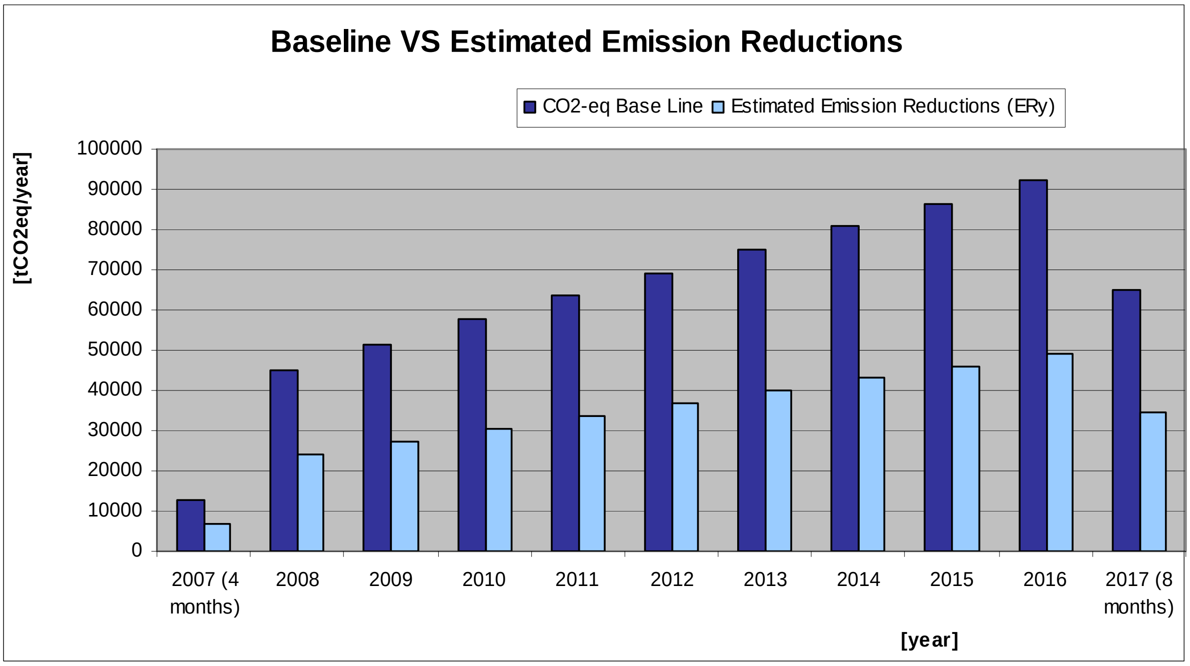
SUMMARY TABLE	
Relevant emissions [tonCO2]	34089731.81
Total Generated Electricity [GWh]	105896
Average CEF [kg CO2/MWh]	321.9164534

According to these calculations, the value obtained for $CEF_{electricity}$ is **0.321916 ton CO_{2eq}/MWh**

The quantity of imported electricity will be estimated knowing that the gas active vacuum extraction and combustion equipment has a design capacity of 47 HP. Such value will be multiplied by a simultaneous operation factor (the ratio between the average electricity continuously consumed by the system and the design power capacity expressed as a percentage) of 75 % and then by the number of hours in a year, so as to obtain the average electricity consumed in a year of operation (in MWh). With this method, the electricity imported annually (EL_{IMP}) will be equal to 230.26 MWh, and after considering a **conversion ratio of MWh to Tonnes of Carbon Dioxide Equivalent of 0.321916**, this gives **74.126 tonnes of CO_{2eq} / year**. This value must be subtracted from the emission reductions estimated previously, as described in the selected methodology ACM0001 / Version 05. This value is an ex-ante estimate. Real measured values will be obtained during the application of the monitoring plan as described in B.7.2.

The results obtained by applying this method are as shown in table form below. Also shown are the estimated emissions for the baseline scenario, obtained by multiplying the generated methane ($CH_{4,y}$) by the global warming potential thereof (GWP_{CH4}).

Year	CO_{2-eq} Base Line [ton CO_2/year]	Estimated Emission Reductions without considering imported electricity [ton CO_2/year]	Estimated Emission Reductions (ERy) [ton CO_2/year]
2007 (4 months)	12901	6883	6858
2008	45162	24094	24020
2009	51416	27430	27356
2010	57500	30676	30602
2011	63448	33850	33776
2012	69290	36966	36892
2013	75054	40041	39967
2014	80767	43089	43015
2015	86452	46122	46048
2016	92134	49154	49079
2017 (8 months)	65222	34796	34747
Total (10 years)	699348	373102	372361



Summary of Variables used in EX-ANTE Calculation:

The values assumed for the relevant variables and the justification of their selection are summarized in the following table:

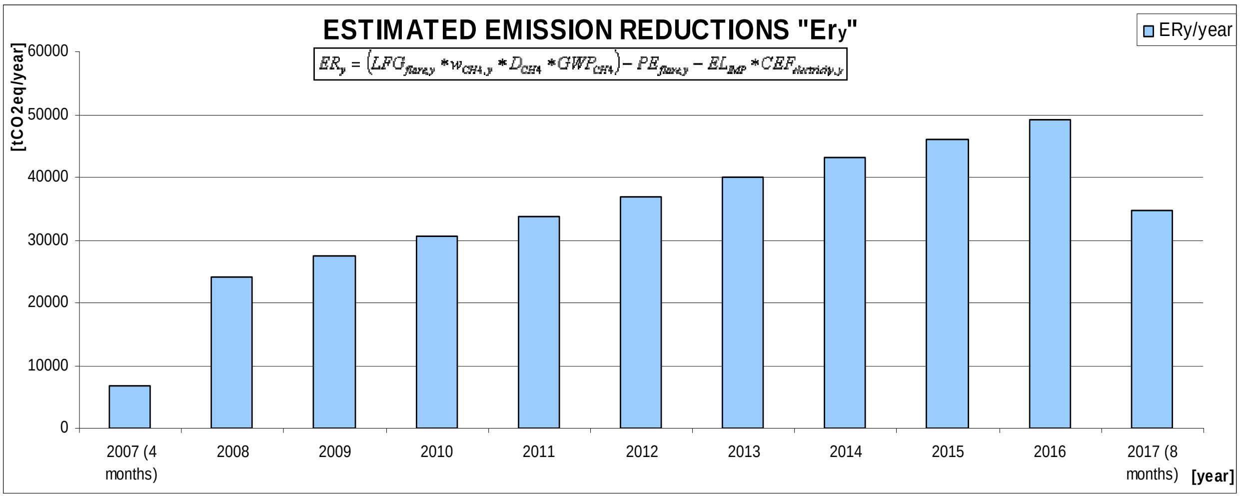
PARAMETER	VALUE	UNIT	SOURCE	DESCRIPTION
GWP_{CH4}	21	$tonCO_2/ton\ CH_4$	Revised 1996 IPCC Guideline	Methane Global Warming Potential
AF	0		Enforcement of applicable Laws and regulations.	Base Line Adjustment Factor for emission enforcement of applicable Laws and regulations.
$\eta_{flare,h}$	0.97		Minimum eficiency value recomended by the supplier.	Flare efficiency in the hour "h"
D_{CH4}	0.0007168	ton/Nm^3	ACM0001 / Version 05	Methane density at 0ºC and 1 atm
$t_{1/2}$	7	Years	Estimated	Waste half life
MCF	1		Table from IPCC Guidelines-2000	Methane correction factor, assigned according solid waste disposal management
DOC_F	0.77		Default value from IPCC Guidelines-2000	Degradable organic carbon dissimilated
$CEF_{electricity}$	0.32191	$ton\ CO_{2eq}/MWh$	Calculated according to AMS I.D methodology. Data obtained from *"Balance Energético Nacional"*	Emissions of CO_{2eq} from the generation of 1 MWh consumed by the system. Based on the IPCC guideline and the *"Balance Energético Nacional"* from *"Secretaría de Energía Argentina"* http://energia3.mecon.gov.ar/contenidos/ verpagina.php?idpagina=2131 paper
A	14.1	%	Engineering Department Research, (UNAM)	Fraction of waste that is and textiles
C	53.1	%	Engineering Department Research, (UNAM)	Fraction of waste that is food waste
D	0.4	%	Engineering Department Research, (UNAM)	Fraction of waste coming from wood or agriculture
F	0.5	Nm^3 CH4 / Nm^3 landfill gas	Average value from IPCC Guidelines-2000	Fraction of Methane in landfill Gas
FC	55	%	Estimated	landfill gas collection factor assigned according to the design and the operation system of the Fachinal Sanitary landfill.

It is important to note that once the project is commissioned, emission reductions will be recorded with the accuracy and frequency determined by the monitoring plan described in section B.7.

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

The following table shows a summary of estimated reductions to be achieved by implementing the project:

Year		Estimation of project activity emissions (tonnes of CO_{2e})	Estimation of baseline emission (tonnes of CO_{2e})	Estimation of Leakage (tonnes of CO_{2e})	Estimation of Emission Reductions (tonnes of CO_{2e})
2007	4 months	6043	12901	-	6858
2008	12 months	21142	45162	-	24020
2009	12 months	24060	51416	-	27356
2010	12 months	26898	57500	-	30602
2011	12 months	29673	63448	-	33776
2012	12 months	32398	69290	-	36892
2013	12 months	35087	75054	-	39967
2014	12 months	37752	80767	-	43015
2015	12 months	40404	86452	-	46048
2016	12 months	43055	92134	-	49079
2017	8 months	30476	65222	-	34747
Total (tonnes of CO2e)		326987	699348	-	372361



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

The monitoring plan to be implemented by the "Fachinal Sanitary landfill gas capture and flaring project" is based on the parameters considered by the Approved and Consolidated Methodology ACM0001 / Version 05.

This methodology applies to projects where the activity is associated to the capture of landfill gas and the baseline scenario (i.e. the scenario expected to occur in the absence of the project) is the emission of all or a part of the landfill gas into the atmosphere, including situations such as direct Flaring of the captured gas, or its use to produce energy (electric or thermal), whether or not the emission reductions are claimed for displacing or avoiding energy from other sources. For the above, our project is comprised within the scope of this methodology. Pursuant to the recommendations in this methodology, the "*Tool to determine Project emissions from flaring gases containing methane*" will be used as a supplement.

The monitoring methodology is based on direct measurement and recording of the quantities of landfill gas captured and flared by the installed system. The submitted monitoring plan permits taking measurements with a certain frequency and accuracy, which ensures the consistency and quality of such data.

The variables to be measured will permit determining the emission reductions, in Carbon Dioxide equivalent values, for each year of operation of the system.

B.7.1 Data and parameters monitored:

A description of the parameters to be monitored is described below.

Data / Parameter:	**2.$LFG_{flare,y}$**
Data unit:	Nm^3
Description:	Total amount of landfill gas captured, at 0ºC and 1 atm, during year "y"
Source of data to be used:	Continuous measurement, integrated with the related landfill gas Pressure, Temperature and moisture values, measured by a standard and approved fixed flowmeter.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	The value will change on a yearly basis. Refer to section B.6.3
Description of measurement methods and procedures to be applied:	A standard and approved flowmeter will be used. Data will automatically and continuously be monitored and recorded.
QA/QC procedures to be applied:	Flowmeter will be calibrated as per manufacturer recommendations, at least annually per an officially accredited entity. Flowmeter will be subject to a regular maintenance, testing and calibration regime in accordance with manufacturer specifications to ensure accuracy.
Any comment:	

Data / Parameter:	**5.$PE_{flare,y}$**
Data unit:	tCO_{2eq}
Description:	Project Emissions from flaring of the residual gas stream in year "y"
Source of data to be used:	Calculated
Value of data applied for the purpose of calculating expected emission reductions in section B.6	The flare is expected to operate 100 % of the time, with a flaring efficiency above 97 % as specified by the supplier. This value will be used in the formula proposed by the tool, to determine EX-ANTE project emissions from the flaring of landfill gas in each year of operation.
Description of measurement methods and procedures to be applied:	The parameters used for determining the project emissions from flaring of the residual gas stream in year y ($PE_{flare,y}$) will be calculated as per the "*Tool to determine project emissions from flaring gases containing Methane*". The parameters used for the determination of $PE_{flare,y}$ are $LFG_{flare,y}$, $W_{CH4,y}$, $fv_{i,h}$, $fv_{CH4,FG,h}$ and $t_{O2,h}$.
QA/QC procedures to be applied:	Regular maintenance will ensure optimal operation of the flare. Analysers will be calibrated according to manufacturer's recommendations.
Any comment:	The flare will be designed to provide an internal combustion temperature above 700°C.

Data / Parameter:	**T_{flare}**
Data unit:	° C
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	A Thermocouple type N will be used.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	N/A
Description of measurement methods and procedures to be applied:	Data will continuously be registered through a data logger.
QA/QC procedures to be applied:	Thermocouples will be replaced or calibrated as per the manufacturer recommendations every year.
Any comment:	A UV sensor will also provide another indication that the flare is burning landfill gas.

Data / Parameter:	$t_{O2,h}$
Data unit:	-
Description:	Volumetric fraction of O_2 in the exhaust gas of the flare in the hour *h*
Source of data to be used:	Measurements by project participants using a continuous gas analyser
Value of data applied for the purpose of calculating expected emission reductions in section B.6	Not used in the calculation of the expected emission reductions
Description of measurement methods and procedures to be applied:	Continuously. Values to be averaged hourly or at a shorter time interval. Extractive sampling analysers with water and particulates removal devices. The point of measurement (sampling point) will be in the upper section of the flare (80% of total flare height). Sampling will be conducted with appropriate sampling probes adequate to high temperature level
QA/QC procedures to be applied:	Analysers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard gas.
Any comment:	

Data / Parameter:	$fv_{i,h}$
Data unit:	-
Description:	Volumetric fraction of component *i* in the residual gas in the hour *h* where *i* = CO_2, O_2
Source of data used:	Measurements by project participants using a continuous gas analyser
Value of data applied for the purposed of calculating expected emission reductions in B.6	Not used in the calculation of the expected emission reductions.
Description of measurements methods and procedures to be applied:	Continuously. Values to be averaged hourly or at a shorter time interval. A gas sample will be taken from the residual gas that has passed through a condensate trap before being analysed. Value will be logged through a datalogger at least hourly. Measurement will be made on dry gas.
QA/QC procedures to be applied:	Analysers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas.
Any comment:	As defined within the "*tool to determine project emissions from flaring gases containing methane*", N_2 will be determined from the CH_4, CO_2 and O_2 concentration.

Data / Parameter:	**$fv_{CH4,FG,h}$**
Data unit:	mg/m^3
Description:	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h*.
Source of data to be used:	Continuous gas analyser.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	Not used in the calculation of the expected emission reductions.
Description of measurement methods and procedures to be applied:	Continuously. Values to be averaged hourly or at a shorter time interval Extractive sampling analysers with water and particulates removal devices or in situ analyser for wet basis determination. The point of measurement (sampling point) shall be in the upper section of the flare (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperatures level
QA/QC procedures to be applied:	Analysers must be periodically calibrated according to manufacturer's recommendation at least annually. A zero check and a typical value check should be performed by comparison with a standard gas.
Any comment:	Monitoring of this parameter is only applicable in case of enclosed flares and continuous monitoring of the flare efficiency. Measurement instruments must display their readings in ppmv values or % by volume. To convert from ppmv to mg/m^3 simply multiply by 0.716. (1% equals 10 000 ppmv).

Data / Parameter:	**6.$W_{CH4,y}$**
Data unit:	m^3 CH_4 / m^3 LFG
Description:	Methane fraction in the landfill gas
Source of data to be used:	Continuous gas quality analyser.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	50%
Description of measurement methods and procedures to be applied:	A fixed gas analyzer will be used. The gas quality will be continuously recorded through a data logger
QA/QC procedures to be applied:	The gas analyzer will be subject to regular maintenance, testing and calibration in accordance with manufacturer specifications, in order to ensure accuracy. Once a year the gas analyser will be calibrated by an independent company.
Any comment:	

Data / Parameter:	7. T
Data unit:	° C
Description:	Temperature of the landfill gas
Source of data to be used:	Measured to determine the density of methane D_{CH4}. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	0°C (suitable with the landfill gas model)
Description of measurement methods and procedures to be applied:	Data will continuously be registered through a data logger.
QA/QC procedures to be applied:	The temperature gauge will be calibrated as per supplier recommendations. It will be subject to regular maintenance, testing and calibration in accordance with manufacturer specifications, in order to ensure accuracy.
Any comment:	

Data / Parameter:	8. P
Data unit:	Pa
Description:	Pressure of the landfill gas.
Source of data to be used:	Measured to determine the density of methane D_{CH4}. No separate monitoring of pressure is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	1.013bar
Description of measurement methods and procedures to be applied:	Data will be registered through a data logger.
QA/QC procedures to be applied:	The pressure gauge will be calibrated as per supplier recommendations. It will be subject to regular maintenance, testing and calibration in accordance with supplier specifications, in order to ensure accuracy.
Any comment:	

Data / Parameter:	**10. EL_{IMP}**
Data unit:	MWh
Description:	Total amount of electricity imported to meet project requirement
Source of data to be used:	Required to determine CO_2 emissions from use of electricity to operate the project activity.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	230.26 MWh/year
Description of measurement methods and procedures to be applied:	Electricity consumption will be monitored continuously and archived electronically.
QA/QC procedures to be applied:	The meter will be subject to regular maintenance, testing and calibration regime in accordance with manufacturer specifications, to ensure accuracy.
Any comment:	

Data / Parameter:	**11.CEF**
Data unit:	tCO_2/MWh
Description:	CO_2 emission intensity of the electricity and / or other energy carriers in ID.9
Source of data to be used:	In case a specific source is displaced or used for imports, emission factor is estimated for that specific source. Electricity will only be imported from the national grid. The emission factor is based on the 2006 IPCC guidelines for national greenhouse gas inventories and the "Balance Energético Nacional" (National Energy Balance Sheet), published by *"Secretaría de Energía Argentina"*.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	0.321 TCO_{2eq} / MWh
Description of measurement methods and procedures to be applied:	Estimated with the latest figure available from the IPCC at verification stage.
QA/QC procedures to be applied:	All support documentation, assumptions and/or calculation will be made available for review by a verifier.
Any comment:	

B.7.2 Description of the monitoring plan:

>> The primary purpose of the monitoring plan is to provide certain structured and organized measurement and calculation tasks that permit keeping a full and accurate record of the parameters required to calculate the quantities of CO_{2eq} reduced in each year of operation of the system.

The monitoring equipments, described herein, may be modified to meet operational requirements or system upgrades. Any modifications will take into account the monitoring requirements specified in the applied methodology and will be subject to review in the verification process.

Applied methodology

ACM0001 Approved Monitoring Methodology "Consolidated monitoring methodology for landfill gas project activities" / Version 05.

1. Brief description of the methodology

Under the approved monitoring methodology, it is acceptable to assume that the volume of LFG actually recovered is an indication of the volume of gas that would have been emitted without the project. This reduction will be monitored.

2. Data to be collected or used in order to monitor emissions from the project activity and how this data will be achived

The emission reductions are defined as the difference between emissions in the baseline situation and in the project situation. The data will be analysed on a monthly basis and then aggregated to obtain the yearly emission reductions. Since the instrumentation will provide series of finite figures, the data will be analysed as follows:

$$MD_{project,y} = \sum_{m=1}^{12}\left(\sum_{h=1}^{Hm}\left(\frac{0.016}{22.4} LFG_{flare_h} * \eta_{flare,h} * \frac{\sum_{t=1}^{N_h} W_{CH4_{t,h}}}{N_h}\right)\right)$$

where,

$$\eta_{flare,h} = \begin{cases} 0 \rightarrow if.\dfrac{\sum_{t=1}^{N_h} N_{>500°C,t}}{N_h} * 60 \leq 40mn \\ (1 - \dfrac{TM_{fg,h}}{TM_{rg,h}}) \rightarrow if.\dfrac{\sum_{t=1}^{Nh} N_{>500°C,t}}{N_h} * 60 > 40mn \end{cases}$$

Where,

$MD_{project,y}$ is the methane actually destroyed/combusted during the year y in tCH_4
$LFG_{flare,h}$ is the amount of landfill gas captured and flared in Nm^3 at the hour h .
$W_{CH4t,h}$ is the concentration of methane in the landfill gas at the time t of the hour h
N_h is the number of measurements available during the given hour.
Hm is the number of hours within the considered month
0.016 = molecular weight methane (t/kmol)
22.4 = molecular volume at 0 °C and 1013 hPa (m^3/kmol)
$\eta_{flare,h}$ is the flare efficiency during the hour h.
$TM_{fg,h}$ is the methane mass flow rate in exhaust gas in the hour h, in kg/h.
$TM_{rg,h}$ is the methane mass flow rate in the residual gas in the hour h., in kg/h
$N_{>500°C,t}$ is 1 if the flare temperature is above 500°C; and 0 if the flare temperature is below 500°C.

The molecular weight of methane will be adjusted according to the pressure and temperature of landfill gas.

Instrumentation

ID number	Data variable	Source of data	Data Unit	Recording frequency	Calibration method and frequency	Default Value to use in case of failure	Comment
2. LFG flare..y	Total amount of landfill gas captured	Flowmeter	Nm^3	Continuously	Annually or according to the supplier requirements if more stringent. The calibration will be made by an officially accredited entity.	Daily average of the volume in the previous month	Measured by a flowmeter. Data to be aggregated monthly and yearly.
6. **W_i.y**	Fraction of the component i in measured gas	Gas analyser	m^3 i/m^3 of gas	Continuously	Automatic calibration or manually by an AESA Misiones technician or external entity following the supplier recommendations. The calibration frequency will be adjusted to ensure the accuracy remains above 95%	In case of failure on the residual landfill gas stream manual measurements will be taken daily using an infrared portable device	Fixed Gas analyser to be used on site or equivalent model providing the same level of data quality and consistency. On the residual gas stream, i = CH_4, O_2, CO_2 On the exhaust gas stream i = CH_4, O_2

7 **T**	Temperature of the landfill gas	Temperature gauge	°C	Continuously	Annually, by AESA Misiones technician	Daily average of the temperature in the previous month	Analogical devices Measured to determine the density of methane $D_{CH4;}$ *These devices may be replaced by a Flowmeter that integrates the measurement of the pressure and temperature in order to provide a direct reading of the normalized gas flow.*
8 **P.**	Pressure of the landfill gas	Pressure gauge	Pa	Continuously	Annually, by AESA Misiones technician	Daily average of the pressure in the previous month	
10. **EL_{Imp}**	Total amount of imported electricity and/or other energy used in the project for gas collection	Imported Electricity meter	kWh	Continuously	In accordance with the specification of the equipment and electricity supplier,	Daily average of the electricity consumed in the previous month	Only electricity from the grid will be used to feed the blowers and to ignite the flare.
11.	CO_2 emission intensity of the electricity consumed, in ID 10	Source of data as the latest figure available from the IPCC and the Argentinian energy balance sheet published by *"Secretaría de Energía Argentina"*	T CO_2/kWh	annually	N/A	N/A	The methodology used follows the recommendation of the small scale methodology AMS.I.D / Version 9, section 9, b

13.	Regulatory requirements relating to landfill gas projects	Official publication	Test	N/A	N/A	N/A	Required for any changes to the adjustment factor (AF) or directly $MD_{reg..y}$

As recommended within the "tool to determine project emissions from flaring gases containing methane" all concentration and gas flow will be referred to in dry conditions (moisture will be removed from the sample or discounted from the flow rate and composition).

The vacuum collection and flaring unit can be represented as shown below.

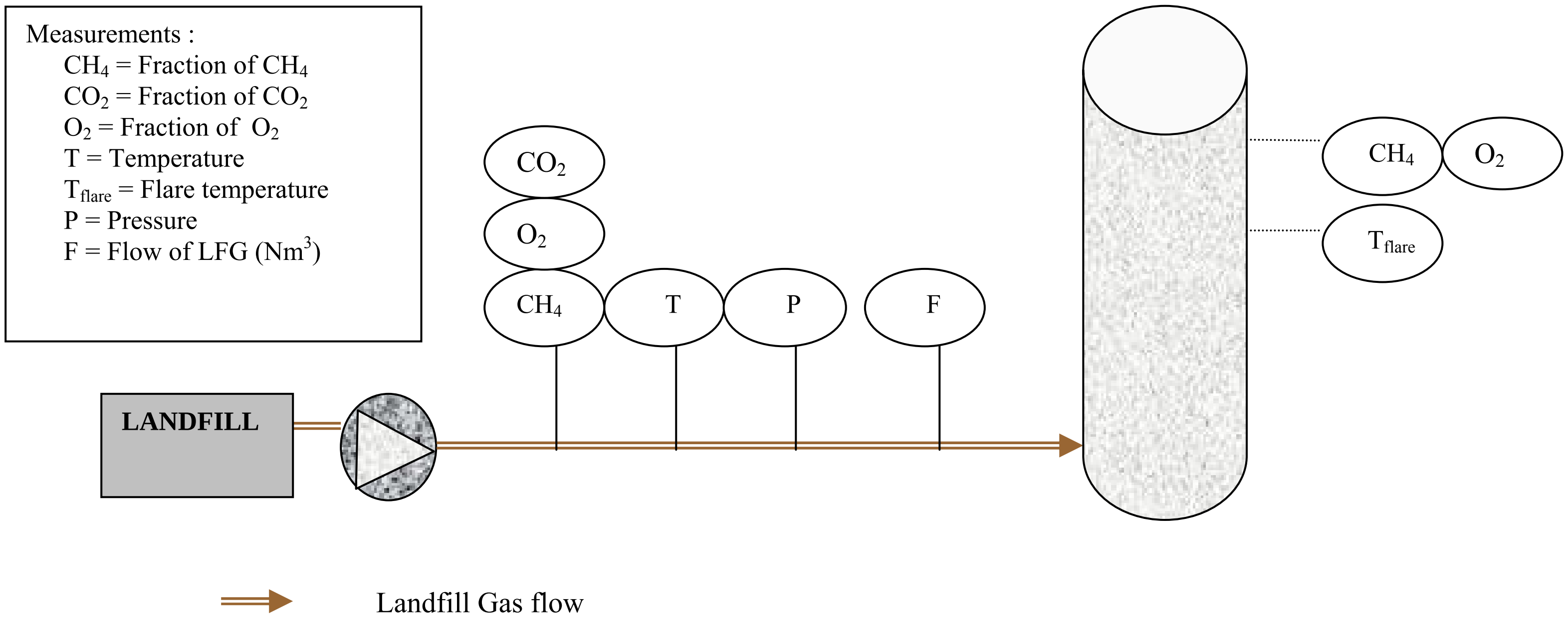


Figure 8: P&I Project Diagram to be implemented at AESA Misiones Fachinal Sanitary landfill site

Calibration Procedures:

Instrumentation will be calibrated as recommended by manufacturers or by the methodology ACM0001 / Version 05. The most stringent procedures will be used. Calibration frequency and procedures are detailed in the table above.

Procedures for record handling:

Most data will be recorded through a data logger. The file will be converted into a spreadsheet using a pre-defined format. The file will then be directly used for the verification report.

Data not automatically recorded will be registered daily from Monday to Saturday onto a dedicated monitoring form by the sanitary landfill Technician.

The paper forms will be aggregated and kept on site. Electronic data will be stored onsite on a computer hard drive.

Monthly, data from the data logger will be downloaded to a computer hard drive and transferred to a spreadsheet. Computer will be located in a separate location than the datalogger.

Procedures for dealing with monitoring data, adjustments and uncertainties

As described in the table above, in some cases alternative methods could be used to monitor the performance of the project activity. In case adjustment shall be carried out, it will be done manually. All changes will be marked.

The verification report will assess the uncertainty associated with each category of adjustments.

All data will be kept on site for the duration of the crediting period + 2 years.

Procedures for internal audits, performance reviews and corrective actions to be taken

Any abnormal condition detected by the System Operator in the measuring equipment or in the landfill gas capture and flaring system must be reported immediately to the System Manager or to the person designated for such duties, and the comment must be entered in the relevant Log Sheet. The System Manager reviews the problem and defines a mitigation plan permitting the allocation of the necessary resources and coordinating the relevant action and follow-up. Once the problem has been mitigated, a brief description of the contingency, the action taken and its results is entered in the Log Sheet. On a monthly basis, the Sanitary Landfill General Manager will review the performance of the project activity and take any action he/she deems necessary.

Data collection:

Some data are collected automatically through a data logger such as information on exhaust gas temperature, gas volume, etc.

Daily visual inspection will be carried out by a System Operator. During this visit the System Operator checks the instrumentation and monitoring data such as gas quality, gas flow, vacuum, and exhaust gas temperature.

During this daily visit, the System Operator analyses the data and balances the landfill gas collection system to the adequate suction of the landfill to maintain a steady gas quality throughout the operation. Periodically, gas quality and vacuum level are checked at each individual gas well, using a portable meter. This monitoring plan allows maximising gas collection and maintaining the infrastructure.

During this daily visit, the System Operator analyses the data and adjusts the applied vacuum within the sanitary landfill.

From time to time, gas quality and vacuum levels are also checked directly at each gas well, using a portable meter. This routine monitoring allows to identify underperforming gas wells and to take necessary corrective actions. The combination of these two inspections optimises the landfill gas collection efficiency.

The person responsible for taking the measurements and collecting the information obtained from the relevant equipment will be the “Landfill gas Capture and Flaring Operator”. Any measurements will be entered in a “Landfill gas Log Sheet” which will be delivered to this person, and will have to be completed for each parameter measured, and where any necessary comments will have to be made. Such “Landfill gas Log Sheet” must be delivered periodically to the person responsible for the landfill gas capture and flaring system that, on a monthly basis, will review, process and group the information, together with any news or clarifications, in the document called “Monthly Report of Emission Reductions”.

Data Analysis:

The data are analysed on a daily basis by the operator. In case of a drift of one parameter, the operator can react quickly and fix any potential problems.

All data required for the emission reductions calculations will be kept in an on-site database. This information will be reported on a monthly basis.

Data Storage:

Data will be monitored and archived as described in the ACM0001 / Version 05 monitoring methodology.

Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity whatever occurs the latest.

Project Management Responsibility

The project implementation and operation will be under the direct Supervision of the System Manager, who reports to the Sanitary Landfill Manager and/or the AESA Misiones General Manager.

Project Management organization

The registration of the project is managed by AESA Misiones in collaboration with Proactiva Technical Department and the Environment and Quality Department of Veolia Propreté.

The monitoring, measurement, and reporting will be realized following the below procedure.

This procedure allows for numerous crosschecks of the validity of the data.

Normal Operation

Aesa Misiones System Operator:

- Daily monitoring of key parameters (paper)
- Monthly transmission of the data to the System Manager
- Perform preventive maintenance and necessary calibration

Aesa Misiones System Manager:

- Verify the quality of the data
- Monthly report the number of ER
- Carry out the scheduled investment in order to enhance the landfill gas collection and its combustion.

Report to **AESA Misiones** General Manager

Contingencies

In case of unforeseen problems

- Alert the System Manager
- Used troubleshooting procedure defined by manufacturers

In case of unforeseen problems

- Analyze the nature of the problem
- Act accordingly in order to limit its impact on the CDM project
- In case of major failure inform directly the Treatment Facility Manager

Figure 9: Monitoring and reporting organization.

Training of monitoring personnel

Once a year the monitoring personnel will be trained internally or externally. Training will include:

- Calibration of the landfill gas collection system
- Calibration of monitoring equipment
- Impact of the monitoring on the CDM activity

Procedure in case of failure

If there is an equipment (volume meter, gas analyser, gauge, etc.) failure, the equipment supplier will be immediately notified. If possible, repairs will be carried out. If the damaged equipment cannot be repaired, it will be replaced by the same or an equivalent unit as soon as possible. In some cases, portable tools may be used in order to carry out daily monitoring. These data will be recorded on paper.

The previously provided table included the alternative measurement procedures that would be used in case of failure of a measuring device.

The flare will be equipped with a flame-based UV detector that permits detecting no-flame situations in addition to the continuous monitoring of the flare stack temperature. If flaring stops, an automatic device immediately shuts down the intakes and commences the re-lighting cycle. In this situation no landfill gas will be burned and no credits will be claimed during this period.

In case of failure of one of the monitoring devices, portable tools will be used in order to carry out periodic daily monitoring of the parameter(s). These data will be recorded on paper.

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

>> Monitoring methodology and baseline study have been completed on February 6, 2007. For information on the baseline please refer to sections B.6.1, B.6.3 and B.6.4 of this document

This study was performed by the Technical Department of Proactiva Medio Ambiente Argentina under the technical supervision of Felipe Urbano (felipeu@proactivaargentina.com.ar) in collaboration with Veolia Propreté (Gary Crawford: gary.Crawford@veolia-propreté and Lionel Bondois: Lionel.Bondois@veolia-proprete.fr).

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>> The estimated starting date of the project is May 1, 2007

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

>> 10 years

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

C.2.1. Renewable crediting period

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

>> Not applicable to our type of project

C.2.1.2. Length of the first crediting period:

>> Not applicable to our type of project

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>> The starting date is the same as the registration date of the project with the Executive Board of the CDM. The date is estimated to be about September 1, 2007

C.2.2.2. Length:

>> 10 years

SECTION D. Environmental impacts

>>

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

>> Under provincial law nº 3079/93 "*Responsabilidades y criterios para el uso e implementación de la Evaluación del Impacto Ambiental* " (Responsibilities and criteria for the use and implementation of an Environmental Impact Assessment), an Environmental Impact Assessment (EIA) is required prior to constructing a sanitary landfill site. Such assessment was submitted to the Designated Control and Application Authority who approved it prior to the installation and operation of the Fachinal Final Disposal and Treatment Centre for Solid Urban Wastes.

The project activity, landfill gas collection and flaring, is a supplementary part of the Sanitary landfill operations. The Environmental Impact Assessment for this project was prepared as an appendix of the EIA for the Fachinal Final Disposal and Treatment Center for Solid Urban Wastes. The assessment concludes that the project will give rise to a large number of positive impacts associated thereto, and no significant negative residual impacts have been detected.

Below is a transcription of the conclusions of the Environmental Impact Assessment performed with respect to the landfill Gas Capture and Flaring System at the Fachinal Sanitary landfill.

Environmental:

Capturing and flaring the landfill gas is an effective way of preventing the emission of methane into the atmosphere, thus reducing the release of gases having a greenhouse effect, and therefore minimizing contribution to global warming.

Besides, this methodology permits extracting and channelling the gases generated within the sanitary landfill, accordingly increasing the sanitary landfill stability.

In addition, flaring of the collected LFG does not only destroy methane, but will also destroy compounds in the LFG such as volatile organic compounds and ammonia This gas management methodology will decrease the emission of gases to the atmosphere, thus improving air quality in the surrounding area.

Socio-economic:

The sale of CERs earned by implementing the project will generate a substantial flow in foreign currency to the Province of Misiones. This income will be shared with the Government of the Province for the research and promotion of new Sustainable-Development Projects.

The construction, operation and maintenance of the system will result in new direct and indirect jobs in the project area.

This project will promote new projects within the Clean Development Mechanism at national and provincial levels.

The project will be a vehicle for technological development in the Province, and will permit the engagement and formation of specialists and new projects in the field of the capture of the Landfill gas, so as to overcome the technological barriers presented by this type of project.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>> No potential negative residual impacts have been identified in relation to the project.

SECTION E. Stakeholders' comments

>>

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

>> The company has continuously interacted with local stakeholders, both for the dissemination of information associated to the System for the Management of Urban Solid Wastes in the Province of Misiones, and for different improvement projects involved in such plan, especially the project reviewed herein.

It is so that, in mid September 2006, the intention of the Ecology Ministry of the Government of the Province of Misiones, jointly with AESA Misiones S.A., to perform the first project within the Clean Development Mechanism in the Province, was made publicly known.

On October 12, in Posadas (Capital of the Province of Misiones), the relevant parties publicly presented the project and the execution of the Agreement for Capture and Use of Gases from the Fachinal Sanitary landfill between the Government of the Province and AESA Misiones S.A. All the stakeholders were invited, including ministerial, provincial and municipal representatives, press, academic community, provincial and municipal legislators and neighbours.

This presentation published the main features of the project, the benefits pursued and the predicted results.

Since then, the project has been continuously promoted.. In January 2007, potential stakeholders were given access to the project, by publishing detailed information on the official website of AESA Misiones, with a contact form for any queries or suggestions. There has been a wide diffusion of this detailed information by e-mail and regular mail.

E.2. Summary of the comments received:

The comments received from the local population have been encouraging, insofar as they evidenced an understanding of the significance of a project of this type and the likelihood of new associated projects in the future.

Ministerial, provincial and municipal representatives showed their support for the project, and emphasized its importance as the first in its type in the Province and as an opening for new opportunities of Sustainable Development.

The academic and political community showed great interest in the project because it promotes social development by including state-of-art technology in the Province.

The attending neighbours showed a certain interest in knowing about any possible impact that could result from the implementation of a project of this type. Upon being informed of the results expected, as described in section D "Environmental Impacts" of this document, the neighbours confirmed their support to the implementation of the project.

It is important to remark that no adverse comments have been received from any of the interested parties.

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

>> The queries stated during the meetings and presentations were answered and clarified at the meetings.

Such queries did not result in any comments that could cause changes to be done to this Project Design Document.

Queries and comments received on electronic support (via the website or by regular mail) have been duly answered and saved on the same type of support.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding related to this project.

Annex 3

BASELINE INFORMATION

Please refer to section B.6.3.

Annex 4

MONITORING INFORMATION

Please refer to section B.7.2

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