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Report No. 32475-AR

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED PURCHASE OF EMISSION REDUCTIONS BY THE COMMUNITY DEVELOPMENT CARBON FUND

IN THE AMOUNT OF US$589,500.00

FOR THE

ARGENTINA: OLAVARRIA LANDFILL GAS RECOVERY PROJECT

May 31, 2005

Environmentally & Socially Sustainable Department
Argentina, Chile, Uruguay and Paraguay Management Unit
Latin America and Caribbean Region

CURRENCY EQUIVALENT

(Exchange Rate Effective)

Currency Unit = US$

Argentine Pesos (ARS) = US$.34677

US$ = ARS$2.8912

Fiscal Year

January 1 – December 31

ABBREVIATIONS AND ACRONYMS

CAS	Country Assistance Strategy
CDCF	Community Development Carbon Fund
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CF	Carbon Finance
CO2e	Carbon Dioxide equivalent
DOC	Degradable Organic Content
DOE	Designated Operational Entity
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ER	Emission Reduction
ERPA	Emission Reduction Purchase Agreement
FOD	First Order Decay
GEF	Global Environment Facility
GHG	Greenhouse Gas
GOA	Government of Argentina
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
LFG	Landfill Gas
MO	Municipality of Olavarría
MP	Monitoring Plan
MSW	Municipal Solid Waste
NCDF	Netherlands Clean Development Mechanism Facility
NGO	Nongovernmental Organization
NSWMS	National Solid Waste Management Strategy
OAMDL	Argentina's Designated National Authority for the Clean Development Mechanism *(Oficina Argentina para el Mecanismo de Desarrollo Limpio)*
PCF	Prototype Carbon Fund
PDD	Project Design Document
PPA	Power Purchase Agreement
RE	Recovery Efficiency
SAyDS	Argentina's Secretariat of the Environment and Sustainable Development
SWM	Solid Waste Management
UNCPBA	National University of the Center of Buenos Aires Province *(Universidad Nacional del Centro de la Provincia de Buenos Aires)*
UNFCCC	United Nations Framework Convention on Climate Change

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ARGENTINA

Olavarria Landfill Gas Recovery Project

CONTENTS

List of Tables

List of Figures

ARGENTINA

Olavarría Landfill Gas Recovery Project

PROJECT APPRAISAL DOCUMENT

Latin America and Caribbean Region (LAC)
Finance, Private Sector, and Infrastructure (FPSI)

World Bank PCF

Date: May 31, 2005 **Country Director:** Axel van Trotsenburg **Sector Manager/Director:** Abel Mejia **Project ID:** P088934 **Lending instrument:** Community Development Carbon Fund (CDCF)	**Team Leader:** Horacio Terraza **Sectors:** Solid Waste (100%) **Environmental screening category:** B **Safeguard screening category:** S_2 **Theme:** Climate Change and Pollution Management and Environmental Health.

Project Financing Data:

[ ] Loan [ ] Credit [ ] Grant [ ] Guarantee [X] Other: Emission Reductions (ER) Purchase

For Loans/Credits/Others: The Project does not involve Bank financing. Total Bank Carbon Financing amounts to $589,500.00

Proposed terms: $4.50 per ton CO2e for 131,000 ton CO2e

Financing Plan ($m.)

Source	Local	Foreign	Total
Borrower:			
IBRD/IDA:			
Others: CDCF		$589,500.00	
Total:			$589,500.00

Borrower: Municipality of Olavarría
Responsible agency: National University of the Center of Buenos Aires Province.

Estimated disbursements (FY/$) $589,500.00

FY	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Annual	39,100	44,200	49,000	53,600	57,900	62,000	65,900	69,600	73,200	75,100
Cumulative	39,100	83,200	132,200	185,800	243,700	305,700	371,600	441,200	514,400	589,500

Project implementation period: mid-2006 through 2015
Expected effectiveness date: January 2005
Expected closing date: January 2016

Does the project depart from the Country Assistance Strategy (CAS) in content or other significant respects?	○ **No**
Does the project require any exceptions from Bank policies? Have these been approved by Bank management? Is approval for any policy exception sought from the Board?	○ **No** ○ **Yes** ○ **No**
Does the project include any critical risks rated "substantial" or "high"?	○ **No**

Does the project meet the Regional criteria for readiness for implementation?	**Yes**

Project development objective: ***Ref. PAD page 3***

To help mitigate climate change through the facilitation of market-based mechanisms in support of clean energy sources and technologies

Project description: ***Ref. PAD annex 4***

The project aims to capture and destroy the landfill gas (LFG) accumulating at the municipal landfill of the town of Olavarría through recovery and flaring. An active collection system will be installed at the landfill that will consist of gas extraction wells, collection piping, mechanical blowers, LFG condensate and flare systems, as well as a monitoring and control system. The resulting reductions in LFG emissions will be monitored, verified, certified, and sold as ERs to the CDCF administered by the World Bank. Part of the income from the sales of ERs will be used by the Municipality of Olavarría to install a safe and reliable distribution system for potable water in the rural village of Espigas, 80 km. from Olavarría, as well as solar water heating systems in two local schools.

Which safeguard policies are triggered, if any? ***Ref. PAD Annex 8***

O.P. 4.01 – Environmental Assessment

Significant, non-standard conditions, **if any**, for:

Board presentation: None, as no World Bank lending is involved.

Effectiveness: Effectiveness will be achieved upon execution (signature) of the Emission Reductions Purchase Agreement (ERPA), as there are no conditions precedent.
Covenants applicable to project implementation: None

A. STRATEGIC CONTEXT AND RATIONALE

1. Country and Sector Issues

Overview

Argentina's management of the final disposal of solid waste is poor. About 26,000 tons per day, or 60 percent, of the country's solid waste is disposed of in open dumps without sanitary controls. The economic crisis of the past 3 years has worsened solid waste management (SWM) practices and disproportionately affected the lowest socio-economic groups. Small and medium-sized cities are the ones most affected by open dumping. An estimated 60 percent–90 percent of these cities dump domestic, commercial, and industrial waste in their outskirt, with no provisions for liners, leachate collection and treatment, or gas collection systems.

This practice not only degrade land and water resources but also has serious implications for public health and global environmental issues related to climate change. Poor final disposal practices in controlled landfills are the most significant contributors to methane emissions, which escape into the atmosphere, add to overall greenhouse gas (GHG) emissions and thereby contribute to global warming. Emissions from landfills contribute approximately 15 percent of total methane emissions and approximately 7 percent of GHG emissions in Argentina.

Government Strategy

To address this issue, the Government of Argentina (GOA) through the Secretariat of Environment and Sustainable Development (SAyDS) under the Ministry of Health and Environment has given top priority to SWM in the framework of the National Environmental Agenda launched by the new administration in 2004. The GOA's integral strategy to address the solid waste sector includes 1) the development of a National Solid Waste Management Strategy through the ongoing World Bank Pollution Management Project, 2) the preparation of a Solid Waste Management Investment Project to support the strategy, and 3) the use of carbon financing through the Clean Development Mechanism to improve current SW final disposal practices. Having ratified the Kyoto Protocol, Argentina is eligible to participate in the flexibility mechanisms under the Protocol, such as the Clean Development Mechanism (CDM). The country could thus participate in the international carbon market by selling Emission Reductions (ERs) from projects that capture and flare landfill gases (LFGs), thereby generating a steady revenue stream.

Carbon Finance Issues

Olavarría is one of the few medium-sized cities in the interior of the country that demonstrates acceptable final disposal practices. The proposed project, which will be the first initiative to receive carbon finance support in Argentina, will capture and flare an estimated 131,000 tons of atmospheric CO2 equivalent (ton CO2e) from LFG over a 10-year period. The project will be implemented through a public-private partnership between the Municipality of Olavarría (MO), the private operator, and the College of Engineering of the Universidad Nacional del Centro de la Provincia de Buenos Aires (National University of the Center of the Province of Buenos Aires, or UNCPBA).

2. Rationale for Bank Involvement

The World Bank's Carbon Finance initiatives are part of a larger global effort to combat climate change and are consistent with the Bank's mission to reduce poverty and improve living standards in the developing world. In Argentina the poorest people bear the highest environmental, social, and health costs linked to inadequate SWM practices. For example, during the economic crisis that affected the country in 2002, an estimated 100,000 people subsisted from waste-related activities—namely garbage picking and informal recycling—that made them vulnerable to a wide variety of hazards.

Through the proposed Olavarría Landfill Gas Recovery Project, the World Bank is in a unique position to help alleviate both climate change and poverty by 1) improving SWM practices through the capture and flaring of LFG generated in the landfill and 2) reducing the emission of GHGs and selling these ERs in the international carbon market. In addition, the project will benefit from Community Development Carbon Fund (CDCF) resources, which require implementation of a social program with part of the revenues from the sale of ERs. The project's social program will allocate part of the ER revenues to install a micro potable water distribution network in the nearby rural village of Espigas and solar water heating systems in local schools, thus improving the quality of life of the community. The Carbon Finance Business Unit in the World Bank also administers the following trust funds: the Prototype Carbon Fund (PCF), the Netherlands Clean Development Mechanism Facility (NCDF), the BioCarbon Fund, and the Italian Carbon Fund.

As the first World Bank carbon finance project and the first CDM project in Argentina, the Olavarría project is expected to raise awareness of the role of carbon finance in the solid waste sector and provide country-wide lessons on costs and efficacy. In addition, this project will become a best practice case for replication not only in the national SWM investment project but also within the framework of the National Solid Waste Management Strategy under preparation through the Pollution Management Project. The future national SWM investment project will finance the construction of landfills and include an umbrella carbon finance component to support part of each sub-project.

3. Higher Level Objectives to Which the Project Contributes

In line with the Country Assistance Strategy (CAS), which recommends establishing clear priorities for action in strategic sectors such as water resources and urban waste management, the Olavarría Landfill Gas Recovery Project addresses one of the main pillars of the SAyDS's strategy for SWM: financing the improvement of waste final disposal facilities through the Carbon Finance (CF) mechanism. The project will address the overarching goal of sustained economic growth with equity by attracting investment in infrastructure and the goal of social inclusion by reaching the rural poor.

The recovery and destruction of methane from landfills, as well as its utilization for energy, are targeted under Argentina's National Strategy for Climate Change and the related National Programs developed by SAyDS. These programs deal with Climate Change Impact

(Resolution 1125/01), Renewable Energy and Fuels (Resolution 166/01), and Biofuels (Resolution 1076/01). However, at present these programs are far from fully implemented.

B. PROJECT DESCRIPTION

The Olavarría Landfill Gas Recovery Project aims to capture and destroy landfill gas accumulating at the Olavarria municipal landfill and sell the resulting Emission Reductions to the CDCF. Part of the income from the ER sales will be used to install a safe water distribution network and solar water heating for schools in the village of Espigas. The project's objectives, components, design, and evaluation indicators are detailed below.

1. Lending Instrument

There is no World Bank Group lending in the project. The CDCF, administered by the IBRD as Trustee, will purchase ERs from the project and make annual payments upon verification of the generated ERs by an independent entity.

2. Project Development Objective and Key Indicators

The overarching objectives of the proposed project are to improve municipal solid waste (MSW) management practice in the Municipality of Olavarría and strengthen its commercial viability by leveraging additional revenue from carbon finance at the local landfill.

To achieve these objectives, the project proposes to capture and destroy methane currently generated at Olavarría's municipal landfill. The project will also implement a micro-social enterprise to improve overall living conditions of the 550 inhabitants in the rural village of Espigas by enhancing potable water and water heating supply at the local school through a renewable energy system. The CDCF will purchase ERs under a contract analogous to a Power Purchase Agreement (PPA). The ERs are a result of avoided methane emissions in the atmosphere through degradation of organic matter in a landfill and are generated as a by-product of the plant's routine operations.

Performance indicators: The primary performance indicator is the timely delivery of ERs, for which payments will be made by the CDCF in accordance with the Emission Reductions Purchase Agreement (ERPA) and the accompanying Monitoring Plan (MP) outlined in annex 8, table 13. The second performance indicator is the number of households with access to the new water supply network.

Regarding methane capture, the generation and purchase of ERs for approximately 131,000 ton CO2e produced over the first decade of operation could amount to $589,500.[1]

The expected generation of Certified Emission Reductions (CERs) is as follows:

[1] All currency amounts are in U.S. dollars.

Annual average for a 10-year period	=	13,550 ton CO2e
Up to and including 2012	=	82,522 ton CO2e
Up to a period of 10 years	=	131,000 ton CO2e
Up to a period of 7 years	=	82,522 ton CO2e
Up to a period of 14 years	=	206,434 ton CO2e

At a price of $4.50 per tCO2e and with a minimum total ERs of 131,000 ton CO2e over 10 years agreed under the ERPA, the total ERPA value is $589,500. Implicit in the ERPA is the allocation of a premium of $0.50 per ER purchased for the social component of the project.

Project activities will deliver local community benefits through the creation of new jobs during the construction, operation, and maintenance stages of the LFG recovery plant and construction of the water distribution system. The captured LFG could also be utilized as a renewable energy resource in a future project stage. An important additional benefit is the expected triggering of environmental awareness related to waste management, renewable energy resources, and climate change through replication of project activities in other towns in the country.

3. Project Components

The proposed Olavarría Landfill Gas Recovery Project has two main components: GHG capture and a social component directly linked to GHG capture.

Component 1 – GHG capture. The capture and flaring of methane generated at Olavarría's municipal landfill will generate ERs, which will be monitored, independently verified, and sold to the CDCF. The income resulting from the ER sales will make it possible to eliminate the financial barriers to implementing this project and help promote GHG mitigation projects throughout Argentina.

Component 2 – installation of a water distribution system in the rural village of Espigas. One of the unique aspects of this project is its social component. Part of the income from the ER sales will be used to install a safe and a reliable water distribution network in the village of Espigas. Without a potable water supply network, the inhabitants of the village use shallow and often contaminated wells to meet their water needs. Hence, gastrointestinal diseases related to contaminated water are a major health problem. Because students at the local elementary and high schools lack a low-cost and reliable water heating system, the project will also install much-needed solar water heating systems in both schools.

4. Lessons Learned and Reflected in the Project Design

As well as being Argentina's first World Bank carbon finance project and first CDM project, the Olavarría Landfill Gas Recovery Project is one of the first projects in the world to be developed specifically under the CDCF. The project will be implemented by a private operator contracted by the Municipality of Olavarría to run the LFG capture and flaring equipment in close coordination with the College of Engineering of the UNCPBA, the MO, and the operator of the Olavarría landfill. The project benefits from the experience of the

World Bank Carbon Fund in the Nova Gerar LFG-to-Energy Project in Brazil, Chacabuquito Hydropower Project in Chile, Jepirachi Wind Farm Project in Colombia, and Umbrella for Renewable Energy Resources Project in Costa Rica, as well as Global Environment Facility (GEF) LFG projects such as the Monterrey LFG Plant Project in Mexico and the Maldonado Methane Capture Project in Uruguay. The following lessons from these projects were applied during the design and preparation of the current project:

- Established and verified LFG generation and capture models can be adopted.
- A broader stakeholder consultation process, with coordination as early as possible among the private sector (landfill operator), municipal organizations, local community, and scavengers, if present, can avoid delays during implementation.
- Sound and strong technical and financial viability studies reduce financial risk.
- Economic commitment to the project, such as up-front investment, from the municipal, state, or federal government improves the overall financial structure and reduces uncertainty.
- Technical and financial flexibility to adapt to the changing rules of the Kyoto Protocol are important to prevent changes in the modalities and procedures for CDM projects that could alter the estimation of ERs.
- Because defining ownership of waste and therefore LFG is in many cases a new issue for landfill operators and municipalities, agreement should be reached among all relevant stakeholders on ownership of the ERs to avoid conflict during project implementation or operation.
- The use of proven technology already in operation in similar projects in the region, such as in Mexico and Uruguay, can reduce technical risks significantly.
- Local technology and expertise can lower maintenance and operation costs.

5. Alternatives Considered and Reasons for Rejection

The only alternative considered for the proposed project was to use captured LFG for electricity generation rather than simply flaring it. The size of the project and the risk to small-scale power producers from low electricity tariffs in the Argentinean electricity market prevented the project developers from branching into electricity production at this stage.

The LFG flaring option was selected because the prospective revenues from the sale of ERs would only increase the project's financial returns to a level sufficient to justify the acquisition of a capture and flaring system. In relative terms, the cost of a capturing and flaring system represents approximately 20 percent–30 percent of the cost of an electricity generating system. The important breakthrough opportunity to disseminate this type of activity throughout the country was also considered. The Olavarría landfill was selected as a leading candidate for CDCF assistance because of the commitment of the MO demonstrated in its up-front financing, the technical advantages of the existing controlled landfill and associated low technological risk, and the MO's partnership with the local university.

C. IMPLEMENTATION

This section describes the Bank's plans for implementing the Olavarría Landfill Gas Recovery Project, including institutional arrangements and monitoring and evaluation of project performance in line with the requirements of international environmental frameworks. Project sustainability and risks are explored, and loan and credit conditions outlined.

1. Institutional Arrangements

The project sponsor is the Municipality of Olavarría, which has a formal agreement with the UNCPBA for technical cooperation and project implementation. The MO will pre-finance the project with an estimated amount of $377,166. At the time the ERPA is signed, an anticipated schedule of payments based on the delivery of ERs will be prepared according to the methane eliminated. The project sponsor will request payment annually from the CDCF, as stated under the ERPA. The CDCF will only disburse against delivery of verified ERs that have been monitored in accordance with the Monitoring Plan annexed to the ERPA. The ERPA, with the CDCF, will terminate once the total contract ERs of 131,000 ton CO2e have been delivered.

The College of Engineering of the UNCPBA, which was responsible for the engineering design system for the LFG capture, negotiations with the Bank, and preparation of the Environmental Impact Assessment (EIA), will be in charge of general project supervision. The technical team of the MO was responsible for ensuring compliance of the water design system with local regulations. Both the capture and flaring of LFG and water treatment distribution will be the responsibility of a private operator to be selected through a public tender process. An international consulting firm will provide the training for operation of the flaring system.

The rules and modalities under the Kyoto Protocol require that CDM projects be approved by the national government through the Designated National Authority for CDM projects. The so-called "Letter of Approval" for this proposed project activity was requested from the Argentine Office for the Clean Development Mechanism (OAMDL) in May 2004 and is expected before the signature of the ERPA.

In the event that it fails to deliver the quantity of ERs for any given calendar year as set forth in Article XII of the ERPA, the project sponsor (MO) will be required to recover the shortfall over the course of the following calendar year or other period agreed with CDCF. Apart from Carbon Finance Business Unit support (which in this case comes from corporate and government participants that are investors in the CDCF), the project does not include any World Bank or International Finance Corporation financing.

2. Monitoring and Evaluation of Outcomes and Results

Carbon Finance projects are initially evaluated on the basis of an ex-ante analysis of the emissions baseline (conventional generation and emissions that would have occurred in the absence of the project) and determination of project additionality (see annex 2, table 4). Project performance is then monitored as per a Monitoring Plan included in the ERPA. The

performance of the Olavarría Landfill Gas Recovery Project will be evaluated according to achievement of the expected ERs. Monitoring and evaluation of ERs is implicit in the project as a function of the amount of methane captured and combusted in a flare. The applied procedure involves accounting for ERs based on on-site field measurements of the LFG captured and continuously analyzing the methane content in the captured LFG.

To increase the likelihood that ERs acquired via ERPAs will satisfy the requirements of the United Nations Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol, the CDCF has retained the services of an internationally recognized and fully independent third party to validate 1) the project design and 2) the project baseline (test of additionality against the sector-wide baseline) and monitoring arrangements laid out in the Project Design Document (PDD) required by the CDM. Another independent third party will periodically verify and certify the ERs generated and issue a Verification Report that includes the following:

- A statement of the amount of verified ERs the project has generated in the relevant period, typically one year.
- Verification of compliance with Bank safeguard policies.
- Verification of achievement of the community benefits laid out in the Community Development Plan, which is part of the ERPA.
- Other matters as may be required by the UNFCCC or Kyoto Protocol.

3. Sustainability

Sustainability of the project is based on the strong commitment of the MO, which will absorb the initial project costs while expecting cost recovery from the sales of ERs. Funding for ERs is guaranteed by the ERPA independent of the Kyoto Protocol entering into force. CDM projects are expected to be accepted by the European Union Emissions Trading Regime and other national and international regimes even without the Kyoto Protocol entering into force. In addition, upon termination of the ERPA with the CDCF, the MO would have the opportunity to sell the ERs from future years of project operation to other carbon buyers at possibly higher prices that reflect the development of the carbon market at that time, thereby maximizing its cost recovery.

Financial sustainability associated with the social program will be ensured through the establishment of a previously agreed tariff for water consumption that reflects total costs of operation and maintenance. Sustainable operation and maintenance of the solar water heating systems will be assured by savings generated from not using containerized gas and the social demand for a reliable bathing service for students.

From the technical point of view, project sustainability has been assured by 1) training of a solid local technical team from the University by international LFG experts, 2) applying best practices and proven technologies from similar Bank-financed projects and LFG international experience, 3) assessing the adequate operation of the existing landfill, and 4) ensuring the leadership of international experts in training for operation and maintenance.

4. Critical Risks and Possible Controversial Aspects

No controversial aspects are foreseen in the project. The implementation of the methane capture technology in the landfill is expected to make almost no discernable changes in the operation of the site or affect waste collection for the local population. While LFG capture and flaring technologies are well known and proven around the world, small-scale CDM projects normally involve a slight project business risk because of financial sensitivity and dependence on the revenue from ERs. CDCF participants assume any potential financial risk of the Kyoto Protocol not entering into force. Table 1 shows the risk ratings of the proposed project.

Table 1: Risk Ratings of the Olavarría Landfill Gas Recovery Project

Risk	Risk mitigation measures	Risk rating with mitigation
To project development objective		
Baseline risk	Baseline and monitoring methodologies used in the current project are pre-approved by the Clean Development Mechanism (CDM) Executive Board for Small-Scale CDM Projects. The project has already obtained a favorable validation report from an independent CDM Designated Operational Entity (DOE).	Low
Kyoto Protocol risk	CDCF will honor the contract even in the absence of the Kyoto Protocol entry into force.	Low
To component results		
Technical risks	The local implementing body is the College of Engineering of the UNCPBA.	Moderate
	The technology to be used has been proven worldwide.	
ER non-delivery risk	The landfill is already well managed. CDCF's contracting for payment only upon delivery of Emission Reductions (ERs) limits the risk of non-recovery of preparation costs. Article XII of the ERPA provides for failure to generate minimum amount of GHG ERs.	Low
Country risks	Argentina is recovering from the economic crisis. A National Solid Waste Management Strategy is under elaboration.	Low
Financial risk	Because the project's financial sustainability depends highly on the ERs agreed in the ERPA, the baseline and ER estimates were	Low

	carried out based on conservative assumptions. The MO has a record of healthy municipal finances. The MO provided up-front investment for project development.	
Overall risk rating		**Low**

5. Loan and Credit Conditions and Covenants

Carbon finance is not part of the World Bank's lending program. There will be no regular loan disbursements, but payments will be made under the ERPA that the World Bank will make as a Trustee for the CDCF.

D. APPRAISAL SUMMARY

The section below analyzes the project's financial components, potential environmental and social impacts, and applicable Bank safeguard policies.

1. Financial Analysis

The project is based on the development of a well-controlled sanitary landfill site in the Municipality of Olavarría, close to the capital city of Buenos Aires. The enterprise comprises landfilling activity, gas collection, and gas flaring. Despite the total dependence of the gas generation on the accumulation of solid waste in the site, the landfilling activity is not part of the CDM project and will not result in any carbon dioxide emission reduction equivalent (CO2e). Therefore, the landfilling capital expenditure, maintenance costs, and collection fees will not be part of this financial evaluation. The numbers to be analyzed will comprise the gas collection and gas flaring systems ("project figures"). In addition to the gas recovery, the project will develop a Community Development Plan, which is further addressed below.

According to the assumptions elaborated by the sponsor, the total project investment is $352,500, broken down in tables 2 and 3.

Table 2: Total Investments

Development costs	**$37,600**
Civil work and machinery	**$171,900**
Community Development Plan	**$143,000**
Total project costs	**$352,500**

Table 3: Investment Breakdown

CAPEX	2005	2006	2007	2008	2009	2010	2011	2012	2013
Civil works LFG	$2,069	$0	$0	$0	$0	$0	$0	$0	$0
Civil works Comm. Devel. Plan	$71,500	$71,500							
Total civil works	**$73,569**	**$71,500**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Years of depreciation									
Machinery and equipment	**$81,368**	**$0**	**$0**	**$11,053**	**$0**	**$11,053**	**$0**	**$0**	**$11,053**
Years of depreciation									
Intangible	**$20,883**	**$16,745**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Years of depreciation									
Total investment LFG	$83,437	$83,437	$83,437	$94,490	$94,490	$105,544	$105,544	$105,544	$116,597
Total investment Comm. Devel. Plan	$71,500	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000

2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
$0	**$11,053**	**$0**	**$0**	**$11,053**	**$0**	**$11,053**	**$0**	**$0**	**$11,053**	**$0**	**$11,053**	**$0**
$0	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
$116,597	$127,651	$127,651	$127,651	$138,704	$138,704	$149,758	$149,758	$149,758	$160,811	$160,811	$171,864	$171,864
$143,000	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000

The current evaluation did not establish local due diligence except through an initial approach with the project developers (professors in the Faculty of Engineering of the University of Olavarría). In addition, because of the intrinsic characteristic of carbon finance projects, no check was made of the procurement and legal rights of the parties. It is important to note that the World Bank's participation in the project does not include lending. Risk in this type of project is limited to the Bank's preparation costs and advance payments for ERs, which in this project represent $65,000, or about 11 percent of the total carbon finance payments for ERs (estimated at $592,000 from 2005 to 2015).

According to the project developers, all development studies incurred by the project so far have been covered by the project sponsor (MO). The sponsor will conclude the project with its own resources to be provisioned in its upcoming annual budgets. The advance carbon finance payments of $65,000 will also be allocated to the investments in the Community Development Plan agreed by the parties. The Community Development Plan aims to develop a water distribution system and solar water heating systems and is expected to require $143,000 in investments, as shown in table 3 above.

Project financial evaluation will be based on financial projections for the project life of 21 years. Special attention will be given to the period until 2015, which represents the tenure of the ERPA contract being signed by the CF of the World Bank and the project sponsors for the acquisition of the ERs.

Based on a formal consultation between the project developers and competent authorities in Argentina and because of the assumption of the project by the MO, the project will not incur the usual taxes applied to commercial projects. The tax exemptions include Value Added Tax and Sales and Income Taxes and represent a substantial increase in the project's profitability.

Because the Olavarría Landfill Gas Recovery Project does not aim to pursue electricity generation, ERs will be the sole source of income. Accurate estimation of the generation of

ERs is therefore of fundamental importance to the project's viability. For this reason the project developers adopted conservative estimates of organic content in the solid waste and methane content in the gas generation that were checked by specialized consultants. The technical design of the landfill site and collection and flaring systems was also revised and validated by the technical experts of the Bank.

2. Technical

The proposed project will capture and destroy methane that is currently generated at the Olavarría municipal landfill. The project's annual average direct emissions of 1,278 ton CO2e are less than the 15,000-ton CO2e maximum established under the CDM definition for small-scale projects of this type.

Baseline and Additionality

The emission baseline is "the amount of methane that would be emitted into the atmosphere during the crediting period in the absence of the project activity" and "shall cover only the capture and flaring that would not have happened in the absence of the project activity." The proposed project is additional, as it would clearly not be carried out in the absence of the incentives and benefits provided by the CDM to the project sponsor.

Potential Barriers

There are several barriers to project implementation. First, no current SWM regulatory framework exists at either the national or the provincial level in Argentina. A federal law recently approved by the GOA is too broad to include specific economic and environmental principles and will have to be complemented by by-laws. The provinces will start to enact their own regulations, which cannot be less restrictive than the national laws. In Buenos Aires Province, the 1995 Integral Law of Environment No. 11723 (Chapter VII, Articles 65 and 66) establishes that MSW management is the responsibility of the municipality in which the waste is generated. The law does not set legal obligations for the construction of sanitary landfills as a final waste disposal site. As a result of the legal negligence, open dumps are still common practice in most cities and towns around Argentina. Notably, LFG recovery is not required under current legislation.

Second, additional barriers arise from institutional issues and lack of information on LFG technology, international climate change mitigation efforts, and carbon markets among the general public and municipal governments in Argentina. It is envisaged that the development of this project, which is facilitated by the CDCF, will make it possible to disseminate in the region information about the potential for LFG recovery, activities such as renewable energy and energy efficiency, and the CDM in general. The project was presented in several forums in 2003 and 2004 and has since drawn the attention of local and regional media. Several municipalities from the region have asked both the project developers and sponsor about technical, economical, and financial issues related to the carbon market and CDM.

Third, the significant investment required to realize the project and the MO's inability to afford the capital investment and operation and maintenance of the LFG recovery plant create

financial barriers to implementation. Lack of financing as a result of the country's economic crisis aggravates the financial constraint. The sale of the ERs generated by the proposed project will help support construction, operation, and maintenance costs of the LFG recovery plant.

Fourth, a technological barrier arises from lack of experience in the operation and maintenance of LFG recovery plants. Revenues from ERs would address this issue by supporting training of the LFG plant operator and other parties involved.

The barriers described above have prevented the development and implementation of this type of project in the past. However, participation in the carbon market through the CDM with the assistance of the CDCF is helping to overcome these barriers and demonstrate the additionality of the Olavarría project.

Calculation of ERs

The First Order Decay (FOD) method was used to estimate the total anthropogenic emissions (i.e., baseline emissions) from Olavarría's landfill. This method produces an emission profile that reflects the true pattern of the degradation process over time. Total MSW disposed in a given year—MSWT(x)—is known from records kept since the beginning of the landfill operations in November 1999. To estimate the MSWT(x) for future years, Argentina's projected 6 percent GDP growth per year was taken into account. To define the baseline scenario, an MSW generation growth rate of 3 percent was then assumed for the first 2 years of the project (2006–2007), while a more conservative 2 percent was assumed for the remaining years of the project's crediting period (2008–2026). Thus the annual average of the MSW disposed at the landfill during the 21-year crediting period is 40.8 Gg per year. The methane generation rate k was estimated using the formula given by the Intergovernmental Panel on Climate Change (IPCC).

Following IPCC recommendations, a degradable organic carbon (DOC) half-life of 7 years was assumed for this project, considering both the high moisture conditions in Olavarría and the large amount of rapidly degradable material in the waste. This half-life yields a value of k = 0.099 $year^{-1}$. The recovery efficiency of the LFG collection system can be estimated from previous experience recounted in the literature or standards recommended by specialized research institutions. Given that Olavarría's landfill was not originally designed for LFG recovery, a conservative recovery efficiency (RE) of 50 percent was assumed. This efficiency is smaller than that of most current LFG recovery projects and other recommended values.

The values of L_o (methane generation potential), MSWT(x) and k obtained as explained above, in addition to the assumed RE, allow calculation of the total methane emissions (baseline emissions) within the boundary of the project. The annual estimated average baseline emissions are 18,580 ton CO2e over the 21-year crediting period beginning in 2006. In this project the emissions reductions can and will be measured directly at the landfill site once the LFG recovery plant is installed and operating. However, a preliminary estimation of ERs was made by subtracting the direct emissions resulting from the project activity from the baseline emissions. This resulted in an estimated annual average ERs of 17,301 ton CO2e over the 21-

year crediting period beginning in 2006. The total ERs during the 21-year crediting period starting in 2006 are 363,331 ton CO2e, and the annual average ERs for the same period are 17,301 ton CO2e. The CDCF will purchase ERs only for the first 10 years of the project operation. These are rounded to 131,000 ton CO2e.

3. Social

No major negative social issues will arise from the methane capture project because no scavenger activities are found at the landfill site. Instead, many social benefits will result from both the methane capture component and the water distribution component. Job opportunities will be created during the construction and operation phases. Moreover, both components will help raise awareness of the importance of SWM and global warming. Specifically, the community of Espigas will improve its quality of life as a result of the implementation of a reliable and safe water distribution network. The population will realize economic savings because they will not be forced to buy expensive bottled water. Water sanitation will also be improved considerably in the community.

Public participation was taken into account during project preparation. The feasibility study on expanding the Olavarría MSW management system carried out by the College of Engineering in 2002 launched a discussion of the future of MSW management in the city. The project sponsored by the MO focused public attention on GHG mitigation, climate change, the CDM, and potential local impacts from LFG technology and utilization and project replicability in the region. In 2002 and 2003 the College of Engineering organized several meetings to inform stakeholders about the project. Community representatives of nongovernmental organizations (NGOs) such as the environmental Fundación Nuevo Horizonte (New Horizon Foundation) and local Rotary Club and representatives of the municipal legislative body and industrial organizations actively participated in those meetings and made public their opinions about the project. The current landfill operator was also informed about the proposed project activities and participated in and facilitated the first field tests on the landfill site.

Monitoring of social impacts, especially for the community of Espigas, is described in the Community Development Plan in annex 8. Social impacts will be monitored by the project sponsor and verified annually along with the ERs.

4. Environment

The primary focus of the Olavarría Landfill Gas Recovery Project is the efficient collection of biogas and combustion of methane from the existing controlled landfill in Olavarría. The project is expected to 1) reduce methane GHG by combusting biogas, 2) improve management of municipal waste in the municipality, and 3) help improve the quality of life for the inhabitants of Espigas through the social component of the methane capture project. Because of the nature of the project, an impact assessment limited to the LFG flaring was added to the existing full EIA. In addition, environmental guidance was suggested for the activities related to the social component. Environmental aspects of the project are discussed below and in further detail in annex 8.

The town of Olavarría has a population of 100,000 and is located at the center of Buenos Aires Province, 360 kilometers from the capital. The current sanitary landfill, owned by the Municipality and in operation since November 1999, has a total area of 33 hectares and a total waste disposal capacity of approximately 30 years. Current access to the landfill is by a gravel road in fairly good condition. The landfill site is connected to the main electrical grid but not to the natural gas distribution network. The landfill was designed and constructed following sanitary engineering requirements. According to previous hydro geological studies, the site was selected to prevent groundwater contamination. The landfill was isolated using a low permeability soil along with a synthetic liner and has a leachate treatment system with a stabilization pond and recirculation pumps and piping. The methane recovery system will mainly benefit the MO and community by reducing environmental impacts such as GHG emissions, internal landfill fires, and explosions that would otherwise occur without the project.

The installation and operation of methane recovery and flaring equipment entail negligible infrastructure works and will involve no negative environmental impacts. The only possible negative impact could arise from the air emission pollutants associated with flaring combustion. These pollutants include nitrogen oxides, sulphur oxides, acid gases, non-methane volatile organic compounds, and particulates. However, this risk has been mitigated by the technical specification of well design and technologically proven flares, which guarantees that these pollutants will be present in insignificant concentrations in terms of potential environmental effects.

The construction and operation of the water distribution system in the rural community of Espigas will not entail major environmental impacts. The main environmental concern is related to the hydrological characteristics of the aquifer from which the potable water will be pumped to the distribution network and to the construction of the network. The characteristics of the aquifer have been evaluated by the MO, and measures will be implemented to assure the treatment and sustainability of the potable water supply. During construction of the network, mitigation measures will have to be adopted to reduce high noise levels from machinery, and remediation measures will be needed to restore or even improve municipal conditions prior to the installation of the network. These measures will be included in the bidding documents and construction contract.

The EIA includes a series of mitigation and enhancement measures designed to minimize any negative impacts and improve positive impacts. These measures, together with a budget, timetable, and institutional responsibilities, constitute the project's Environmental Monitoring Plan (EMP), which is summarized in annex 8.

5. Safeguard Policies

Only one project safeguard policy is applicabl to the project, as shown in table 4.

Table 4: Applicability of Safeguard Policies to the Olavarría Landfill Gas Recovery Project

Policy	Applicability
Environmental Assessment (OP 4.01, BP 4.01, GP 4.01)	Yes
Natural Habitats (OP 4.04, BP 4.04, GP 4.04)	No
Forestry (OP 4.36, GP 4.36)	No
Pest Management (OP 4.09)	No
Cultural Property (OPN 11.03)	No
Indigenous People (OD 4.20)	No
Involuntary Resettlement (OP/BP 4.12)	No
Safety Dams (OP 4.37, BP 4.37)	No
Projects in International Waters (OP 7.50, BP 7.50, GP 7.50)	No
Project in Disputed Areas (OP 7.60, BP 7.60, GP 7.60)	No

As designed, this category B project complies with the World Bank's environmental and social safeguard policies. The project has taken measures to comply with OP4.01 on Environmental Assessment, carrying out an EIA and EMP for the methane capture component. Guidance has also been provided on environmental aspects of the water distribution network.

E. COMPLIANCE WITH BANK POLICIES

This project complies with all applicable bank policies.

Horacio Terraza
Task Manager

Abel Mejia
Sector Manager

Axel van Trotsenburg
Country Director

ANNEX 1: COUNTRY AND SECTOR BACKGROUND

ARGENTINA: Olavarría Landfill Gas Recovery Project

Argentina has a population of nearly 38 million, with an estimated per capita annual waste generation of 375 kilograms. While residential collection in urban areas is satisfactory in most cases, final disposal of solid waste is poor. About 26,000 tons per day, or 60 percent, of solid waste is disposed of in open dumps without sanitary controls. More than 300 open dumps have been identified in the metropolitan area of Buenos Aires alone, and an estimated 2,000 countrywide. The main reason for the disparity between collection and proper disposal of solid waste is the population's lack of willingness to pay for a problem that does not affect them directly (the dumps are outside the city limits and not directly in front of their houses).

Problems resulting from disposal in uncontrolled dump sites include inadequate buffering from inhabited areas, uncontrolled access by waste pickers and children, location of sites in areas subject to flooding that usually do not meet environmental protection standards, and in some cases commingled final disposal of health care waste and regular household waste. These practices pose serious health and safety hazards linked to surface and ground water contamination and disease. The lack of legislation and management to deal properly with solid waste, the population growth rate, rural migration to urban centers (88 percent of the population lives in urban areas), and consumption patterns exacerbate the problem.

The economic crisis of the past 3 years has also worsened solid waste management (SWM) practices and disproportionately affected the lowest socioeconomic groups. More than half of the population is estimated to live below the poverty line. This phenomenon worsened two main problems related to SWM. First, about 100,000 people across the country earned a livelihood from informal waste collection in urban areas and waste picking at dumpsites. Second, final disposal of solid waste was under-budgeted during the crisis, generating widespread open dumping. The result was a high cost to society in terms of public health impacts and social and environmental degradation.

In addition, municipalities show a very low cost recovery level related to SWM service. SWM expenses typically represent between 5 percent and 35 percent of municipal budgets. Currently the main problem related to financial sustainability of SWM services is ineffective enforcement of policies to ensure that the population pays for them. In an estimated 70 percent of municipalities, only 30 percent of the population pays the SWM user fee (ABL, or *alumbrado barrido y limpieza*). Only 1 percent to 3 percent of municipalities successfully claim 80 percent of the collection rate, by charging for the ABL service in electricity bills. To compound the situation, user fees are generally set at levels below full cost recovery, and fees for industrial or commercial waste generators are not differentiated from those for household waste generators.

Another problem is that all revenues generated by the SWM service do not go to a segregated account to cover SWM operational and investment costs. Because there are typically general accounts for revenues, there is no possibility of tracking revenues for SWM separately.

While a broad federal law was recently approved by the Government of Argentina (GOA), it does not include specific economic and environmental principles and will have to be complemented by by-laws. The provinces will start enacting their own regulations, which cannot be less restrictive than the national laws. Clarity is needed on roles, responsibilities, and budgetary commitments at all three levels of government.

Now that the economic situation has begun to improve, municipalities are increasingly interested in addressing these issues. Reflecting the same concern, the GOA, through the Ministry of Health and the Secretariat of Environment and Sustainable Development (SAyDS), has given top priority to SWM in the framework of the National Environmental Agenda launched by the new administration in 2004. The first step was the development of an Integrated National Solid Waste Management Strategy (NSWMS). Preparation of the NSWMS was launched under the existing World Bank-financed Pollution Management Project executed by the SAyDS, the agency responsible for setting national solid waste policies and directing federal assistance in this area. The NSWMS will provide guidance to provincial and municipal governments on how to develop cost-effective and sustainable Waste Management Plans using a strategic planning approach to set targets and priorities and implement cost-recovery mechanisms.

The provincial strategy will be based on the establishment of inter-municipal agreements that will direct regional waste transfer, treatment, and disposal operations. Waste disposal responsibility will remain with the individual municipalities, with collection operations carried out under service contracts with communal enterprises or private operators. These plans will have to be supported by a provincial solid waste regulatory framework as an integral part of the Provincial Waste Management Plans. Owing to the high level of public awareness and demand for adequate SWM in the country, some provinces and municipalities, such as Olavarría, have already developed their own SWM plans. However, implementation is hampered by financial limitations.

The GOA is also seeking financial resources for SWM-related projects from the international emissions trading market. As a developing country (non-Annex B) that has ratified the Kyoto Protocol, Argentina is eligible to participate in the flexibility mechanisms such as the Clean Development Mechanism (CDM) enabled under the Protocol. Waste disposed of in landfills generates gases typically composed of 50 percent methane (greenhouse gas) that can be captured and flared or utilized. Those Emission Reductions (ERs) can be sold to Annex B countries to generate economic revenue for the improvement of current SWM practices. Current international prices are around $4–$5 per ton of CO2 equivalent (ton CO2e). An estimated 3–6.5 million ton CO2e could be mitigated and sold until 2012 through SWM projects such as the Olavarría Landfill Gas Recovery Project.

ANNEX 2: MAJOR RELATED PROJECTS FINANCED BY THE BANK OR OTHER AGENCIES

ARGENTINA: Olavarría Landfill Gas Recovery Project

In 1999 the Republic of Argentina received loan No. 4281-AR for the implementation of the Pollution Management Project. The objective of the project is to strengthen the institutional capacity of the Natural Resources and Sustainable Development Secretariat (SAyDS) to pilot, demonstrate, and coordinate the mainstreaming of innovative pollution management instruments. One of the project's main components is the design of a National Solid Waste Management (SWM) Strategy. This strategy focuses on providing a national framework for the strategic and adequate management of municipal solid waste (MSW), including waste reduction, recovery and recycling, remediation of dump sites, and construction of regional state-of-the-art landfills.

To support the National Strategy once it is completed, the Bank is working in parallel in the preparation of a Solid Waste Management Investment Loan. The main objectives of the new project will be to support and strengthen the National Strategy by financing the development of Provincial and Municipal Solid Waste Management Plans, grouping of municipalities for collection services and use of final disposal sites, and construction of sanitary landfills.

The Government of Argentina (GOA) has included in its strategy to address SWM the use of carbon financing through the Clean Development Mechanism (CDM) to improve current solid waste final disposal practices. Having ratified the Kyoto Protocol, Argentina is eligible to participate in flexibility mechanisms such as the CDM under the Protocol. The country could thus participate in the international carbon market by selling Emission Reductions (ERs) from projects that capture and flare landfill gases (LFGs), thereby generating a steady revenue stream. The Olavarría Landfill Gas Recovery Project, the first Carbon Financed project to be developed in Argentina, will help strengthen good SWM practices promoted by the above activities.

Another related project is the enabling activity for the preparation of the Second National Communication of the Argentine Government to the Convention on Climate Change. This Communication will enable the GOA to satisfy requirements under Article12.1 of the United Nations Framework Convention on Climate Change in accordance with decisions 10/CP.2, 11/CP.2, and 8/CP.5 and the new guidelines for the preparation of National Communications accorded in CP.8. The GOA submitted its First National Communication in 1997 and a revised version in 1999. According to the last version, emissions from SWM were 4.44 Mton CO2e, representing around 7 percent of total greenhouse gas (GHG) emissions in Argentina. The proposed project will contribute to the reduction of emissions from this sector.

A landfill methane recovery demonstration project is being implemented in Maldonado, Uruguay. The project objectives are to eliminate the emission of 18,962 tons of methane from the municipal landfill of Las Rosas, create local capacity to properly manage a landfill recovery project as part of Uruguay's action plan for improving municipal SWM, and draw lessons for replication elsewhere in Uruguay and Latin America. The project will build a

methane recovery system on the landfill's existing waste pile and six landfill cells and produce electricity to be sold to the national grid owned by the national electric utility.

Other emission reduction activities in the Latin America and the Caribbean (LAC) region include nearly 20 World Bank Carbon Finance projects under preparation. Most utilize hydro or wind power, although cogeneration, biomass, geothermal, SWM, and gas flaring reduction technologies are also represented. The first waste management project in operation supported by the World Bank Carbon Fund is located in Monterrey, Mexico. A landfill gas (LFG)-to-energy project in the city of Liepaja, Latvia, has been fully negotiated and will start operation shortly. A landfill CDM project being developed in Durban, South Africa, involves the collection of LFG and generation of power in three urban landfills. This project has not yet been approved because of the pending disclosure of the Environmental and Social Assessment. In Brazil the Nova Gerar LFG-to-energy project will start with two SWM sites in the Municipality of Nova Iguaçú: a former open dump in Marambaia and a sanitary landfill in Adrianópolis. The final generation capacity installed in the two sites is 11.4 megawatts. The generators will burn the methane in the LFG to produce electricity for export to the electric grid, to which they will be connected. Combustion of the methane is expected to reduce emissions of 11.8 million tons of carbon dioxide equivalent (ton CO2e) over the next 21 years and 2.5 million until 2012. To a lesser extent, the project is also expected to lead to ERs attributable to the displacement of thermal generation in the interconnected grid.

ANNEX 3: RESULTS FRAMEWORK AND MONITORING

ARGENTINA: Olavarría Landfill Gas Recovery Project

This section is not relevant for a Community Development Carbon Fund (CDCF) project, as there are no disbursements. CDCF Certified Emission Reductions (CER) purchase is inherently linked to the initial baseline analysis, which determines the amount of CERs and is thereafter subject to monitoring and evaluation.

ANNEX 4: DETAILED PROJECT DESCRIPTION

ARGENTINA: Olavarría Landfill Gas Recovery Project

The proposed project will capture and destroy methane that is currently generated at the municipal landfill of the town of Olavarría, which has a population of 100,000 and is located at the center of Buenos Aires Province, 350 kilometers from the capital.

1. General Description

The proposed activity will reduce greenhouse gas (GHG) emissions and thereby generate Certified Emission Reductions (CERs). The income generated from the CER sales will make it possible to eliminate the barriers preventing the implementation of this project.

One of the unique aspects of this project is its social component. Part of the income from the CER sales will be used by the Municipality of Olavarría (MO) to install a safe and reliable water distribution system in the rural village of Espigas, 80 kilometers from Olavarría and within the jurisdiction of the MO. The 550 inhabitants of this village lack a potable water supply network and use shallow and often contaminated wells to meet water needs. Gastrointestinal diseases related to contaminated water are one of the major health problems in Espigas. Project activities will also deliver local community benefits related to the creation of new jobs during construction, operation, and maintenance of the landfill gas (LFG) recovery plant and to the possibility of using captured LFG, a renewable energy resource, for future economic enterprises. An important additional benefit will be the expected replication of project activities in other towns in the country and the triggering of environmental awareness related to waste management, renewable energy resources, and climate change.

The following parties are involved in the Olavarría Landfill Gas Recovery Project:

- Municipality of Olavarría: Sponsor of the project. The municipal government is responsible for providing governance and multiple public services to Olavarría, including the management of municipal solid waste (MSW) collection and disposal at the landfill. The MO has supervised construction of new cells and landfill operation since the beginning of operations in November 1999. The MO owns not only the MSW but also the landfill site and future CERs.

- College of Engineering of the Universidad Nacional del Centro de la Provincia de Buenos Aires (National University of the Center of the Province of Buenos Aires, or UNCPBA): Developer of the project. UNCPBA will provide the human resources needed for engineering planning, project management, and technical assistance during development, construction, and operation of the LFG recovery plant.

- Community Development Carbon Fund (CDCF): Trust fund maintained and operated by the World Bank in its capacity as trustee for the CDCF on behalf of the public and private participants.

- Constructor of the LFG recovery system: To be designated through a bidding process.

- Operator of the LFG recovery system: To be designated through a bidding process.

2. Components

The project will include a Methane Capture component and a Community Development Plan component.

Component 1: Methane Capture

The current sanitary landfill has been in operation since November 1999 and is owned by the MO. It has a total area of 33 hectares and a total waste disposal capacity of approximately 30 years. The landfill was designed and constructed under sanitary engineering requirements. According to previous hydro-geological studies, the site was selected to prevent groundwater contamination. The landfill was isolated using a low permeability soil along with a synthetic liner and has a leachate treatment system with a stabilization pond and recirculation pumps and piping. The municipal landfill is operated by a private concessionaire supervised by the Department of Public Works and Services of the MO. The operation and maintenance of the LFG recovery plant are expected to be performed by a private concessionaire selected through a bidding process.

With respect to technology, an active LFG collection system will be employed to capture and destroy the methane. This technology is widely used in landfills all over the world. In fact, a well-designed active collection system is considered the most effective means of gas collection. The basic operational principle is the application of a vacuum to extract the gas from the waste mass. The main components of the active collection system to be installed are the gas extraction wells and collection piping, the gas moving equipment represented by mechanical blowers, the LFG treatment unit including the LFG condensate and flare systems, and the monitoring and control system. The gas extraction wells will be installed around the perimeter and in the center of the landfill. These wells will be connected to a master pipe that will carry the LFG to the blower facility.

The gas moving equipment will include a pipeline header system and blowers. A pipeline header system conveys the flow of collected LFG from the well system to the blower facility. Blowers of the single-stage centrifugal type will be installed. The LFG treatment unit will consist of condensate and flare systems. A knock-out drum will be used to remove gas condensate. An open flare will be installed to burn the LFG in a controlled environment to destroy harmful constituents and discharge them safely into the atmosphere. A monitoring and control system will be used to measure actual LFG flow and composition to avoid the intrusion of ambient air into the extraction wells and thereby optimize the extraction of gas.

It is important to mention that the gas extraction wells and collection piping will be installed in successive steps, beginning at the current landfill cell and expanding to new cells as they are opened. The other components of the system will be procured and installed at the beginning of the construction of the plant. System components and equipment, as well as the construction of the plant, will be contracted and executed through a bidding process.

In this project LFG will be combusted with no energy recovery, but the utilization of the LFG will be analyzed in future upon actual recovery LFG rate obtained and other economic factors. This analysis is not included in this document. GHG emissions from the Olavarría municipal landfill will be reduced through the collection of landfill gas and subsequent destruction of methane in a flare. These Emission Reductions (ERs) will be directly measured and calculated according to the Monitoring Plan.

ERs can be projected from basic information about MSW in Olavarría. The town generates a daily average of 85 tons of MSW, and 140,000 tons have already been disposed of at the municipal landfill. A study by the College of Engineering of the UNCPBA shows that almost 79 percent of this MSW consists of organic matter: 63 percent food residues and 16 percent paper and cardboard. The field study yielded an LFG composition of 53 percent methane, confirming previous theoretical calculations. An average of 282 cubic meters of LFG per hour are expected during a 21-year period beginning in 2006, calculated using the First Order Decay (FOD) method[2] as a theoretical tool to predict the LFG generation rate at the landfill and assuming a LFG recovery efficiency of 50 percent. Assuming a flare efficiency of 97 percent, a flare availability of 96 percent, methane density at normal pressure and temperature, and a Global Warming Potential (GWP) for methane of 21, estimated annual average ERs are 17,301 tons of carbon dioxide equivalent (ton CO2e) over the 21-year period beginning in 2006. These ERs are the result of the capture and destruction of the methane contained in the LFG that would otherwise be emitted into the atmosphere.

Technical Design

The configuration of the landfill gas capture plant is divided in four components main components:

a) *Extraction and transport system*: 13 wells will be installed in each module in order to extract LFG and transport it through a piping system to the flaring equipment. The depth of the wells will vary according to its position in the module and its radius of influence is expected to be 25 m. The top of the well will have a bentonite and membrane (30 microns) in order to avoid gas leakages. The LFG extracted from the wells will be transported through high density polyethylene pipes to the flaring system;

b) *Vaccuum system*: comprises one blower per module with its accessories. The blower will comply with the technical specifications required to handle explosive gases. The blower will provide the vaccuum needed to absorb LFG out of wells with a maximum flow of 250 m3/hour;

c) *Flaring system*: a closed flare will be installed and connected to all blowers. LFG will be sent to the flare and combusted. The flare will be able to operate with gas flows ranging from 80-250 m3/hour. It will have a combustion efficiency above 97% and will operate between 950 and 1050 oC. in order to assure CO emissions below 100mg/Nm3; and

[2] This method is described in chapter 5 of *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, Intergovernmental Panel on Climate Change (IPCC), Geneva, 2000.

d) *Condensates system*: it is intended to handle the LFG condensates accumulated during its transportation. It comprises condensate traps, condensate tank and a set of pipes and pumps required to transport the condensate into the leachate pond.

Calculation of ERs

The FOD method was used to estimate the total anthropogenic emissions (i.e., baseline emissions) from Olavarría's landfill. The FOD method produces an emission profile that better reflects the true pattern of the degradation process over time. The following formula was used to estimate the total methane generated within the boundary of the LFG recovery facility in a given year:

$$CH_4 = \sum_x A \cdot k \cdot MSW_T(x) \cdot L_o \cdot e^{-k \cdot (t-x)} \cdot RE \qquad (1)$$

where,

CH_4 = methane generated in year t in [Gg CH_4]/year
A = normalization factor [1-exp(-k)]/k
t = year of inventory
x = years for which input data should be added
k = methane generation rate in year^{-1}
$MSW_T(x)$ = total municipal waste disposed at the landfill in year x in [Gg MSW]/year
L_o = methane generation potential in [Gg CH_4]/[Gg MSW]
RE = recovery efficiency of the gas collection system

The methane generation potential L_o was calculated as follows:

$$L_o = MCF \cdot DOC \cdot DOC_F \cdot F \cdot \frac{16}{12} \qquad (2)$$

where,

MCF = methane correction factor
DOC = degradable organic carbon in [Gg Carbon]/[Gg MSW]
DOC_F = fraction of DOC dissimilated
F = fraction by volume of CH_4 in landfill gas
16/12 = conversion from carbon to CH_4 [Gg CH_4]/[Gg Carbon]

The 2000 *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* of the Intergovernmental Panel on Climate Change (IPCC) gives default values for MCF according to the type of site. For this project, MCF = 0.8 was assumed. DOC is given by IPCC as a function of waste composition. Taking into account the waste composition in Olavarría, a value of DOC = 0.175 [Gg Carbon]/[Gg MSW] was calculated. The value of 0.7 assumed for DOC_F is lower than the default value given by the IPCC. F was estimated based on waste composition and verified in the field. Calculations yielded a value of F = 0.53.

Introducing these values in Eq. (2) above and considering the methane density of 0.678 kg/m^3 at normal temperature and pressure (15ºC and 101 kPa respectively), calculations yield L_o = 102 [m^3 CH_4]/[Gg MSW].

Total municipal solid waste disposed in a given year $MSW_T(x)$ is known from records kept since the beginning of the landfill operations in November 1999. To estimate a projection of the $MSW_T(x)$ for future years, Argentina's projected GDP growth of 6 percent per year was taken into account. To define the baseline scenario, an MSW generation growth rate of 3 percent was then assumed for the first 2 years of the project (2006–2007) and a more conservative growth rate of 2 percent was assumed for the remaining years of the project's crediting period (2008–2026). Thus the annual average of the MSW disposed of at the landfill during the 21-year crediting period is 40.8 Gg/year.

The methane generation rate *k* was estimated using the formula given by IPCC.

$$k=\frac{\ln(2)}{t_{1/2}} \qquad (3)$$

where,

k is related to the time taken for the DOC in waste to decay to half its initial mass (the half-life or $t_{1/2}$).

A DOC half-life of 7 years was assumed for this project, following IPCC´s recommendations and considering both the high moisture conditions in Olavarría and the large amount of rapidly degradable material in the waste. This half-life yields a value of k = 0.099 $year^{-1}$.

The recovery efficiency of the LFG collection system can be estimated from previous experience recounted in the literature and standards recommended by specialized research institutions. Given that Olavarría's landfill was not originally designed for LFG recovery purposes, a conservative *RE* of 50 percent was assumed. This efficiency is smaller than that of most current LFG recovery projects and other recommended values.

The values of L_o, $MSW_T(x)$, and *k* obtained as explained above, in addition to the assumed *RE*, allow calculation of the total methane emissions (baseline emissions) within the boundary of the project when introduced in Eq. (1). An annual average of 18,580 ton CO2e of baseline emissions is estimated over the 21-year crediting period beginning in 2006.

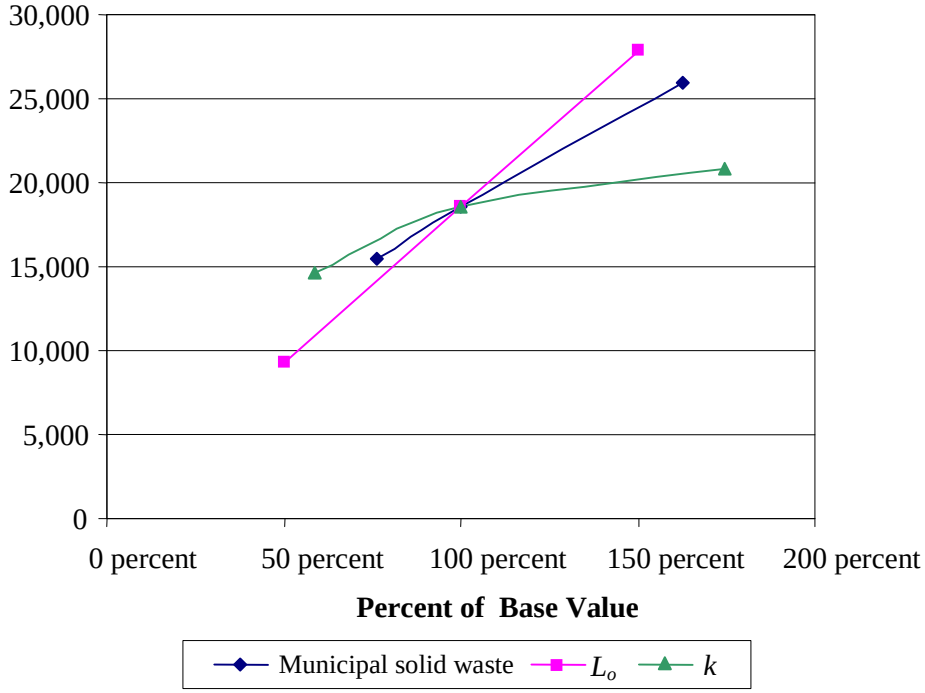
Table 1 shows the baseline emissions in ton CO2e during the lifetime of the project, assuming a Global Warming Potential for methane of 21.

Table 5: Baseline Emissions

Year	Baseline emissions	Cumulative baseline emissions
	ton CO2e per year	ton CO2e
2006	9,315	9,315
2007	10,540	19,855
2008	11,692	31,547
2009	12,778	44,325
2010	1,3805	58,130
2011	14,780	72,910
2012	15,709	88,619
2013	16,597	105,215
2014	17,448	122,663
2015	18,267	140,930
2016	19,059	159,989
2017	19,826	179,815
2018	20,572	200,386
2019	21,300	221,686
2020	22,012	243,699
2021	22,712	266,411
2022	23,402	289,813
2023	24,083	313,896
2024	24,757	338,653
2025	25,427	364,081
2026	26,094	390,175

As explained earlier, inevitable uncertainties underlie the baseline scenario. To account for these uncertainties, a sensitivity analysis of the estimated baseline emissions was carried out based on variations in the MSW generation rate, the methane generation potential Lo, and the methane generation rate k. The results are shown in figure 1. For the MSW, the annual generation growth rate varied from 0 percent to 6 percent for the 21-year crediting period, yielding annual average values of 31.1 for 0 percent and 66.5 [Gg MSW] for 6 percent per year. With respect to the methane potential generation Lo, a value of 102 [m3 CH4]/[ton MSW] was initially calculated. Deviations of 50 percent from this base value were considered to estimate the variation in baseline emissions. The Lo was then varied from 51 to 153 [m3 CH4]/[ton MSW]. The same variation was applied to the methane generation rate k initially set at 0.099 year–1. Then *k* was varied from 0.05 to 0.17 year–1.

Figure 1: Sensitivity Analysis of the Baseline Emissions in Terms of *MSW*, L_o, and *k*

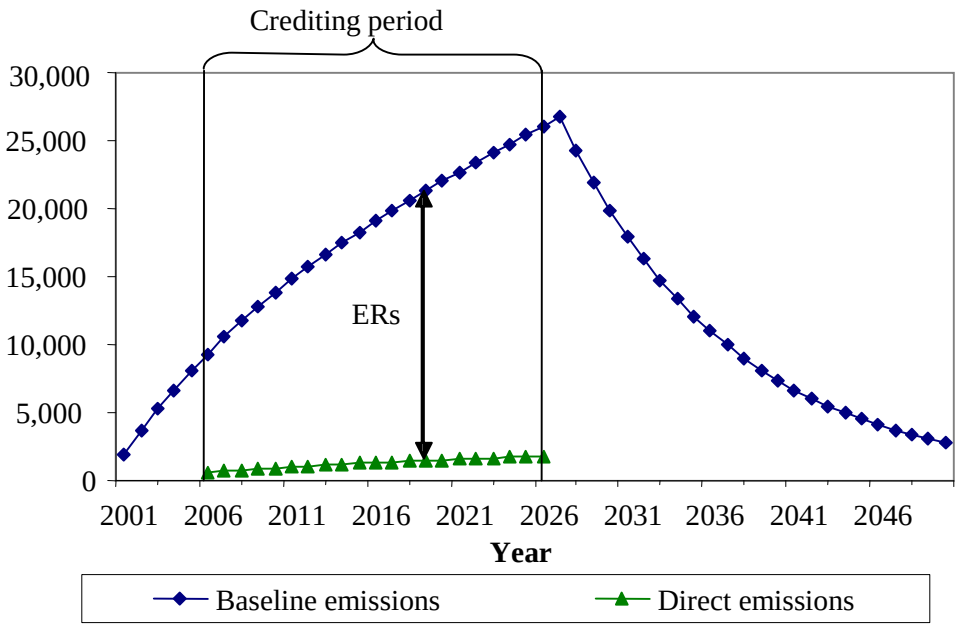


Methane potential generation L_o shows the strongest effect on baseline emissions with respect to the other variables analyzed. A reduction of 50 percent in the base value of L_o yields a similar reduction in the baseline emissions. However, the value of L_o used (and calculated as explained above) to estimate the baseline emissions is already in the lower range given in the literature. Therefore, it seems unlikely that such a reduction in the L_o value can be reached.

In this project the ERs can and will be measured directly at the landfill site once the LFG recovery plant is installed and operating, as described in the Monitoring Plan in annex 8. However, a preliminary estimation of ERs was performed by subtracting the direct emissions resulting from the project activity from the baseline emissions. The estimated annual average ERs are 17,301 tons of CO_2 equivalent over the 21-year crediting period beginning in 2006.

Figure 2 shows the evolution of baseline emissions, direct emissions, and ERs within the boundary of the project over the crediting period in ton CO2e.

Figure 2: Evolution of Baseline Emissions, Direct Emissions, and ERs (in ton CO2e per year)



The total ERs during the 21-year crediting period beginning in 2006 are 363,331 ton CO2e, and the annual average ERs for the same period are 17,301 ton CO2e. Because the flare efficiency of 97 percent and flare availability of 96 percent assumed to estimate the ERs are quite conservative, the risks associated with the ERs estimation are minimal.

Table 2 shows the total baseline emissions, direct emissions, and ERs within the boundary of the project over the crediting period in ton CO2e.

Table 6: Baseline Emissions, Direct Emissions and Emission Reductions

Year	Baseline emissions	Cumulative baseline emissions	Direct emissions	Cumulative direct emissions	ERs	Cumulative ERs
	ton CO2e per year	ton CO2e	ton CO2e per year	ton CO2e	ton CO2e per year	ton CO2e
2006	9,315	9,315	641	641	8,674	8,674
2007	10,540	19,855	725	1,366	9,815	18,489
2008	11,692	31,547	804	2,170	10,887	29,377
2009	12,778	44,325	879	3,050	11,899	41,275
2010	13,805	58,130	950	3,999	12,855	54,130
2011	14,780	72,910	1,017	5,016	13,763	67,894
2012	15,709	88,619	1,081	6,097	14,628	82,522
2013	16,597	105,215	1,142	7,239	15,455	97,977
2014	17,448	122,663	1,200	8,439	16,247	114224
2015	18,267	140,930	1,257	9,696	17,010	131,000
2016	19,059	159,989	1,311	11,007	17,747	148,982
2017	19,826	179,815	1,364	12,371	18,462	167,444

2018	20,572	200,386	1,415	13,787	19,156	186,600
2019	21,300	221,686	1,465	15,252	19,834	206,434
2020	22,012	243,699	1,514	16,766	20,498	226,932
2021	22,712	266,411	1,563	18,329	21,150	248,082
2022	23,402	289,813	1,610	19,939	21,792	269,874
2023	24,083	313,896	1,657	21,596	22,426	292,300
2024	24,757	338,653	1,703	23,299	23,054	315,354
2025	25,427	364,081	1,749	25,049	23,678	339,032
2026	26,094	390,175	1,795	26,844	24,299	363,,331

Component 2: Community Development Plan

The Community Development Plan component of the Olavarría Landfill Gas Recovery Project consists of the construction of a centralized water network to supply potable water to most of the households and public buildings in the village of Espigas. The plan also includes the pilot construction of two solar water heating systems to supply hot water to the elementary school and one of the high schools.

1) *Water distribution network*. The preliminary engineering design for the water distribution network has already been completed by the Department of Public Works and Services of the MO. The network will include two 60-meter wells located in specific sites and deep enough to reach non-contaminated aquifers, two submergible electrical water pumps with 10m3/hour of capacity each, an elevated 50-cubic meter water tank, and a 4,000-meter piping system to carry the water by gravity from the tank to the houses and buildings throughout the village. The network will also include water monitoring equipment and a treatment plant. Water distribution pipes will be laid up to the "municipal line," located on the sidewalk at a certain distance from the curb. Installation of the connecting pipes between the distribution water network and the properties' internal water systems will be the responsibility of each property owner. Public institutions such as the kindergarten, elementary and high schools, and hospital will also be responsible for their own connections to the line; and

2) *Solar water heating systems*. These systems will include flat solar collectors, insulated water tanks, and a control system. An active circulation system will be used to pump the water through the systems. The solar heating equipment will be integrated in the current hot water systems based on propane-fired water heaters and insulated storage tanks. In the first phase of the project, solar water heating will be supplied only to the local elementary and high schools that use wood and expensive containerized gas. The installation of this system will serve as a demonstration of the technology in the village and is expected to encourage new installations in other public buildings in Espigas and elsewhere.

ANNEX 5: PROJECT COSTS

ARGENTINA: Olavarría Landfill Gas Recovery Project

Investment costs

Development costs[1]	$37,600
Installed costs[2]	$171,900
Community Development Plan costs[3]	$143,000
Total project costs	**$352,500**

Other costs

Transaction costs (initial)	$53,400
Initial verification cost	$6,600
Annual transaction cost	$6,600
Annual O&M costs	7 percent of the annualized investment costs

Notes

[1] Planning, design, engineering and contingencies for the LFG recovery plant

[2] Civil works, collection, extraction, monitoring, and flaring system of the LFG recovery plant

[3] Installation of the water distribution network and solar water heating system in Espigas

ANNEX 6: IMPLEMENTATION ARRANGEMENTS

ARGENTINA: Olavarría Landfill Gas Recovery Project

The parties involved in the project activities and their roles in the implementation of the project are listed below.

- Municipality of Olavarría: Sponsor of the project. The municipal government is responsible for providing governance and multiple public services to Olavarría, including the management of municipal solid waste (MSW) collection and disposal at the landfill. The MO has supervised construction of new cells and landfill operation since the beginning of operations in November 1999. The MO owns not only the MSW but also the landfill site and future CERs.
- College of Engineering of the Universidad Nacional del Centro de la Provincia de Buenos Aires (National University of the Center of the Province of Buenos Aires, or UNCPBA): Developer of the project. UNCPBA will provide the human resources needed for engineering planning, project management, and technical assistance during development, construction, and operation of the LFG recovery plant.
- Community Development Carbon Fund (CDCF): Trust fund maintained and operated by the World Bank in its capacity as trustee for the CDCF on behalf of the public and private participants.
- Constructor of the LFG recovery system: To be designated through a bidding process.
- Operator of the LFG recovery system: To be designated through a bidding process.

Implementation of the Community Development Plan

The Community Development Plan will be implemented by the following partners:

- The MO will be responsible for the remainder of the investment costs ($77,500) of the Community Development Plan that are not covered by the sales of CERs from the Olavarría Landfill Gas Recovery Project. The total investment costs required for the water distribution network and solar water heating systems are expected to be $143,000. The CDCF will pay the Municipality $0.50 for each CER contracted under the Emission Reductions Purchase Agreement (ERPA). The MO has already developed a preliminary technical plan and will be in charge of the construction, operation, and maintenance of the water system.
- The developer, the College of Engineering of the UNCPBA, will be responsible for all technical and organizational aspects of the Community Development Plan during the implementation and operation phases, including contracting for the design, construction, and installation of the solar water heating systems. The developer will also be in charge of evaluating the progress of the social program and its sustainability.

Payment and Flow of Funds

At the time of the signing of the ERPA, an anticipated schedule of payments will be prepared based on the delivery of ERs. The project sponsors will make requests for payment to the CDCF as agreed in the ERPA. For this project CDCF agreed to pay up to $65,500 in advance of the generation of ERs. The advance payment is for the execution of a contract for construction of the water distribution system and solar water heating system described in the Community Development Plan. Successive payments from the CDCF will be made against delivery of verified and certified ERs. The ERPA with the CDCF will expire after ERs up to the total contract amount of 131,000 ton CO2e have been delivered.

In the event that the project sponsor fails to deliver the quantity of ERs for any given calendar year as set forth in the ERPA, the project sponsor will be required to recover the shortfall over the course of the following calendar year or as other period agreed with CDCF, as indicated under Article XII of the ERPA. The Carbon Finance Unit support in the project comes from corporate and government participants that are investors in the CDCF and is to be deducted up to a maximum from the ER payments. Apart from this support, the project does not include any World Bank or International Finance Corporation financing.

ANNEX 7: ECONOMIC AND FINANCIAL ANALYSIS

ARGENTINA: Olavarría Landfill Gas Recovery Project

The Olavarría Landfill Gas Recovery Project is based on the development of a well- controlled sanitary landfill site in the Argentinean Municipality of Olavarría, close to the capital city of Buenos Aires. The enterprise comprises landfilling activity, gas collection, and gas flaring. Although the gas generation is totally dependent on the accumulation of solid waste in the site, the landfilling activity is not part of the Clean Development Mechanism (CDM) and does not result in any carbon dioxide emission reduction equivalent (CO2e). Therefore, the final disposal financials (i.e., capital expenditure, maintenance costs, and collection fees) will not be part of this financial evaluation. The numbers to be analyzed will include the gas collection and gas flaring systems ("project figures"). In addition to the gas recovery, the project will develop a Community Development Plan, which is described in annex 8.

According to the assumptions of the project sponsor, the Municipality of Olavarría project investments total $352,500, broken down in tables 7 and 8 below.

Table 7: Total Investments

Development costs	**$37,600**
Civil work and machinery	**$171,900**
Community Development Plan	**$143,000**
Total project costs	**$352,500**

Table 8: Breakdown of Investments

CAPEX	2005	2006	2007	2008	2009	2010	2011	2012	2013
Civil works LFG	$2,069	$0	$0	$0	$0	$0	$0	$0	$0
Civil works Community Devel. Plan	$71,500	$71,500							
Total civil works	**$73,569**	**$71,500**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Years of depreciation									
Machinery and equipment	**$81,368**	**$0**	**$0**	**$11,053**	**$0**	**$11,053**	**$0**	**$0**	**$11,053**
Years of depreciation									
Intangible	**$20,883**	**$16,745**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Years of depreciation									
Total investment LFG	$83,437	$83,437	$83,437	$94,490	$94,490	$105,544	$105,544	$105,544	$116,597
Total investment Comm. Devel. Plan	$71,500	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000	$143,000

The current evaluation did not account for local due diligence, except through an initial approach with the project developers (professors in the Faculty of Engineering of the University of Olavarría). It is important to note that the Bank's participation in the project does not include lending. Risk in this type of projects is limited to the World Bank's preparation costs and advanced payments for the Emission Reductions (ERs), which in this project represent $65,000, or about 11 percent of the total carbon finance payments for ERs (estimated at $592,000 from 2005 until 2015).

According to the project developers, all development studies incurred by the project so far have been covered by the Municipality (project sponsor). The sponsor will also conclude the project with its own resources, to be provisioned in its upcoming annual budgets. The advance

carbon finance payments of $65,500 will also be allocated to the Community Development Plan agreed by the parties. The Community Development Plan aims to develop a water distribution system and solar water heating systems, which are expected to require $143,000 in investments, as shown in table 8 above.

Financial evaluation of the project will be based on the results of the financial projections for the project life of 21 years. Special attention will be given to the period until 2015, which represents the tenure of the Emission Reduction Purchase Agreement (ERPA) contract being signed between the Carbon Finance Unit of the World Bank and the project sponsors for the acquisition of the ERs.

Based on a formal consultation between the project developers and the competent authorities in Argentina, as well as the fact that the project will be assumed by the Municipality of Olavarría, the project will not incur the usual taxes applied to commercial projects. The tax exemptions, which include the Value Added Tax and Sales and Income Taxes, represent a substantial increase in the project's profitability.

Since the project does not aim to pursue electricity generation, the ERs will be the sole source of income. An accurate estimation of the generation of ERs is therefore fundamentally important for the viability of the project. The project developers adopted the conservative assumptions of organic content in the solid waste and methane content in the gas generation, which were checked by specialized consultants. Moreover, the technical design of the landfill site, collection, and flaring systems was revised and validated by the technical experts of the Bank.

The remaining economic and financial assumptions used for this project financial projection are shown in table 9 below.

Table 9: Assumptions Adopted in the Olavarría Project

FINANCIAL ANALYSIS - Assumptions

CERs

Factor ERs	**1**	
Transaction Costs of CERs (initial)	**$53,400.00**	**CGS**
Initial verification	**$6,600.00**	**CGS**
Anual Transaction Costs of CERs	**$6,600.00**	
CER portion to project	**$4.00**	
CER portion to social programs	**$0.50**	
CER total price	**$4.50**	
ERs in 2003	0	
ERs in 2004	0	
ERs in 2005	0	
ERs in 2006	8,674	
ERs in 2007	9,815	
ERs in 2008	10,887	
ERs in 2009	11,899	
ERs in 2010	12,855	
ERs in 2011	13,763	
ERs in 2012	14,628	
ERs in 2013	15,455	
ERs in 2014	16,247	
ERs in 2015	16,776	
ERs in 2016	0	
ERs in 2017	0	
ERs in 2018	0	
ERs in 2019	0	
Total ERs	**$589,500**	
Advance payments for ERs	**$65,000**	**$30,000** **$35,000**

Financing components for the cash flow

Total investment	$352,492.14	**1**	**Project IRR**
% of the investment provided by loan	0.0%	**WACC**	**15.00%**
Loan interest rate	10.0%		
Loan term	10		
grace period	2		
Payments	8		
Discount rate	**15%**		
Income tax	**0%**		

CAPEX

Civil works LFG	$2,069
Civil works Community Development Plan	$143,000
Total civil works	**$145,069**
Years of depreciation	30
Machinery and equipment	**$169,795**
Years of depreciation	10
Intangible	**$37,628**
Years of depreciation	5
Total investment LFG	**$209,492**
Total investment Community Devel. Plan	**$143,000**

Prices/sales assumptions

Gross price per KWh Spot Market	**$0.000**	
Gross price per KWh Free Market (PPA)	**$0.000**	
% of sales in spot market	**100%**	
Total GWh per year (average)	**0.00**	
Price per KW(power) per month	$0.00	**2015**
Total net power (MW)	**0.00**	**0.00 MW**

Extraordinary income

Additional annual income from the Municipality	**$71,500**
	$378,000

Costs and Expenses

Taxes on sales (IPI, ICMS, PIS, COFINS)	**0.00%**	**Gross sale deductions**
O&M	**7%**	**CGS**
Administrative expenses (fixed)	**2%**	**Fixed expenses**
Insurance per year	**1%**	**Fixed expenses**
Inspection per year	$0	**Fixed expenses**
Other contributions	0.0%	**Fixed expenses**
Participation of workers	0% of EBT	**Except. exp/income**
Dividends	**0%**	**After net Income**
VAT investment	**0%**	**CAPEX only**

Based on previous assumptions for the financial model of Olavarría, the following Income Statement (Profit and Loss Statement) may be expected for the project:

Table 10: Projection of Income Statement for the Olavarría Project

		Dec-05	Dec-06	Dec-07	Dec-08	Dec-09	Dec-10	Dec-11	Dec-12	Dec-13	Dec-14	Dec-15	Dec-16
INCOME STATEMENT ($'000)													
GROSS SALES REVENUES		**30**	**35**	**39**	**37**	**33**	**37**	**42**	**53**	**66**	**70**	**73**	**75**
growth					*-6%*	*-11%*	*14%*	*12%*	*28%*	*24%*	*6%*	*5%*	*3%*
- Sales taxes		0	0	0	0	0	0	0	0	0	0	0	0
NET SALES REVENUES		**30**	**35**	**39**	**37**	**33**	**37**	**42**	**53**	**66**	**70**	**73**	**75**
- Cost of goods sold **(w/o DDA)**		0	6	12	27	28	28	29	14	14	15	15	16
growth					*121%*	*3%*	*0%*	*3%*	*-52%*	*0%*	*6%*	*0%*	*5%*
GROSS MARGIN		**30**	**29**	**27**	**9**	**5**	**9**	**13**	**39**	**52**	**55**	**58**	**60**
(margin)				68%	25%	14%	24%	30%	74%	79%	79%	80%	79%
- Fixed expenses		0	5	5	5	5	5	5	5	5	5	5	5
EBITDA		**30**	**24**	**21**	**4**	**(1)**	**4**	**7**	**34**	**47**	**50**	**53**	**55**
(margin)				55%	11%	-2%	11%	18%	64%	71%	71%	73%	73%
- Depreciation and amortization		0	22	22	23	23	24	24	24	25	25	26	26
OPERATING PROFIT (EBIT)		**30**	**2**	**(1)**	**(19)**	**(24)**	**(20)**	**(16)**	**10**	**22**	**25**	**28**	**29**
Interest received	**from B/S**	0	0	0	0	0	0	0	0	0	0	0	0
Interest expenses		0	0	0	0	0	0	0	0	0	0	0	0
Tributes/taxes													
- Net interest expenses/(income)		0	0	0	0	0	0	0	0	0	0	0	0
+ Other operational income/(expense)		36	54	18	18	18	18	18	18	18	18	18	18
OPERATING RESULT (EBT)		**66**	**56**	**17**	**(1)**	**(6)**	**(2)**	**2**	**28**	**40**	**43**	**46**	**47**
+ Exceptional income/(expense)		0	0	0	0	0	0	0	0	0	0	0	0
GROSS INCOME		**66**	**56**	**17**	**(1)**	**(6)**	**(2)**	**2**	**28**	**40**	**43**	**46**	**47**
- Income tax	0%	0	0	0	0	0	0	0	0	0	0	0	0
NET INCOME		**66**	**56**	**17**	**(1)**	**(6)**	**(2)**	**2**	**28**	**40**	**43**	**46**	**47**
(margin)				45%	-2%	-17%	-5%	4%	53%	61%	62%	62%	62%
- Dividends	0%	0	0	0	0	0	0	0	0	0	0	0	0
RETAINED EARNINGS		66	56	17	(1)	(6)	(2)	2	28	40	43	46	47

All figures in table 10 are presented in U.S. dollar terms. The projection does not consider either currency devaluation or local inflation over the project period. because the project has no other source of revenue, annual results depend on carbon revenues. Therefore, the high volatility of the project's Earnings before Interest, Taxes, Depreciation, and Amortization (EBITDA) and Operating Results (Earnings before Interest and Taxes, or EBIT) mainly result from the conditions agreed on in the ERPA. These conditions include advance payments for ERs ($65,000 in 2005 and 2006), their further recovery (from 2008 to 2012), and recovery of the carbon finance preparation costs ($60,000 from 2008 to 2011). Operating Results (Earnings before Tax, or EBT), Gross Income, and Net Income will only be impacted by the Municipality's exceptional capital injection in the project. The absence of loans and exemption from taxes result in no further costs for the project, leading to sound profitability levels and Net Incomes reaching up to 62 percent of Gross Revenues between 2014 and 2016.

The project's liquidity is evaluated based on table 11 below. The Cash Flow projection figures are similar to the figures in the Income Statement, with benefits still adequate to recover the asset's depreciation. To be conservative, no additional positive financial impact has been considered because of the project's cumulative profit, although Free Cash Flow results are extremely strong, with figures reaching over 90 percent of Gross Revenues in several years between 2005 and 2016.

No extensive analysis will be made of the Current Ratio, normally used for liquidity evaluations, because the extremely high cash surplus generated by this project may be transferred between Current and Long Term to better accommodate the above index.

The cumulative cash surplus in the project's operations is expected to reach $400,000 in 2016, which exceeds the total capital expenditure required for the project's development and implementation detailed in table 11.

Table 11: Projection of Cash Flow Statement for the Olavarría Project

		Dec-05	Dec-06	Dec-07	Dec-08	Dec-09	Dec-10	Dec-11	Dec-12	Dec-13	Dec-14	Dec-15	Dec-16
CASH FLOW ($'000)													
NET INCOME		66	56	17	(1)	(6)	(2)	2	28	40	43	46	47
+ Depreciation and amortization		0	22	22	23	23	24	24	24	25	25	26	26
- Interest received		0	0	0	0	0	0	0	0	0	0	0	0
+ Total interest expenses		0	0	0	0	0	0	0	0	0	0	0	0
GROSS OPERATING CASH FLOW		**66**	**78**	**39**	**22**	**17**	**22**	**25**	**52**	**65**	**68**	**71**	**73**
Change in accounts receivable (-)	from B/S	(5)	(1)	(1)	0	1	(1)	(1)	(2)	(2)	(1)	(1)	(0)
Change in inventories (-)	from B/S	0	(1)	(1)	(3)	(0)	0	(0)	3	0	(0)	0	(0)
Change in accounts payable (+)	from B/S	0	1	1	3	0	0	0	(3)	0	0	0	0
+ Working capital requirements	($10)	(5)	(1)	(1)	0	1	(1)	(1)	(2)	(2)	(1)	(1)	(0)
NET OPERATING CASH FLOW		**61**	**77**	**39**	**22**	**18**	**21**	**25**	**50**	**63**	**67**	**71**	**72**
				99%	61%	55%	57%	59%	94%	95%	96%	97%	96%
Payment CPLTD		0	0	0	0	0	0	0	0	0	0	0	0
Interest received		0	0	0	0	0	0	0	0	0	0	0	0
Interest expenses and dividends		0	0	0	0	0	0	0	0	0	0	0	0
- Total debt service		0	0	0	0	0	0	0	0	0	0	0	0
FREE CASH FLOW		**61**	**77**	**39**	**22**	**18**	**21**	**25**	**50**	**63**	**67**	**71**	**72**
				99%	61%	55%	57%	59%	94%	95%	96%	97%	96%
- CAPEX		176	88	0	11	0	11	0	0	11	0	11	0
+ Changes in short-term loans		0	0	0	0	0	0	0	0	0	0	0	0
+ New long-term loans		0	0	0	0	0	0	0	0	0	0	0	0
+ W.T. exemption		0	0	0	0	0	0	0	0	0	0	0	0
+ VAT recovery		0	0	0	0	0	0	0	0	0	0	0	0
+ Other Incomes		0	0	0	0	0	0	0	0	0	0	0	0
CHANGES IN CASH		**(115)**	**(11)**	**39**	**11**	**18**	**10**	**25**	**50**	**52**	**67**	**60**	**72**

The absence of indebtedness makes a solvency analysis irrelevant because the project shows Net Worth/Total Assets of about 1.0 during its lifetime (table 12 below). To check the project's resistance to the critic variables, these variables have been sensitized for different scenarios as follows:

- 25 percent reduction in the generation of ERs (this analysis covers scenarios of eventual reduction in the daily amount of solid waste disposed of in the site, reduction in the organic content of the waste, or even reduction in the collection efficiency in the system).
- 25 percent increase in capital expenditures (i.e., investments).
- The sum of the two scenarios above.

Table 12: Projection of Balance Sheet Statement for the Olavarría Project

BALANCE SHEET (R$'000)		Dec-05	Dec-06	Dec-07	Dec-08	Dec-09	Dec-10	Dec-11	Dec-12	Dec-13	Dec-14	Dec-15	Dec-16
Cash and banks and surplus cash	from CF	0	0	10	10	10	10	10	10	10	10	10	10
Accounts receivable	60	5	6	7	6	5	6	7	9	11	12	12	13
Inventories	60	0	1	2	5	5	5	5	2	2	2	2	3
Recovery taxes (VAT)		0	0	0	0	0	0	0	0	0	0	0	0
Other receivables		0	0	0	0	0	0	0	0	0	0	0	0
Total current assets		**5**	**7**	**19**	**21**	**20**	**21**	**22**	**21**	**23**	**24**	**25**	**25**
Long-term investments		0	0	29	40	58	68	93	143	195	262	321	394
Other long-term assets (mainly interest on capital)		0	0	0	0	0	0	0	0	0	0	0	0
Total long-term assets		**0**	**0**	**29**	**40**	**58**	**68**	**93**	**143**	**195**	**262**	**321**	**394**
Gross fixed assets		176	264	264	275	275	286	286	286	297	297	308	308
Accumulated depreciation		0	22	44	67	90	114	137	161	186	211	236	262
Net fixed assets		176	242	220	208	185	173	149	125	111	87	72	46
Participations/investments		0	0	0	0	0	0	0	0	0	0	0	0
Permanent assets		**176**	**242**	**220**	**208**	**185**	**173**	**149**	**125**	**111**	**87**	**72**	**46**
TOTAL ASSETS		**181**	**249**	**267**	**269**	**264**	**262**	**264**	**289**	**329**	**372**	**418**	**465**
Short-term debt/overdraft/CPLTD		0	0	0	0	0	0	0	0	0	0	0	0
Accounts payable	60	0	1	2	5	5	5	5	2	2	2	2	3
Tax provisions		0	0	0	0	0	0	0	0	0	0	0	0
Other current liabilities		0	0	0	0	0	0	0	0	0	0	0	0
Total current liabilities		**0**	**1**	**2**	**5**	**5**	**5**	**5**	**2**	**2**	**2**	**2**	**3**
Long-term loan		0	0	0	0	0	0	0	0	0	0	0	0
Tax provisions		0	0	0	0	0	0	0	0	0	0	0	0
Other long-term liabilities (mainly interest on capital)		0	0	0	0	0	0	0	0	0	0	0	0
Total long-term liabilities		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL LIABILITIES		**0**	**1**	**2**	**5**	**5**	**5**	**5**	**2**	**2**	**2**	**2**	**3**
Capital stock		0	0	0	0	0	0	0	0	0	0	0	0
Retained earnings (beginning of the year)		0	66	122	139	138	133	131	132	161	201	243	289
Year profit (loss)	from P&L	66	56	17	(1)	(6)	(2)	2	28	40	43	46	47
Retained earnings (end of the year)		66	122	139	138	133	131	132	161	201	243	289	336
Capital/profit reserves		**115**	**126**	**126**	**126**	**126**	**126**	**126**	**126**	**126**	**126**	**126**	**126**
Balancing line		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Shareholders equity		**181**	**248**	**265**	**265**	**259**	**257**	**259**	**287**	**327**	**370**	**415**	**462**
TOTAL LIABILITIES AND SHS' EQUITY		**181**	**249**	**267**	**269**	**264**	**262**	**264**	**289**	**329**	**372**	**418**	**465**

Table 13 shows the Initial Return Rates (IRRs) and Net Present Values (NPVs) of the project with and without ERs. For the NPV calculation, a broad range of discount rates were adopted, adequately covering different opportunity costs and the sovereign risk in Argentina.

Table 13: NPVs and IRR in the Olavarría Project

IRR 2016		IRR 2026	
+ERs	-ERs	+ERs	-ERs
18.09%	-35.22%	18.19%	#NUM!

	NPV Project		NPV 2025	
	+ERs	-ERs	+ERs	-ERs
Disc. rate at 10%	74	(173)	75	(177)
Disc. rate at 12%	51	(173)	52	(176)
Disc. rate at 15%	23	(173)	24	(174)
Disc. rate at 18%	1	(172)	1	(173)
Disc. rate at 20%	(12)	(172)	(11)	(173)

The high profitability will help the project reach a reasonable IRR based on carbon stream only. Without the ERs, the Olavarría Project's IRR until 2016 falls from 18.09 percent to –35.22 percent. At 18 percent of discount rate, the NPV is reduced from $0.001 million to –$0.172 million.

The results of the sensitivity analysis in table 14 shows that project results until 2026 (assuming a lifetime of 20 years) are more negatively affected by the 25 percent reduction in the carbon revenues than by the 25 percent increase in investments. In the first scenario the base case IRR drops from 18.19 percent to 9.76 percent, and in the second scenario, from 18.19 percent to 10.19 percent. The NPV drops in the first scenario from $0.024 million in the base case to –$ 0.039 million, and in the second scenario from $0.024 million to –$0.045 million.

Table 14: Sensitivity Analysis for the Olavarría Project

BASE CASE SCENARIO

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ret revenues	-	-	30	35	39	37	33	37	42	53	66	70	73	75
EBITDA	-	-	30	24	21	4	(1)	4	7	34	47	50	53	55
EBT	-	-	30	2	(1)	(19)	(24)	(20)	(16)	10	22	25	28	29
Net income	-	-	66	56	17	(1)	(6)	(2)	2	28	40	43	46	47
Gross operating cash flow **(A)**	-	-	66	78	39	22	17	22	25	52	65	68	71	73
Free cash flow	-	-	61	77	39	22	18	21	25	50	63	67	71	72
Changes in cash	-	-	(115)	(11)	39	11	18	10	25	50	52	67	60	72
Cash and marketable securities	-	-	-	-	39	50	68	78	103	153	205	272	331	404
- Dividends **(B)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+ Interest income **(C)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest expenses + CPLTD **(D)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Current ratio			**#DIV/0!**	**7.0**	**9.0**	**4.5**	**4.3**	**4.4**	**4.5**	**9.1**	**10.0**	**9.8**	**10.0**	**9.7**
Net worth/total assets			**100%**	**100%**	**99%**	**98%**	**98%**	**98%**	**98%**	**99%**	**99%**	**99%**	**99%**	**99%**
NPV	**$24**													
IRR	**18.19%**													

BAD SCENARIO 1: 25% reduction in the generation of ERs

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net revenues	-	-	30	35	29	26	20	24	27	38	49	52	55	57
EBITDA	-	-	30	24	12	(7)	(13)	(9)	(7)	19	30	32	35	36
EBT	-	-	30	2	(10)	(30)	(36)	(33)	(31)	(5)	5	8	9	10
Net income	-	-	66	56	8	(12)	(18)	(15)	(13)	13	23	26	27	28
Gross operating cash flow **(A)**	-	-	66	78	30	11	5	9	11	37	48	50	53	54
Free cash flow	-	-	61	77	31	12	6	8	10	35	46	50	52	54
Changes in cash	-	-	(115)	(11)	31	1	6	(3)	10	35	35	50	41	54
Cash and marketable securities	-	-	-	-	31	31	37	34	45	79	115	164	206	259
- Dividends **(B)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+ Interest income **(C)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest expenses + CPLTD **(D)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Current ratio			**#DIV/0!**	**7.0**	**8.2**	**4.1**	**3.9**	**3.3**	**4.0**	**8.0**	**8.8**	**8.6**	**8.8**	**8.5**
Net worth/total assets			**100%**	**100%**	**99%**	**98%**	**98%**	**98%**	**98%**	**99%**	**99%**	**99%**	**99%**	**99%**
NPV	**($34)**													
IRR	**9.76%**													

Even in the worst case scenario, with the two negative impacts simultaneously combined, both Operational and Free Cash Flow remain positive in all years. In this scenario, the project's IRR falls to 2.42 percent and the NPV to –$0.103 million.

The main risks and mitigations seen in this project are summarized below:

- There is almost no construction risk because the investments required are low, the Municipality is committed to supporting the project, and the technology used is simple and well proven.
- The extremely low operation and maintenance (O&M) costs, the absence of indebtedness, and the exemption from tax payments make the project strongly resistant to bad economic scenarios.
- The project is financially viable, assuming carbon revenues only and confirming the extreme competitiveness of carbon finance in the solid waste sector.

ANNEX 8: SAFEGUARD POLICY ISSUES

ARGENTINA: Olavarría Landfill Gas Recovery Project

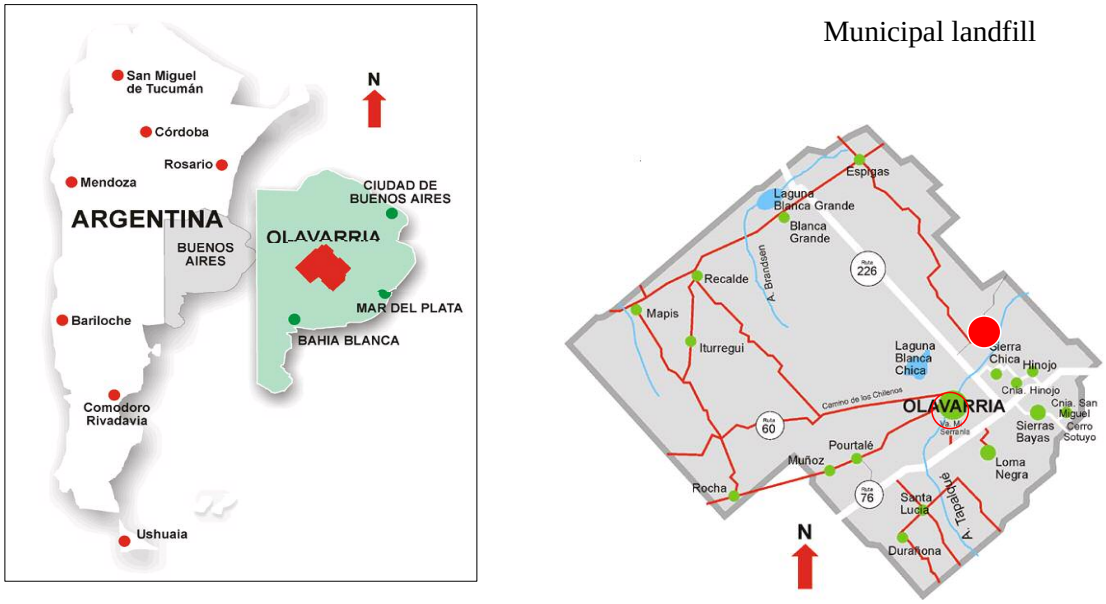
The Olavarría Landfill Gas Recovery Project falls into Environmental Category B since it will not involve any major negative environmental impact. The only safeguard triggered by this project is an Environmental Impact Assessment (EIA). Because of the nature of the project, an impact assessment limited to the landfill gas (LFG) flaring was added to the existing full EIA to comply with Bank safeguard policies. The completed EIA was approved by the regional environmental authority. Also the Bank Task Team's environmental specialist reviewed the document so to make sure it complied with the Bank's EA procedures. The original version of the EIA is publicly available in the Faculty of Engineering's website of the UNCPBA at www.fio.unicen.edu.ar.

Environmental Impact Assessment

This section summarizes the key findings from the EIA carried out by the project developers. The primary focus of the project is the capture and destruction of the methane currently generated at Olavarría's municipal landfill. Linked to this primary objective is the objective of installing in the village of Espigas a safe and reliable water distribution network, for which environmental considerations were also proposed.

The town of Olavarría has a population of 100,000 and is located at the center of Buenos Aires Province, 360 kilometers from Argentina's capital, Buenos Aires (Figure 3).

Figure 3: Project Location



The current sanitary landfill, in operation since November 1999, covers 33 hectares and has a total waste disposal capacity of approximately 30 years. Current access is by a gravel road, which is in good condition. The landfill site is connected to the main electrical grid but not to

the natural gas distribution network. The landfill was designed and constructed under sanitary engineering requirements. According to previous hydro-geological studies, the site was selected to prevent groundwater contamination. The landfill was isolated using a low permeability soil along with a synthetic liner and has a leachate treatment system with a stabilization pond and recirculation pumps and piping. Owned by the Municipality of Olavarría, the landfill is operated by a private concessionaire supervised by the Municipal Department of Public Works. It is projected that a private concessionaire selected through a bidding process will operate and maintain the LFG recovery plant.

Project-related activities

An EIA was carried out for the following key components of the project:

- Construction of the methane capture system (drilling of wells and installation of piping, condensate separation, extraction fan, and flaring systems).
- Operation of the methane capture system (gas extraction, handling of condensates, and flaring of the gas).

Impact identification

Potential environmental impacts were identified for each of the project-related activities. Table 15 lists the environmental vectors for which an EIA was carried out.

Table 15: Environmental Vectors

VECTOR		CODE	RELEVANT FACTOR
Biophysical component	Air	1 2 3	Noise Odors Gases
	Water	4 5	Superficial Underground
	Flora and fauna	6 7	Habitat Diversity
	Soil	8 9	Erosion Composition (quality)
	Landscape	10	Visual impact
Socio-economic component		11 12 13 14 15 16 17	Hygiene Employment New economic activities Land use Transference potential Social participation and awareness Cultural and archeological sites

Evaluation criteria

The evaluation criteria in table 16 were used to assess the magnitude of the impact on the environment.

Table 16: Evaluation Criteria

Criterion	Evaluation	Description
Direction	Positive (+)	Net benefit
	Neutral (0)	No benefit or damage
	Negative (–)	Net damage
Geographic extension	Local (1)	Impact affects only the area of the landfill
	Sub-regional (2)	Impact affects the area covered by all solid waste management activities
	Regional (3)	Impact affects areas beyond Olavarría's city limits
Duration	Short term (1)	Less than 1 year
	Medium term (2)	Between 1 and 5 years
	Long term (3)	More than 5 years
Magnitude	None (0)	No impact
	Low (1)	Slight change in relation to baseline conditions
	Medium (2)	Considerable change in relation to baseline
	High (3)	Changes above permissible limits
Frequency	Continuous (4)	Will occur continuously
	Sparse (3)	Will occur within a specific period of time
	Periodic (2)	Will occur intermittently but repeatedly
	Occasional (1)	Will occur intermittently but sporadically
	Accidental (0)	Will occur rarely
Probability	Low (0.1–0.3)	
	Medium (0.4–0.7)	
	High (0.8–1)	
Reversibility	Short term (0)	Impact can be reversed in less than a year
	Medium term (1)	Impact can be reversed between 1 and 10 years
	Long term (2)	Impact can be reversed in more than 10 years
	Irreversible (3)	Impact is permanent

Evaluation Methodology and Weighting of Impact

A modified Leopold matrix (1971) was used to evaluate the project's impact. This matrix shows the potential identified impacts on the biophysical and socio-economic components. The EIA was carried out using the following formula:

$EA = D*Po*(M+E+Du+F+R)$

where,

D = direction
Po = probability
M = magnitude
E = extension
Du = duration
F = frequency
R = reversibility

Impacts were also categorized according to scores, as shown in table 17.

Table 17: EIA Scoring System

				Color code
15	to	10.1	Highly positive	Green
10	to	5.1	Positive	Light green
5	to	0	Slightly positive	White
–0.1	to	–5	Slightly negative	Yellow
–5.1	to	–10	Negative	Orange
–10.1	to	–15	Highly negative	Red

Summary of the Environmental Impact Assessment

The EIA is summarized below for the construction, operation, and closure of the Olavarría Landfill Gas Recovery Project.

Construction phase

a. *Air*: No major impacts are foreseen during construction of the methane capture and flaring system. The impacts found are related to some increase in noise and emission levels, mainly from working machinery, but are considered minimal.
b. *Water*: No impacts on surface or ground water are observed in this phase.
c. *Flora and fauna*: This vector will not be affected.
d. *Soil*: The landfill gas capture project does not entail any erosion.
e. *Landscape*: There is no impact on this vector.

f. *Socio-economic components*: During this phase, impact will be generally positive because of the demand for labor and its transference and reference potential. As no archeological or cultural values have been found in the area, there are no effects associated with this vector.

Operation phase

a. *Air*: The project at this stage will result in positive impacts on air quality because during the operation of the methane capture and flaring systems, it will be possible to diminish emissions into the atmosphere and generation of odors.
b. *Water*: Methane capture and flaring do not have any impact on surface or ground water. Leachates and methane extraction condensates will be treated to avoid any water pollution.
c. *Flora and fauna*: This vector will not be affected.
d. *Soil*: Because leachate will be collected and treated, there is a very low probability of leakages into the soil.
e. *Landscape*: This vector will not be affected.
f. *Socio-economic components*: The operation of the methane capture and flaring system may have some impact on working conditions (health and safety). Training and safety gear will therefore be provided to personnel, improving the skills of the workers. The requirement for qualified personnel will promote an interest in education in project-related fields. The project will promote the development of similar projects in the region and country. Socially it will also raise awareness of and interest in preserving the environment and addressing climate change.

Closure phase

a. *Air*: This vector will not be affected.
b. *Water*: This vector will not be affected.
c. *Flora and fauna*: After the closure of the methane capture and flaring plant, the habitat will be reconditioned, and effects will be positive.
d. *Soil*: No impacts were detected at this stage
e. *Landscape*: The reconditioning of the area will make positive visual impact.
f. *Socio-economic components*: Labor will be in demand for closure of the site.

Environmental Management Plan

The main objective of the Environmental Monitoring Plan (EMP) is to identify, organize, elaborate, and adopt measures to prevent, mitigate, remediate, or compensate for the project-related impacts on the environment. Actions and solutions for each identified impact of the Olavarría Landfill Gas Recovery Project are listed in this section, together with the entities responsible for implementing them. These responsibilities will be listed in the construction and operation bidding documents for the methane capture and flaring system.

The EMP considers the following types of environmental measures:

- *Prevention*: Actions to avoid the occurrence of the impact.
- *Mitigation*: Measures to reduce the extent of damage.
- *Remediation*: Reconditioning, correction, or modification of the impacted environment.
- *Compensation*: Actions to compensate for irreversible damages caused to the environment, in place or elsewhere.

Table 18 summarizes the planned environmental measures for each EIA vector in the Olavarría project, along with the responsible entities as listed below.

(1) Landfill operator;
(2) Methane capture and flaring system constructing company;
(3) Methane capture and flaring system operating company; and
(4) Municipality of Olavarría.

Table 18: Environmental Measures for the Olavarría Landfill Gas Recovery Project

Factor	Prevention or maximization	Respon - sible entity	Expected implementation date and cost (AR$)	Mitigation	Respons - ible entity	Expected implementation date and cost (AR$)
Noise				Plant fence of trees surrounding project area Reduce worker exposure to heavy equipment Use of safety gear	(1) (3) (3)	Already executed in 2000-2001 $N/A During plant operation $N/A During plant operation $1,200/year
Odors	Assure correct operation of the methane capture system	(3)	During project lifetime 20006-20026 $ 1,500/year	Seal wells after drilling operations are finished	(2)	During construction phase February-July 2005 $N/A
Emissions	Assure correct operation of the methane capture and flaring systems through training	(3)	During project start up phase August 2005 and periodically as required during project lifetime $ 15,000/year			

Superficial and ground water	Monitor the capture and flaring systems	(3)	During project lifetime 2006-20026 $9,000/year	Decrease oxygen content from LFG and reduce gas pressure.	(3)	During project operation as required $N/A
	Perform preventive maintenance of the leachate collection system	(3)	During project lifetime as required $2,400/year			
	Control, extraction, and disposal of condensate	(3)	During project operation on a daily basis $N/A	Transport the LFG condensate recovered from the extraction system to the leachate pond	(1)	During project operation as required $N/A
Habitat and biodiversity	No major impacts were identified					
Topography	No major impacts were identified					
Soil composition	No major impacts were identified					
Visual impact	No major impacts were identified					
Health and safety	Provide adequate safety equipment	(1), (3)	During project construction and operation $2,400/year			
	Monitor all capture system parameters to avoid accidents	(3)	During project operation on a daily basis $N/A			
	Install proper signalization	(1), (2), (3)	During project construction and operation $1,200/year			
Employment	Incorporate local workforce into project-related activities	(2), (3), (4)				

New enterprises	Promote participation of local companies in project construction and implementation	(3), (4)				
	Provide training and knowledge for implementation of other similar projects	(3)				
Transference and reference potential	Promote the use of this technology through workshops or conferences	(3), (4)				
	Promote the use of local knowledge during project implementation	(3), (4)				
	Promote site visits	(3), (4)				
Public participation	Disseminate knowledge and raise environmental awareness	(3), (4)				

Public Consultation

A first round of meetings were held with stakeholders in order to present the basic ideas of the Olavarría Landfill Gas Recovery Project and its connection to the village of Espigas. The attendants could learn about the Olavarría methane capture project, greenhouse gas emissions, global warming and carbon finance activities, specifically about the World Bank's CDCF.

In a second round of meetings, a more detailed presentation of the project together with the proposal of activities for the village of Espigas was carried out. The stakeholders and representatives of the community of Espigas immediately showed they support and commitment towards the project.

Key stakeholders during the consultation process included:

- Espigas kindergarten.
- Espigas elementary school.
- Espigas high school CEPT No. 8.
- Espigas high school Escuela Media No. 43.
- Espigas Municipal Hospital.
- Espigas Cultural Center.
- Government of Olavarría.
- Espigas Sports and Social Club.
- Espigas Municipal Delegate.
- UNCPBA.

The Community Development Plan was based on the stakeholders inputs and addresses two of the most important infrastructure needs in the village of Espigas: access to potable water and affordable energy for hot water supply and space heating in schools. The plan includes the installation of a water distribution network providing potable water to nearly 80% of the inhabitants. The installation of the solar heating system in two schools will reduce the monthly energy bills and demonstrate the potential for the use of this renewable energy among the region.

Community Development Plan

The village of Espigas, where the Community Development Plan associated with Olavarría's Landfill Gas Recovery Project will be implemented, is located 80 kilometers from the city of Olavarría in the province of Buenos Aires. At the time of the preparation of this Community Development Plan, the village's 550 inhabitants included 150 people
under 18 years old, 300 between 18 and 60 years old, and 100 over 50 years old. Espigas has a municipal public hospital with 40 beds, a kindergarten with 34 children, an elementary school with 125 students, a high school with 119 students, and a special school for handicapped children. There is also a police department, a social and sport club, a cultural center, a recreation center, and a local crafts center. Village authority is represented by a Delegate appointed by Olavarría's mayor.

The main economic activities of the village are farming, dairying, and cattle ranching. The population consists mainly of farmers, rural employees, school teachers, and other municipal staff. The average income is approximately $130 per household per month. A small proportion of the Espigas population has cable television and telephone services. The village has access to electricity from the grid, although not all the population is connected to it. Espigas is not connected to the natural gas network.

The main problem confronting the village is the lack of a centralized potable water distribution system. Privately owned and frequently contaminated water wells operated by manual pumps are the main source of water for drinking and other purposes. As a result, the public hospital frequently treats gastrointestinal diseases related to contaminated water consumption, particularly in the elderly and the very young.

The absence of natural gas for space and water heating leaves the population with no choice but to purchase expensive containerized propane, which most people cannot afford, or to use wood, which carries the risks of air contamination, particle pollution, and fire.

The Community Development Plan aims to achieve the following specific community benefits, to be financed partly by the Municipality and partly from the sale of CERs arising from landfill gas recovery at the Olavarría landfill:

1. Installation of a safe and reliable system for distribution of potable water. The system is expected to consist of two 60-meter wells, two submergible electrical water pumps, an elevated 50-cubic meter water tank, and a 4,000 meter piping network to carry the water by gravity from the tank to houses and other buildings throughout the village. The system will also include water monitoring equipment and a treatment plant. Use of water from this system is expected to reduce the incidence of gastrointestinal disease caused by contaminated water from individual wells; and

2. Installation of a renewable energy system based on solar energy for space and water heating in the elementary and high schools. The pilot installation is expected to encourage use of this renewable technology at village farms, households, and community centers. The use of solar water heating will also decrease costs related to the use of containerized gas.

Financing

The Community Development Plan will be financed through three sources: 1) a portion of the revenue from CERs sold to the CDCF ($0.50 per CER), 2) the annual budget of the Municipality, and 3) user fees paid by the residents of Espigas. It is expected that the portion of the revenues to be derived from the sale of CERs will be paid in advance by the CDCF partially to fund the Community Development Plan. This amount is based on the total Contract CERs specified in the ERPA.

The Municipality of Olavarría has committed to funding the remainder of the Community Development Plan. The users will be responsible for the initial cost of their connection to the water distribution network and the operation and maintenance costs, through a monthly fee to be determined. The Municipality will offer financial assistance to the users through financing plans. The elementary and high schools will be responsible for the costs of operation and maintenance of the solar water heating systems.

Community participation

Various entities in the community will assume the following roles and responsibilities during the planning, implementation, and management of the social program:

- The Municipal Delegate in Espigas will be responsible for supervising program implementation, including the installation and maintenance of the water distribution network and solar water heating systems. The Municipal Delegate will also assure individual water connection to the households and other community buildings.
- High school personnel and senior students will collaborate in controlling and maintaining the solar water heating systems, with technical assistance from the project developers.
- High school personnel and senior students will participate with the cultural and recreation centers in campaigns to promote the use of solar energy technology in the village and surrounding areas.
- Authorities of the Espigas Public Hospital will record statistics to monitor the effects of the water supply on the population.

As mentioned, this Community Development Plan was designed by the project developers, project sponsor, and all sectors of the Espigas community. The participation and commitment of all actors involved are key in ensuring the success of the program.

Monitoring and verification

The benefits described will be measured and verified through the following indicators:

- Number of households and people connected to the water distribution network.
- Number of students benefiting from the solar water heating systems.
- Number of new solar water heating systems installed in the community and surrounding areas during the lifetime of the project.
- Hospital statistics on infections related to contaminated water consumption before and after installing the water distribution network.

Timetable

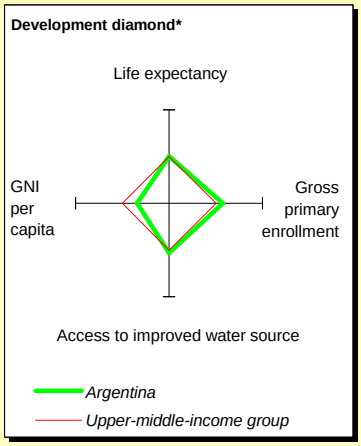
The Community Development Plan will be implemented in the following timeframe:

- Bidding and contracting for the construction of the water distribution network and installation of the solar water heating systems will be finalized no later than December 2004.
- The water distribution network will be constructed within 12 months following the award of the contract.
- The solar water heating systems will be installed within 8 months following the award of the contract.

ANNEX 9: ARGENTINA AT A GLANCE

ARGENTINA: Olavarría Landfill Gas Recovery Project

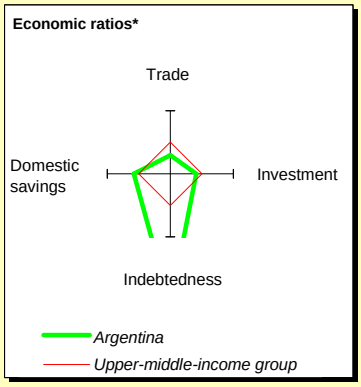
POVERTY and SOCIAL	Argentina	Latin America & Carib.	Upper-middle-income
2003			
Population, mid-year *(millions)*	38.4	534	335
GNI per capita *(Atlas method, US$)*	3,650	3,260	5,340
GNI *(Atlas method, US$ billions)*	140.1	1,741	1,788
Average annual growth, 1997-03			
Population *(%)*	1.6	1.5	1.2
Labor force *(%)*	2.2	2.1	1.8
Most recent estimate (latest year available, 1997-03)			
Poverty *(% of population below national poverty line)*	55	..	..
Urban population *(% of total population)*	90	77	76
Life expectancy at birth *(years)*	74	71	73
Infant mortality *(per 1,000 live births)*	16	28	19
Child malnutrition *(% of children under 5)*	5	..	..
Access to an improved water source *(% of population)*	94	86	89
Illiteracy *(% of population age 15+)*	3	11	9
Gross primary enrollment *(% of school-age population)*	120	129	104
Male	120	131	104
Female	119	126	104



KEY ECONOMIC RATIOS and LONG-TERM TRENDS

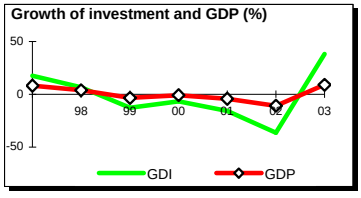
	1983	1993	2002	2003
GDP *(US$ billions)*	104.0	236.5	102.0	129.6
Gross domestic investment/GDP	20.9	19.1	12.0	15.1
Exports of goods and services/GDP	9.2	6.9	27.7	25.0
Gross domestic savings/GDP	24.2	16.7	26.9	25.9
Gross national savings/GDP	..	15.6	21.0	20.7
Current account balance/GDP	-8.0	-3.5	9.4	6.1
Interest payments/GDP	6.2	1.5	9.8	7.4
Total debt/GDP	44.2	30.6	144.1	113.5
Total debt service/exports	73.3	35.9	18.4	51.3
Present value of debt/GDP	..	..	137.0	..
Present value of debt/exports	..	..	439.2	..

	1983-93	1993-03	2002	2003	2003-07
(average annual growth)					
GDP	2.5	1.4	-10.9	8.8	5.2
GDP per capita	1.2	0.1	-12.1	7.6	4.0
Exports of goods and services	4.1	7.8	3.1	6.0	3.7

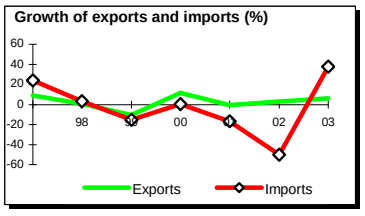


STRUCTURE of the ECONOMY

	1983	1993	2002	2003
(% of GDP)				
Agriculture	8.7	5.5	10.7	11.0
Industry	41.6	29.2	32.0	34.7
Manufacturing	30.7	19.5	21.3	23.9
Services	49.8	65.3	57.3	54.3
Private consumption	..	69.8	60.9	62.7
General government consumption	..	13.5	12.2	11.4
Imports of goods and services	5.8	9.3	12.8	14.2



	1983-93	1993-03	2002	2003
(average annual growth)				
Agriculture	1.4	3.0	-2.3	6.9
Industry	2.0	1.1	-13.8	16.5
Manufacturing	2.1	0.5	-11.0	16.0
Services	2.5	1.6	-9.2	4.2
Private consumption	..	0.5	-15.0	8.8
General government consumption	..	0.7	-5.1	1.5
Gross domestic investment	3.7	1.3	-36.4	38.2
Imports of goods and services	13.4	3.7	-50.1	37.6



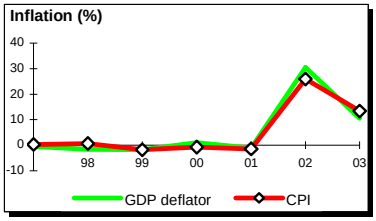
Note: 2003 data are preliminary estimates.

* The diamonds show four key indicators in the country (in bold) compared with its income-group average. If data are missing, the diamond will be incomplete.

1/ Change in shares to GDP in 2002 relative to 2001 is partly the result of real currency depreciation.

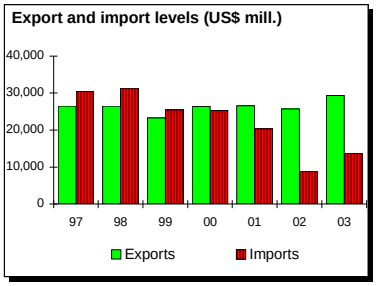
PRICES and GOVERNMENT FINANCE

	1983	1993	2002	2003
Domestic prices				
(% change)				
Consumer prices	343.8	10.6	25.9	13.4
Implicit GDP deflator	382.4	-1.5	30.6	10.7
Government finance				
(% of GDP, includes current grants)				
Current revenue	20.4	18.9	17.6	20.5
Current budget balance	-3.1	2.6	-0.8	1.3
Overall surplus/deficit	-5.7	1.6	-1.5	0.5



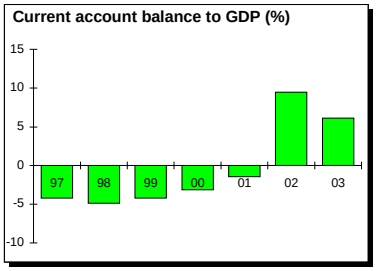
TRADE

	1983	1993	2002	2003
(US$ millions)				
Total exports (fob)	..	13,269	25,709	29,376
Food	..	1,454	2,273	2,597
Meat	..	748	913	1,043
Manufactures	..	8,603	13,429	15,185
Total imports (cif)	..	16,783	8,990	13,813
Food	..	..	..	..
Fuel and energy	..	461	482	544
Capital goods	..	7,773	1,293	2,500
Export price index *(1995=100)*	..	100	91	99
Import price index *(1995=100)*	..	100	87	87
Terms of trade *(1995=100)*	..	100	105	113



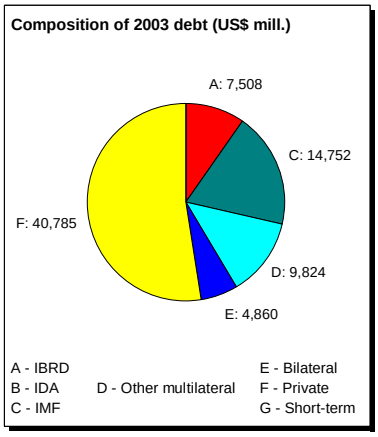
BALANCE of PAYMENTS

	1983	1993	2002	2003
(US$ millions)				
Exports of goods and services	9,288	16,339	28,684	33,231
Imports of goods and services	5,819	22,026	13,135	18,485
Resource balance	3,469	-5,688	15,548	14,746
Net income	-5,921	-2,997	-6,498	-7,425
Net current transfers	-5,905	522	576	620
Current account balance	-8,357	-8,163	9,627	7,941
Financing items (net)	6,051	3,913	-5,111	-12,493
Changes in net reserves	2,306	4,250	-4,516	4,552
Memo:				
Reserves including gold *(US$ millions)*	1,172	13,791	10,489	14,153
Conversion rate *(DEC, local/US$)*	1.05E-6	1.0	3.1	2.9



EXTERNAL DEBT and RESOURCE FLOWS

	1983	1993	2002	2003
(US$ millions)				
Total debt outstanding and disbursed	45,920	72,425	135,681	146,955
IBRD	533	3,739	8,513	7,508
IDA	0	0	0	0
Total debt service	6,805	5,860	5,291	17,042
IBRD	98	567	1,870	3,350
IDA	0	0	0	0
Composition of net resource flows				
Official grants	2	32	..	..
Official creditors	331	2,672	-1,850	1,277
Private creditors	1,134	4,397	-3,253	-1,883
Foreign direct investment	185	2,793	1,741	456
Portfolio equity	0	4,979	-27	150
World Bank program				
Commitments	100	1,590	250	1,850
Disbursements	70	1,507	424	1,963
Principal repayments	40	334	1,353	2,968
Net flows	30	1,173	-928	-1,005
Interest payments	36	230	512	359
Net transfers	-6	943	-1,441	-1,364



ANNEX 10: PROJECT PREPARATION

ARGENTINA: Olavarría Landfill Gas Recovery Project

	Planned	Actual
PCN review	01/14/2004	01/14/2004
Initial PID to PIC	11/10/2004	11/10/2004
Initial ISDS to PIC	11/04/2004	11/22/2004
Appraisal	11/09/2004	11/09/2004
Negotiations	12/09/2004	12/09/2004
Sign ERPA	12/09/2004	12/07/2004

Key institutions responsible for preparation of the project:

University of the Center of the Buenos Aires Province; and
the Municipality of Olavarría.

Bank staff and consultants who worked on the project included:

Name	Title	Unit
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Lasse Ringius	Sr. Environmental Specialist	ENVCF
Alexandre Kossoy	Sr. Financial Specialist	ENVCF
Charlotte Streck	Legal Counsel	ENVCF
Robert O'Sullivan	Junior Professional Associate	LEGCF
Hans Willumsem	Landfill Gas Specialist	Consultant
Thomas Jeffrey Ramin	Social Specialist	SDV
Francisco Grajales Cravioto	Junior Professional Associate	LCSEN
Ana Beatriz Iraheta	Program Assistant	LCSES
Santiago Sandoval	Program Assistant	LCSES