IMPLEMENTATION COMPLETION MEMORANDUM (ICM)

TF Name: UY – Methane Recovery Demonstration Project
TF Number: 023722
Report Date: August 24, 2006
Program: OP#6: Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs

Net Grant Amount: US$975,200

Donor(s): GEF
Approval Date: 05/09/2000
Closing Date: December 31, 2005

A. GRANT OBJECTIVES

Original Statement of Grant Objectives
Provide original statement of objectives from the approving grant or cleared IBTF.

The main objectives of the project were to (i) reduce Uruguay's emissions of greenhouse gases (GHG) by capturing methane from the landfill gas (LFG) generated by the municipal landfill of Las Rosas in the Municipality of Maldonado (*Intendencia Municipal de Maldonado*, or IMM), (ii) create local capacity for the sound management of the landfill gas recovery sub-project, which is part of Uruguay's action plan for improving municipal solid waste management (SWM), and draw lessons for replication in Uruguay and Latin America, and (iii) raise awareness of global warming and methane gas recovery in the context of Uruguay's Climate Change Strategy.

Changes to Grant Objectives
If original objectives have been changed, explain the nature of the revisions and the justification for them.

Objectives have not been changed.

Achievement of Grant Objectives
Discuss and rate the extent to which the activity achieved its relevant objectives.

The Methane Recovery Demonstration Project successfully contributed to reducing Uruguay's greenhouse gas emissions through the destruction of methane from the Las Rosas landfill. This reduction was accomplished through the installation of a gas collection system and an electric generation plant that uses landfill methane as a fuel. The project financed a 1-megawatt (MW) power plant (renewable energy capacity added to the Uruguayan grid) that generated 2,609 megawatt-hours (MWh) in 2005 and destroyed

approximately 879 tonnes of methane.[1] The project thus demonstrated that methane recovery systems are a highly effective short-term climate change mitigation measure. Moreover, as the first project of its kind in Uruguay and South America and one of the few in the developing world, the initiative strongly contributed not only to creating local capacity for landfill gas management but also to proving the technical and economic viability (taking into account climate change externalities) of the installation of a landfill gas capture system and an energy generation plant.

Finally, the following key activities under the project helped raise awareness about climate change: (i) presentation of the project by Uruguay's national environmental body, the National Direction of the Environment (*Dirección Nacional de Medio Ambiente*, or DINAMA), the municipality of Maldonado, and their technical teams in local and international workshops and seminars that discussed climate change, (ii) organization of workshops on the project and on climate change, and (iii) arrangement of visits to the project site and the LFG to energy plant.

As a result of these achievements, several Bank and non-Bank projects in the region have been designed and implemented based on the Methane Recovery Demonstration Project. Section D of this report contains more information about dissemination activities and replication.

The objectives of the grant were met ***satisfactorily***.

B. OUTPUT

Achievement of deliverables

1. Discuss and rate the actual output or deliverables completed, compared to the expected output, for each component of the grant.

The project was structured as a grant with the following components:

a. Construction and operation of the methane capture system
b. Technical assistance

a. Construction and Operation of the Methane Capture System

The objective of this component was to install and operate a methane capture system that would lead to electricity generation. This energy would then be sold to the Uruguayan national electricity authority.

[1] With the establishment of a global carbon market, greenhouse gas emission reductions are expressed as tonnes of carbon dioxide equivalent (tCO_2e). This project achieved 18,459 tCO_2e in methane emission reductions in 2005. If sold to the market, these tCO_2e would represent approximately US$138,400 in extra revenues to the project.

In addition to the construction and operation of the gas recovery plant, an expected output of this component was the destruction of approximately 18,962 tonnes of methane in a 15-year period (figure 1).

Figure 1 Expected methane destruction, Methane Recovery Demonstration Project

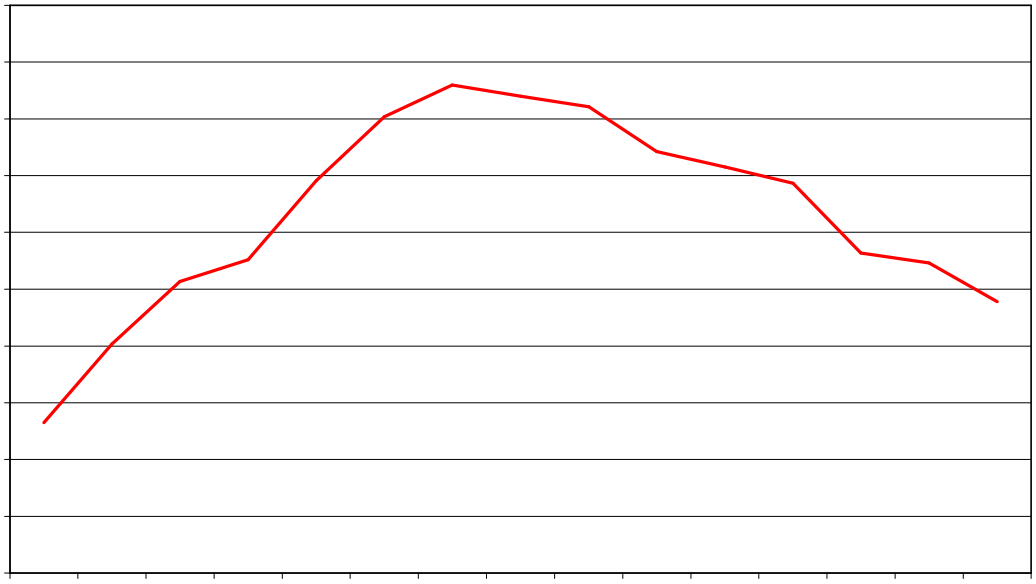

Table 1 Energy production and biogas capture, Methane Recovery Demonstration Project, 2005

Year 2005	Energy production (megawatt-hours, or MWh)	Biogas capture (thousands of Normal cubic meters, or Nm^3–50% methane (CH_4)	Percentage methane
01–05	141.36	165	51.8
02–05	161.46	188	51.8
03–05	228.82	203	51.8
04–05	259.51	231	53.3
05–05	272.46	251	54.6
06–05	268.78	246	54.4
07–05	272.40	258	54.6
08–05	256.71	243	54.3
09–05	260.87	193	54.1
10–05	241.14	176	50.7
11–05	152.31	129	50.1
12–05	93.36	95	51.4
Total	**2,609,18**	**2,379**	

The Guascor-Sufi consortium signed a contract with the Municipality of Maldonado to design and build a plant that would capture 2,969,640 Normal cubic meters (Nm^3) of landfill gas in the first year of operation, with a margin of error of ± 15 percent.[2] With a methane concentration of 50 percent, this would have meant the destruction of 1,039 tonnes of methane.

According to data provided by the operator of the LFG capture and energy generation plant, during the first year the plant captured 2,379,000 Nm^3 of LFG. With an average methane concentration of 52.8 percent, approximately 879 tonnes of methane were destroyed in 2005. This amount represents approximately 84.6 percent of the amount of methane agreed on with the winning consortium. This performance is roughly in line with the expected error margin.

Factors that contributed to lowering the plant's performance are listed below.

- Unexpected plant stoppage resulting from the following:
  - Unscheduled maintenance because of the presence of leachate in the gas wells
  - Fine tuning of the energy generation plant through installation of parallel equipment to regulate energy generation according to LFG availability
  - Other unscheduled maintenance such as work on the voltage converter and condensation extraction equipment
- Drier-than-expected weather
- Lack of engine modulation
- Problems with field measurement equipment

[2] Although this margin may appear high, commonly used LFG generation models have inherent errors of up to 50 percent.

- The need for plant tests

Although undesirable, these issues greatly contributed to lessons learned from the Methane Recovery Demonstration Project. These lessons are found in Section F: Lessons Learned and Recommendations of this report.

The output for this component is rated ***satisfactory***.

b. Technical Assistance

The main goals of the Bank's technical assistance under the Methane Recovery Demonstration Project are listed below.

1. Create local capacity for the sound management of the LFG recovery sub-project as part of Uruguay's action plan for improving municipal SWM and draw lessons for replication in Uruguay and Latin America.

2. Raise awareness of global warming and methane gas recovery in the context of Uruguay's Climate Change Strategy.

The project successfully created local capacity for LFG project management. It was the first of its kind in Uruguay and at the time it was designed and constructed, the first in South America. Very few local people had the specific engineering and operational skills during the design and construction period to deal with the complexities of a project of this nature. As a result of project implementation, the local operator, as well as DINAMA and the Municipality of Maldonado, gained unique expertise to design and operate LFG to energy projects. Important lessons were learned as a result of the problems faced in the plant's first year of operation, such as the drier than expected weather and lack of engine modulation. The project operation team is now skilled in LFG treatment, gas extraction from low pressure wells, and modulation of LFG to energy generation (i.e., adjusting the LFG supply to the power plant in order to generate targeted quantities of electricity).

Lessons drawn from the project were applied in developing similar initiatives in Uruguay and Latin America. A project under development in Montevideo, the capital of Uruguay, is following the Clean Development Mechanism (CDM) of the Kyoto Protocol in order to generate certified emission reductions that will be sold to the Bank. The Olavarría Project in Argentina and Nova Iguaçu Project in Brazil are already operational, and at least 10 other projects are under development (see Section D.3: Follow-up Activities and/or Investment in this report for more details). All the developers and owners of these projects visited the Maldonado plant during the design stage of their projects.

Although for budget reasons part of the funds originally allocated to concept diffusion were used for plant design and construction (in this document, see Section F: Lessons Learned and Recommendations), the project organized seminars and visits to raise awareness about the initiative in the context of Uruguay's Climate Change Strategy. One seminar was held in Montevideo and two at the project site. The most important seminar conducted with the grant money was held during the opening of the plant. Approximately 70 participants attended from the municipalities of Canelones, Cerro Largo, Colonia,

Lavalleja, Durazno, Maldonado, Montevideo, Paysandú, Rivera y San José, Treinta y Tres, and Tucuarembó, as well as Uruguay's Climate Change Unit (*Unidad de Cambio Climático*, or UCC), several other public organizations, and 18 private sector companies.

The project and its benefits were presented in more than 14 international and local workshops, including a World Bank-ESMAP LFG to Energy Initiative workshop in Monterrey in 2003. Notably, Uruguay hosted the Latin American Landfill Gas Project Expo in 2005 because of the Methane Recovery Demonstration Project. More than 140 participants from the public sector and private sector in the Latin American Region and 18 project developers attended the Expo and visited the plant. The Expo was opened by the ministers of environment of both Uruguay and Argentina. In 2005 alone, more than 15 groups visited the plant, including schools from every department in Uruguay, nongovernmental organizations (NGOs), engineering firms, and local and regional governments. The start up of the plant was widely covered by the national media.

The output for this component is rated ***highly satisfactory***

2. Discuss and rate how well the grant output met the quality standards of the recipient and the beneficiary.

The project was successful in delivering its outputs at a high level of quality. Both components were implemented successfully, with the LFG plant fully operational and technical capacity transferred as a consequence of the technical assistance activities.

The amount of electricity delivered to the grid in the first year of operation was below the expected target but within the error margins. This does not relate directly to project outputs. Although all the components of the plant were installed and functional, abnormal climate behavior and technical problems that are not unusual in a plant's first year of operation led to operational adjustments. These, in turn, caused the electricity delivery to under-perform in the first year. It is expected that the average value of the bell shaped curve will be in line with the expected target.

The output for this component is rated ***satisfactory***

C. OUTCOME

1. Achievement of developmental results
Discuss and rate the actual developmental results, compared to the expected outcomes, for each component of the grant.

Component 1

The construction of the plant was behind schedule. The main reason for this was the economic crisis that affected Argentina and Uruguay in 2002 and prevented the IMM from securing its counterpart funds. In spite of the delay, achievement of the stated grant objectives is considered ***satisfactory***. The construction of the energy plant and installation

of the methane capture provided an effective way to reduce GHG emissions to the atmosphere and an alternative source of energy, as well as encouraging replication of the project by other municipalities.

Component 2

Developmental results are rated ***highly satisfactory*** for this project. This and a similar initiative in Monterrey, Mexico, were the first of their kind in Latin America. Both public and private institutions throughout the continent have discussed the core idea, engineering details, and operational experience. This discussion has led to extensive dissemination of the technical and economic potential of LFG projects, especially in the framework of the Clean Development Mechanism. Today more than 10 similar Bank-related projects and an equal number of private-led operations are under development.

Moreover, landfill gas capture is usually seen as part of improving final solid waste disposal practices. Recent experience has shown that landfill stabilization and improvement of the environmental profile of landfill sites are usually implemented along the construction of the LFG plant.

Table 2 shows project compliance with expected outcomes.

Table 2 Compliance with expected outcomes, Methane Recovery Demonstration Project

Targets for 1– 36 months	Progress (%)	Targets for 37–60 months	Progress (%)
Publication of the general bidding announcement in the United Nations development business website	100		
No objection from the Bank to the ICB documents	100		
Availability of the ICB documents	100		
Procurement of supplies	100		
No objection from the WB to the awarding of the contract	100		
Signature of the contract	100		
Completion of the design phase within the contract	100		
		Completion of the recovery system and suction and controlling system within the contract	100
		Completion of the generation system within the contract	100

	Completion of the contract	100
	Diffusion of lessons learned within the project	100

2. Relevance

Rate how well this activity was consistent the development priorities of the country, the Bank's country assistance strategy (CAS) and the Bank's sector strategy.

When the project was designed in 2000, it was in line with the Bank's Country Assistance Strategy (CA FY98–00) for Uruguay. At that time the Bank focused mainly on two environmental issues, among others: urban pollution and private sector participation in key sectors, including energy.

The Methane Recovery Demonstration Project addressed urban pollution by promoting the use of a renewable energy source to generate electricity while flaring landfill gas that can pollute the urban environment. The project also fostered private sector participation in infrastructure development. By bridging the private sector (Aborgama, the landfill operator, and Guascor-Sufi, the LFG plant designer and builder) and the public sector (the Municipality of Maldonado and the electricity system operator), the project was able to reach goals that would likely not have been achieved at the same cost if either sector had developed the initiative alone. This association was therefore in line with the CAS guidance on private participation in infrastructure.

3. Efficacy

Rate how well the activity achieved its stated grant objectives.

The project was completely successful in achieving its objectives. Uruguay's greenhouse gas emissions are being reduced because methane is being captured and flared at the Las Rosas landfill. Local capacity has been built for sound management of the LFG recovery project. A local group of knowledgeable experts learned lessons during project design and operation that will enable them to deal with similar projects. Finally, awareness has been raised about global warming and methane gas recovery in the context of Uruguay's Climate Change Strategy. This awareness is clearly shown by the larger-scale Montevideo Landfill Gas Recovery Project under development by local authorities with support from the Bank.

4. Efficiency

Rate the results of this activity relative to its associated costs, implementation times, and economic and financial returns.

The project was managed in accordance with accepted practices and high standards. The contribution of the local supporting team (local technical committee) was key to this success.

Nevertheless, the grant budget for the project was underestimated. The main reason was that it did not take into account the inclusion of a procurement specialist for the Project

Unit and the hiring of an international recognized expert to overview the installation and the operation of the plant. Also, the costs of the contract for the construction of the plant were higher than expected, requiring the reallocation of funds from other activities and the increase of contribution from the private partner.

Moreover, because of the Argentinean economic crisis, the project suffered a delay in implementation that affected the project economics and meant that some resources earmarked for dissemination were reallocated to the design and construction of the LFG to energy plant. In spite of this problem, the project met its technical assistance and awareness raising targets.

The activity's efficiency is rated ***satisfactory***.

D. IMPACT

1. Capacity Building Impact

Rate how well this activity contributes to capacity building.

Because the project was a demonstration pilot, one of its objectives was to encourage replication in other municipalities and elsewhere in the region. It was therefore important to prove the efficiency and effectiveness of the LFG recovery system and energy generation.

The approach adopted at project design to support the replication of achievements was to organize dissemination activities, consultative workshops, and informational events. The following activities, among others, were conducted to disseminate information about the project's operation and results:

1. Workshops and seminar to demonstrate the benefits of the generation capacity of LFG in the Las Rosas landfill for 12 municipal authorities, members of the Maldonado Departmental Board (*Junta Departamental de Maldonado*), and other professionals (2004)
2. Promotion and dissemination workshop for environmental NGOs (2001)
3. Presentation at the World Bank-ESMAP LFG-to-Energy Initiative workshop in Monterrey, Mexico (2003)
4. Presentation at the Solid Waste Association of North America (SWANA) annual meeting, San Diego, California (2005)
5. Presentation at the International Solid Waste Association (ISWA) meeting in Buenos Aires, Argentina (2005)
6. Presentation at the 2005 Carbon Expo, organized by the World Bank
7. Presentation at the Latin American LFG Project Expo in Montevideo, followed by a plant visit (2005)
8. Presentations at the United Nations Commission for Sustainable Development meeting (2006)
9. Presentations in internal World Bank workshops

10. Exposition for engineers during Uruguay's National Congress for Sanitary and Environmental Engineering (*Congreso Nacional de Ingeniería Sanitaria y Ambiental*) (2001)
11. Training seminar for authorities and officials of national institutions during a promotional event for Global Environmental Facility (GEF) projects in Uruguay (2002)
12. Videoconference between Maldonado and national and municipal authorities, technical professionals, NGOs, and other professionals in Montevideo to present and launch the project
13. Organization of visits by staff of eight other projects to the LFG plant

The Department of Montevideo is poised to sign an Emission Reduction Purchase Agreement (ERPA) with the World Bank to implement an LFG recovery project. This new project will comprise a gas collection and flaring system to reduce approximately 1.4 $MtCO_2e$ from 2007 to 2012 to benefit the environment as a whole through climate change mitigation. This is the largest controlled landfill in Uruguay. The informal workers who sort recyclables in an area near the landfill will benefit from the project through better air quality and reduced risk of landfill fires.

2. Sustainability

Rate how likely the results will be sustained.

The economic and financial sustainability of the plant were key to continued operation and environmental benefits. During project appraisal, the national electric utility (*Usinas y Transmisiones Eléctricas***,** or UTE) signed an agreement with the IMM that committed the UTE to purchase electricity from the project at US$0.027 per kilowatt hour (kWh) for 15 years.

During project design, operation and maintenance costs were estimated as a basis for assessing project sustainability. When these costs are compared with the expected revenues from electricity sales, as showed in table 3, project sustainability can be rated as ***highly likely.***

Table 3 Expected costs and revenues (US$), Methane Recovery Demonstration Project

Year	Equipment maintenance	Labor (maintenance)	Labor (operation)	Total costs	Expected energy generation (MWh)	Energy revenues	Surplus / deficit (US$)
1	11,557	16,130	44,157	71,844	2,794	75,435	3,590
2	40,783	16,130	44,157	101,071	4,261	115,050	13,979
3	60,607	16,130	44,157	120,894	5,416	146,240	25,345
4	41,227	16,130	44,157	101,514	5,824	157,260	55,745
5	107,436	16,130	44,157	167,723	7,289	196,816	29,092
6	44,924	16,130	44,157	105,211	8,474	228,797	123,586
7	60,842	16,130	44,157	121,129	9,068	244,829	123,699
8	43,363	16,130	44,157	103,650	8,859	239,186	135,535
9	107,988	16,130	44,157	168,275	8,662	233,874	65,598
10	44,349	16,130	44,157	104,636	7,831	211,442	106,806

11	59,463	16,130	44,157	119,751	7,547	203,775	84,024
12	45,403	16,130	44,157	105,690	7,238	195,429	89,738
13	106,867	16,130	44,157	167,154	5,944	160,493	-6,661
14	45,050	16,130	44,157	105,338	5,760	155,525	50,186
15	57,784	16,130	44,157	118,071	5,041	136,107	18,036

The sensitivity analysis in table 4 illustrates how energy prices affect project sustainability. A base scenario of US$0.027/kWh is juxtaposed with two other scenarios: one with an energy price 25 percent lower and the other with an energy price 25 percent higher.

Table 4 Sensitivity analysis, Methane Recovery Demonstration Project (all values in US$)

	Scenario 1: Base price * 75%			Scenario 2: Base price			Scenario 3: Base Price * 125%		
Year	**Energy revenues**	**Total costs**	**Surplus /deficit**	**Energy revenues**	**Total costs**	**Surplus /deficit**	**Energy revenues**	**Total costs**	**Surplus /deficit**
1	56,579	71,844	**-15,266**	75,435	71,844	3,590	94,298	71,844	22,454
2	86,285	101,071	**-14,786**	115,050	101,071	13,979	143,809	101,071	42,738
3	109,674	120,894	**-11,220**	146,240	120,894	25,345	182,790	120,894	61,896
4	117,936	101,514	**16,422**	157,260	101,514	55,745	196,560	101,514	95,046
5	147,602	167,723	**-20,121**	196,816	167,723	29,092	246,004	167,723	78,281
6	171,599	105,211	66,388	228,797	105,211	123,586	285,998	105,211	180,787
7	183,627	121,129	62,498	244,829	121,129	123,699	306,045	121,129	184,916
8	179,395	103,650	75,745	239,186	103,650	135,535	298,991	103,650	195,341
9	175,406	168,275	7,131	233,874	168,275	65,598	292,343	168,275	124,068
10	158,578	104,636	53,942	211,442	104,636	106,806	264,296	104,636	159,660
11	152,827	119,751	33,076	203,775	119,751	84,024	254,711	119,751	134,960
12	146,570	105,690	40,880	195,429	105,690	89,738	244,283	105,690	138,593
13	120,366	167,154	**-46,788**	160,493	167,154	**-6,661**	200,610	167,154	33,456
14	116,640	105,338	11,302	155,525	105,338	50,186	194,400	105,338	89,062
15	102,080	118,071	**-15,991**	136,107	118,071	18,036	170,134	118,071	52,063

Table 4 shows that the energy price has a considerable impact on project sustainability. With the base price scenario, if actual conditions are similar to those predicted during project design, the project is likely to be financially constrained during only 1 year (year 13). However, with an electricity price 25 percent lower, the project would generate a deficit for 7 years (years 1–5, 13, and 15). With an electricity price 25 percent higher, the project would operate comfortably in the black, even compared with the base scenario. It should be noted that maintenance costs were drastically reduced in the Methane Gas Recovery Project because of the devaluation of the Uruguayan peso. As a consequence even in the 25 percent lower scenario the project may end up being profitable in the entire life of the project.

Table 5 shows another relationship between the project's global benefits and the international carbon market. By the time the Methane Gas Recovery Project was approved, this market was still under development. Now greenhouse gas emission reductions are traded in international exchanges and therefore can be clearly priced.

Because it was developed through a GEF grant, this project could not benefit from the Clean Development Mechanism. Nevertheless, it is interesting to note that the net present value of the investment would be positive if the emission reductions (ERs) to be achieved by the project were sold in the international market. This indicates that the project would be financially sustainable solely based on the ER commercialization.

Table 5 Hypothetical greenhouse gas emission reductions revenues, Methane Recovery Demonstration Project

Year	LFG captured (Nm^3/h)	LFG captured (Nm^3/year)	Methane destroyed (tCH_4)	Methane destroyed (tCO_2e)	Revenues (@ US\$7.5/tCO_2e)
1	339	2,969,640	1,039	21,827	163,701
2	400	3,504,000	1,226	25,754	193,158
3	465	4,073,400	1,426	29,939	224,546
4	424	3,714,240	1,300	27,300	204,747
5	474	4,152,240	1,453	30,519	228,892
6	519	4,546,440	1,591	33,416	250,623
7	480	4,204,800	1,472	30,905	231,790
8	443	3,880,680	1,358	28,523	213,922
9	407	3,565,320	1,248	26,205	196,538
10	374	3,276,240	1,147	24,080	180,603
11	341	2,987,160	1,046	21,956	164,667
12	309	2,706,840	947	19,895	149,215
13	280	2,452,800	858	18,028	135,211
14	250	2,190,000	767	16,097	120,724
15	224	1,962,240	687	14,422	108,168

For the above cash flow, with an investment of US$1,469,860 (see Section E: Performance in this report), a price of US$7.5 /tCO2e per tonne and a discount rate of 8 percent (based on a Uruguayan sovereign bond issuance at the end of 2005), the net present value of the ERs commercialization is US$177,370.

In Uruguay electrical power generation, transmission, and distribution are controlled by UTE, a state-run monopoly. The project therefore relied completely on UTE to buy the electrical power generated by the landfill. Without an open market for electricity commercialization, the project had no other option. Under such circumstances, there is little room for price negotiation.

3. Follow-up Activities and/or Investment

Provide a description of any follow-up activities or investments resulting from the original activity.

Check, if applicable:

Investment:
_____ Recipient/Other Investment; _____ Grant Project/Program; ___X__ Bank Project[3]; _____ IFC Financial Project/Activity

The most relevant replication of the Maldonado Methane Recovery Demonstration Project is an LFG flaring project under development in Montevideo. The municipal authorities have signed a Letter of Intent (LoI) with the World Bank to sell greenhouse gas ERs to be generated at the Felipe Cardoso landfill. The goal of this project goes beyond the ERs themselves. The municipality is strongly committed to using the financial resources obtained to improve the landfill conditions and implement thorough monitoring and closure plans for the site. In addition, the Bank is negotiating another LoI with the Municipality of Canelones. If this project is completed, the three most important cities in Uruguay will have developed LFG-related CDM operations with the Bank.

The Olavarría LFG Project in Argentina was developed under the Clean Development Mechanism and is already generating ERs that will be sold to the Bank. Similar initiatives developed at regional level are already operational. Three similar facilities are under development in Argentina in the municipalities of Río Cuarto, Salta, and San Nicolás. In Paraguay the Bank is negotiating an LoI with the Municipality of Asunción. In Brazil the NovaGerar Project in the Municipality of Nova Iguaçu is currently flaring methane, with ERs also to be sold to the Bank, and prospective projects are being developed in four other cities. Based on the experience of the Methane Gas Recovery Demonstration Project, the Bank has signed ERPAs related to LFG projects in Lima, Peru, and Cartagena, Colombia, and is negotiating a project in Chihuahua and a group project, both in Mexico.

Other Results:
___X__ Transferability of Know-How, Knowledge Base/Key Concepts; ___X__ Replicability, Modeling, Best Practices; _____ New Sectors or Products; _____ New Forms of Cooperation with Other Development Institutions/NGOs

Other projects not related to the Bank also benefited from the transfer of knowledge and replicability of the Methane Recovery Demonstration Project. These include the Bandeirantes LFG to Energy Project in São Paulo, Brazil (operational) and Gramacho Project in metropolitan Rio de Janeiro, Brazil (under development).

[3] In this case, the activities are not standard Bank operations, they are carbon finance operations.

There was no exchange of personnel between the Methane Recovery Demonstration Project and any of the projects mentioned. Experience was shared through site visits, telephone calls, email, and participation in events and related conferences.

E. PERFORMANCE

1. Bank

Discuss and rate how well the Bank carried out specific responsibilities assumed by the Bank for this trust funded activity.

The Bank has been a major actor in achieving project goals, solving unanticipated problems and closely monitoring the activities both at a distance and through several on-site missions. Thus, the Bank performance was ***highly satisfactory***. Even though the supervision cost exceeded the original budget the Bank management judged that the extra support was acceptable due to the complex nature of the demonstration project. Ultimately the project's results and achievement of objectives supported this judgment.

The task team responded promptly and successfully to the lack of counterpart funds, retained the project objectives, and maintained cost control and targets through project supervision despite difficulties. In the case of the counterpart funds, the Bank team managed to build a case for the project with the Ministry of Housing, Planning, and Environment, the landfill operator, and the Municipality of Maldonado so that project implementation could continue. The team showed that the project was in line with Uruguay's policies for climate change and explained how the private operator could benefit from the initiative by enhancing its profile in landfill management practices and how the municipality could improve the environment while showing its engagement in current environmental trends.

The Bank utilized US$164,560.26 for supervision over 5 years, compared with the original estimate of US$50,000 over 3 years for this medium-sized project (MSP). The main reason for the discrepancy was the economic crisis and consequent extended supervision period, and the need to include an international recognized engineer in these types of projects to technically supervise engineering design, construction and operation. However, the budget was inadequate for the project's high level of technical and implementation complexity, which is part of its demonstration characteristics.

Several disbursements were made to the project, totaling US$975,200. Table 6 presents information on the initial and final budget allocations by component.

Table 6 Initial and final budget per component, Methane Recovery Demonstration Project (US$)

Co financing (Type/ Source)	IA own Financing (US$)		Central Government – Ministry of Housing, Planning and Environment (US$)		Local Government – Municipality of Maldonado (US$)		Private Sector – Aborgama, landfill operator (US$)		Other Sources* (US$)		Total Financing (US$)		Total Disbursement (US$)	
	Proposed	**Actual**	**Proposed**	**Actual**	**Proposed**	**Actual**	**Proposed**	**Actual**	**Proposed**	**Actual**	**Proposed**	**Actual**	**Proposed**	**Actual**
Grant	975,200	975,154									975,200	975,154	975,200	975,154
Credits														
Loans														
Equity			60,000	59,958	334,800	334,748	100,000	100,000					494,800	494,706
In-kind									-	85,114			-	85,114
Non-grant Instruments														
Other Types														
TOTAL	975,200	975,154	60,000	59,958	334,800	334,748	100,000	100,000		85,114	975,200	975,154	1,470,000	1,554,974

Table 7 shows that the project managed to raise the co-financing resources planned during the design stage. As predicted, such resources were of fundamental importance to project implementation.

Table 7 Co-financing, Methane Recovery Demonstration Project (US$)

Institution	Planned	Actual
Ministry of Housing, Land Management, and Environment	60,000	59,958
Private operator of the landfill (Aborgama)	100,000	100,000
Municipality of Maldonado	334,800	334,748
Total	**494,800**	**494,706**

The project received funding other than what was originally proposed. One source was the sale of the bidding documents and from UNDP funds. The total amount raised through this source was US$10,114. Work provided by some of DINAMA's and IMM's staff accounted for an estimated US$ 75,000 to the project.

The project's financial reports were audited for 5-year periods. Each report was reviewed by the World Bank's Financial Management Specialist and found acceptable. The UNDP carried out the financial management of project resources, performing sound financial bookkeeping of the accounts and reporting periodically to the Bank on the financial status of the project. In addition to those activities, the UNDP produced adequate annual progress project reports.

2. Recipient

Discuss and rate how well the Recipient fulfilled the different tasks that were expected as part of the trust funded activity.

The high level of commitment of each of the partners during the life of the project was vital in overcoming the difficulties that appeared during implementation. The UCC and the Project Execution Unit of the Ministry of Housing, Planning, and the Environment at all times fostered agreement among the parties to find solutions to problems that arose. The UCC satisfactorily administered project funds with support from the UNDP.

A Project Operations Committee was established to ensure high-quality project management. This committee, which included representatives of the Ministry of Housing, Planning, and the Environment, the Municipality of Maldonado, and Aborgama, was in charge of analyzing, assessing, and deciding on technical, operational, and logistical issues.

The IMM and Aborgama continually demonstrated their interest and commitment, not only through financial contributions but also through their willingness to learn and find solutions to technical issues that arose. The project promoted and trained a local technical team in Aborgama that could keep the system working and optimize performance once the plants were fully operational. The municipality's full ownership of the project from beginning to end ensured its sustainability.

UTE demonstrated its interest in the project by collaborating with the Project Execution Unit to secure acceptance of the design of the electricity component proposed by the company that won the international public tender.

UCC staff managed the project in a highly satisfactory manner. This positive administrative performance was critical for the continuation and recovery of the project after the economic crisis. Project performance was unsatisfactory only during the crisis, but this factor was not under the control of the UCC. After the crisis was resolved, implementation improved considerably. UCC also was proactive in implementing a communication campaign, preventing problems, finding solutions with the contractor, and informing other stakeholders of results. Its managerial capacity was key in achieving the project outcomes. Moreover, together with IMM and Aborgama, UCC organized workshops, training sessions, forums, and seminars to share lessons learned with NGOs and private sector institutions. As a result, the project is now widely known in Uruguay.

Overall, the recipients' fulfillment of the different tasks was ***highly satisfactory***.

F. LESSONS LEARNED / RECOMMENDATIONS

Discuss the most significant positive and negative lessons learned from the success or failure of the grant activity and make recommendations for different stakeholders.

Recommendations for Project Developers

1. ***Know how to manage a plant under different conditions and how to enhance its operational profile.*** Unfortunately, the project did not fully achieve its expected results in terms of LFG captured in the first year of implementation. The main reason for this under-performance was plant stoppages for (i) maintenance to address leachate in gas wells, (ii) installation of parallel equipment to regulate energy generation with LFG availability, (iii) maintenance of the voltage converter, and (iv) maintenance of the condensate extraction equipment. Other factors that affected project performance were (v) drier-than-expected weather in 2005**,** reducing moisture in the landfill and thereby reducing landfill gas production, (vi) lack of engine modulation, (vii) problems with field measurement equipment, and (viii) the need for plant tests under different operating conditions.

   Attention to such issues before project operation begins, if possible, can enhance the operational profile of projects similar to the Methane Recovery Demonstration Project. For example, if the presence of leachate in gas wells is predicted, pumps can be installed to extract the leachate before the project begins operation. Steps can be taken while the landfill is under construction to improve the design of the drainage system. Energy regulation with LFG availability and lack of engine modulation can be forestalled by appropriately checking equipment specifications. Such experience can be shared with similar projects.

2. ***Consider the importance of energy prices for project viability, sustainability, and replicability.*** Energy price is a key factor in the viability and sustainability of this type of project. Successful replication will depend greatly on the development of the energy sector in Latin America. The necessary market conditions have to be in place for renewable energy projects to become more attractive to investors. (Please refer to Section D: Impacts, in this report, for a sensitivity analysis of electricity prices.)

3. ***Factor in site characteristics and conditions that may influence project performance.*** Weather patterns, the organic content of waste, and gas drainage systems tend to affect the outputs of LFG project. A well-designed and well-operated sanitary landfill minimizes problems and enhances gas generation and collection, which in turn increase the likelihood of expected energy generation. The Las Rosas landfill was a reasonably well-operated facility. Project results might have been different if the site had not been chosen following internationally recognized landfill practices. In the Montevideo landfill, the initial revenues from the sale of ERs will finance improvement of the basic cells infrastructure, including leachate and rainfall drainage design, installation of a leachate treatment plant, and a groundwater monitoring system.

Recommendations for the Bank

1. ***Assess institutional capacity before the start of project implementation***. The institutional capacities of UCC should have been better assessed by a technician with experience in procurement. The inexperience of the UCC and the UNDP with the fairly complex bidding process, which involved preparing specialized bidding documents, meant that this process took longer than expected.

2. ***Ensure adequate project budget and Bank supervision budget.*** The inclusion of more budget to ensure the procurement, construction and technical capacity of the local team for such an innovative project was necessary. Demonstration projects potentially result in high supervision cost indifferent to the size of the project. The cost-effectiveness should be considered at the early stage of the project formulation.

3. ***Consider exchange-rate variations in project design.*** The contract with Guascor-Sufi, the private contractor, was made in euros; when the exchange rate increased, so did the counterpart requirements. These exchange-rate variations were not taken into consideration in project design in either legal or procurement terms.

4. ***Ensure that government agencies encourage private sector participation.*** From the beginning the project benefited from the valuable participation of Aborgama, the private operator of the landfill. Its participation meant that the landfill was in good condition to capture the methane gas. During project execution, Aborgama was a good partner for the IMM, contributing not only resources but also staff to supervise the contractor.

Recommendations for the Recipient (Client)

1. ***Ensure staff stability and good project management.*** UCC's attention to these issues were critical for the continuation of the Methane Recovery Demonstration Project after the economic crisis. Project implementation was delayed only during the crisis and then for reasons that were not under the control of the UCC. After the crisis, when the IMM was able to secure its counterpart funds, continuity in UCC staffing allowed for the recovery and successful implementation of the project.

2. ***Develop a monitoring and evaluation system and follow up key outcome indicators to detect problems and prevent delays in project completion***. The project developed an appropriate M&E system to measure progress during the implementation period. With the reporting system developed by the UNDP, project staff were able to monitor implementation and progress in fulfilling project objectives. As a result, the Bank supervision teams were able to identify delays and problems early enough to propose timely remedial measures.

Recommendations for the Donor(s)

1. ***Allocate adequate resources for project dissemination***. This step is key to publicizing the positive environmental impacts generated by this type of project. Although the Methane Recovery Demonstration Project satisfactorily achieved its promotion and dissemination targets, there is a perception that more resources were required to encourage private sector participation in the management of landfills and reduction of methane emissions.

G. PROCESSING

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Date Submitted: August 24, 2006

Comment :

Manager :

Date Approved:

Comment: