

Project Name	Mexico-Methane Gas Capture and Use at a (@)... Landfill-Demonstration Project
Region	Latin America and the Caribbean
Sector	Environment
Project	MXGE63463
Borrowers	Government of Mexico
Implementing Agency(s)	SIMEPRODESO, SEDESOL
Environmental Category	B
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1. Country and Sector Background

Mindful of the long-term costs of improper solid waste management, the Government of México (GoM) has initiated (with assistance from the World Bank) a program designed to address some of the underlying causes of improper solid waste management. The program supports efforts to: a) strengthen regulations and institutions at a federal and local level conducive to more effective practices and incentives; and b) assist in the development of sustainable solid waste management practices. This program is assisting specific communities, committed to policy, institutional reform and the implementation of sustainable practices in its efforts to develop, design and operate long-term, solid waste management programs. The assistance will also result in the mapping of a comprehensive recycling plan. To date, the baseline project has been successful in reaching policy and institutional agreements with a series of municipalities representing a wide-spectrum of local conditions. This current add-on project will complement the baseline project by focusing on incorporation of landfill gas (LFG) capture and use into solid waste management practices.

2. Objectives

To address these concerns, this add-on project would support the design and implementation of a system to capture and utilize landfill gas, at landfills developed under the baseline program. Implementation of these systems would prevent the escape of methane to the atmosphere. Adding a methane capture component to the baseline program would lay the basis for future replication efforts by demonstrating costs, potential, and effective management arrangements under Mexican conditions while addressing generic institutional barriers.

3. Rationale for Bank's Involvement

The involvement of the Bank/GEF in the proposed project provides an opportunity to support a critical effort by the GoM to improve solid waste management, reduce dependence on imported energy, and improve global environmental quality through the reduction of greenhouse gases. In the

absence of Bank involvement, it is unlikely that the country would have been able to mobilize adequate resources and technical assistance required to implement the baseline project. Without GEF involvement, the GoM would not have been able to develop a methane-capture and use demonstration project. As previously stated, the project could serve as a paradigm for other small and medium-sized cities in Mexico, which are all facing serious problems with the management of solid waste and emissions of methane.

4. Description

A. Detailed Engineering Design and Construction of a Plant for Methane Capture and Use.

This component will provide funding for the design and construction of a landfill gas collection system and a power plant (estimated to be 7 MW) at a 44 ha closed cell at the SIMEPRODESO landfill (Monterrey, Nuevo Leon). The facility will include: i) the wells, piping network and blowers that will collect the methane produced by the landfill and deliver it to the power plant, ii) a power plant with and a treatment plant to remove moisture from the LFG before combustion, iii) a flare that burns off excess methane not used by the power plant and thus allows for maximal destruction of methane even during plant shutdowns, iv) supporting infrastructure such as roads, sewerage, water supply, buildings and lighting, and v) project design, operator training and supervision. The design, construction and operation of the plant will be implemented through a private-public partnership (see institutional section of Summary Analysis). As the project will be a demonstration project, the development of the facility will be documented by SIMEPRODESO for use in the Capacity Building and Regional Dissemination Components. This will include: 1) Design and construction summary report 2) an annual operational summary report 3) an annual "lessons learned" report that would cover operational, financial, managerial and institutional issues important to the project and 3) an annual environmental summary report.

B. Capacity building.

In order to promote replication of LFG collection and use facilities elsewhere in Mexico, this component will build the capacity of SEDESOL, local and state government entities and private contractors to promote and manage LFG projects. In addition, this component will fund the preparation of a national replication strategy.

SEDESOL will implement this component and components C and D. To build SEDESOL's capacity to implement the project and future projects, this component will fund international training of SEDESOL employees on issues important to their role as a federal agency and also the construction, operation and management details important to local and state governments and private contractors. The project will also allow SEDESOL to build capacity and promote LFG adoption in state and local governments and private companies in the solid waste industry. Funding will be provided for the preparation of dissemination materials, for training workshops, and for twinning arrangements where an operating facility would provide managerial and technical assistance to a developing facility. Public dissemination will also be undertaken through news releases, tours and demonstrations.

The replication strategy will focus on: a) "retrofitting" existing cells in sanitary landfills with LFG management systems, landfill gas extraction

for new cells within existing landfills, and in new facilities; b) introducing LFG management issues in the process of converting open dumps to sanitary landfills, including discussion of methodologies, analysis and options for scavengers; c) incorporating LFG management in the planning, design and construction of future landfill sites; and, d) assessing the prospects of using non-grant financing modalities for future support to municipalities. The later would include detailing the economics of such plants on a broader scale and consideration of contingent grants and other financing mechanisms. In addition, the project will undertake a study on worldwide economic effectiveness of the plants as part of the replication strategy, ultimately detailing how future replication could be self-financing. An analysis of the potential for replication including an assessment of the estimated need for LFG facilities will be undertaken.

C. Regulatory reform.

The project will fund the necessary technical background studies to support the inclusion of landfill gas management within the scope of existing SWM legislation. The results of this study will be intended for inclusion in the proposed new legislation for landfill gas management. SEDESOL will implement this component.

D. Regional (Latin America) Dissemination.

The project will support efforts aimed at facilitating the dissemination of design and operational experience gained in Monterrey and other projects worldwide (such as those supported by the Bank in Indonesia, Latvia, Uruguay as well as others) for possible use throughout the region. The following activities will be funded by the project and implemented by SEDESOL:

- i) Development of information tools (such as a webpage and newsletter);
- ii) Organization of international workshops for owners and operators of sanitary landfills interested in LFG management and other potentially interested parties from the private sector, such as independent power producers in the region (outside of México); and
- iii) Twinning arrangements that include internships and site visits for managers and operators at operating LFG facilities in other countries.

E. Project Management.

The project will fund the technical and administrative support necessary to implement the components and to provide monitoring of the project as a whole. Landfill gas specialists will be employed for the project in SEDESOL and SIMEPRODESO. The specialist at SIMEPRODESO will act as a project manager for the first component. The specialist at SEDESOL will be in charge of the capacity building and Latin American dissemination components. A portion of the costs of implementing the environmental management plan will also be funded. In accordance with the procurement capacity assessment, this component will pay for a consultant to organize the booking and train SIMEPRODESO's procurement team. In accordance with the financial capacity assessment, the salaries of independent auditors for annual audits of SIMEPRODESO will also be funded. The costs of production of the required project monitoring, supervision and auditing reports, the operational summary report, the environmental summary report and the lessons learned report will also be funded.

5. Financing

	Total (US\$m)
Total Project Cost	13.25
GEF	6.27
Mexico	0.4
Private Sector	6.58

6. Implementation

Recipient and Guarantor: SIMEPRODESO will be the recipient of the grant. The Government of Mexico will be the Guarantor of the grant, with SEDESOL acting as the specialized technical agency for the purpose. BANOBRAS will act as financial agency for this project.

Executing agencies: SEDESOL will retain overall responsibility for the project and implement the capacity building, legal and regulatory reform and Latin America dissemination components. To implement these components the project will provide funds to SEDESOL for the salary for a LFG specialist and for training of other staff. SIMEPRODESO will be responsible for coordinating with SEDESOL to provide the necessary information, tours and other support to implement these components.

The first component, the construction of the LFG demonstration plant, will involve the formation of a Co-generation Company between SIMEPRODESO, a private partner ("Strategic Partner"), the Municipality of Monterrey, and Servicios de Agua Y Drenaje. SIMEPRODESO will be responsible for the overall administrative implementation of the demonstration project via an agreement with the Strategic Partner. The project management unit will cover the following functions: planning, monitoring and evaluation, financial management, accounting, risk management, procurement and information technology. The Strategic Partner will be responsible for the overall technical implementation of the project.

Participation Strategy. Given the demonstration character of the project, public participation is essential for the dissemination of results and to facilitate early replication of the experience. The capacity building and Latin America dissemination components are specifically designed for participation for the purpose of project replication. These components will include dissemination and training workshops, twinning arrangements and public awareness activities such as tours and press releases. The development of the materials for these components will be done in a participatory fashion through consultation of the major project stakeholders and interested public, private and non-profit entities. In addition, USEPA's Landfill Methane Outreach Program, a voluntary program designed to provide technical and project facilitation assistance to landfill owners and government agencies, will assist in the development of the materials for dissemination and the twinning arrangements.

7. Sustainability

This GEF project is a continuation of a World Bank-financed project. Factors critical to the sustainability of the project include: i) The proposed technology (LFG collection from production wells for the purposes of power generation in internal combustion engines) is well-proven elsewhere; ii) The current regulation for solid waste management does not cover LFG issues. However, regulatory reform is in the process of being formulated that would

satisfactorily address construction and management issues related to LFG. As part of the project a framework for more detailed inclusion of LFG issues in Mexican legislation will facilitate future replication of the project; iii) The financial analysis carried out in context of the feasibility study shows that without GEF assistance, the project's financial rate of return is marginal. However, with GEF involvement, the return is at a level more attractive. It is anticipated that gains in operational experience and economies of scale will contribute to further improve the financial rate of return in subsequent projects; iv) The institutional capacity of SIMEPRODESO has been tested during the operation of the sanitary landfill (the second largest in México). A financial capacity assessment of SIMEPRODESO indicated that they satisfy the Bank's minimum financial management requirements but do not have in place an adequate project financial management system for PMR-Based disbursements. An action plan including details of accounting, auditing arrangements, reporting, flow of funds and management information system has been formulated with the client to address the financial issues. A procurement capacity assessment prescribed an action plan to assist SIMEPRODESO during the project and build their capacity. This plan will be followed during project implementation. In addition, SIMEPRODESO's management and operational capacity for the LFG plant will be further strengthened as part of the project through the involvement of a private sector partner with experience in LFG management. Given the past management record and the proposed additional support, the institutional capacity supports the sustainability of the project. From the perspective of replication of the demonstration project, the project is also sustainable. The prefeasibility study found many potential sites for development of landfill gas projects in Mexico and as evidenced at recent workshops on LFG in Mexico and SEDESOL's commitment to this issue, there is great interest at the federal and local level for LFG projects and therefore replication of the demonstration project.

8. Lessons learned from past operations in the country/sector

The preparation team has drawn on the experience and lessons learned from other GEF supported projects in order to improve project design and benefit from best practice. Peer reviewers have included task managers of on-going and planned methane capture projects in Latvia and Uruguay. An outside expert has also provided useful comments.

The following lessons have been applied during project preparation:

Decision-makers at the municipal level should support the project objectives prior to site selection.

The project has been conceived and is being prepared with full participation of the municipal authorities and the proposed owner-operator (SIMEPRODESO).

Workshops and training are critical for enabling the replication of project activities.

A technical training program has been included in project design.

Technical assistance provided to municipalities is essential.

The baseline project has provided the necessary technical assistance and training in municipal SWM to support an integrated approach which includes LFG capture and use. The proposed GEF project will provide technical assistance focused on LFG management.

Development of integrated plans is essential for effective management of municipal solid waste.

The baseline project has provided needed training and technical support to local and national decision makers in developing integrated municipal SWM plans. The proposed project will build upon these plans by integrating LFG management and utilization.

Full cost recovery is necessary to promote sustainability.

The LFG plant will be financed with GEF equity financing (grant) and financing from a private investor. The financial analysis has determined that with GEF financing the plant is financially viable and that all costs will be recovered.

Clear managerial and institutional responsibilities are required.

The general project is under the purview of SEDESOL who has ultimate responsibility for its implementation, with a particular focus on project replication and dissemination of technical and educational materials. Implementation of first component, the construction and operation of the demonstration project, will be the primary responsibility of SIMEPRODESO.

9. Program of Targeted Intervention (PTI) N

10. Environmental Aspects (including any public consultation)

Environmental Assessment Process and Main Conclusions

An environmental assessment for the Monterrey LFG facility has been finalized. The assessment revealed that, as the plant will reduce emissions of greenhouse gases as well as volatile organic compounds (VOCs) from the landfill, the major impacts of the project will be beneficial to the environment. Some minor negative impacts will also occur as a result of the project. An environmental management plan was also developed by an engineering consulting firm with the participation of the executing agency (SIMEPRODESO) to mitigate these problems. The EMP will be implemented by SIMEPRODESO and the Strategic Partner with implementation required in the grant agreements and bidding documents. The effects of the project are described in more detail below.

Effects of Landfill Gas Plant Construction

Global warming gas emissions: The LFG plant to be constructed in Monterrey will result in the capture of 214 million cubic meters of methane (a potent greenhouse gas). In addition, the energy produced by the plant will substitute for other energy sources that use fossil fuels, thus reducing the emission of global warming gases from these sources. If successful, the replication strategy will catalyze the construction of more plants in Mexico. The regional dissemination component of the project is intended to have a similar effect in other Latin American countries.

Other pollutant emissions: In addition to the methane, the landfill gas mixture that will be combusted for power generation contains volatile organic compounds (VOCs). If VOCs are allowed to be released directly from a landfill they can be hazardous to humans and contribute to low-level ozone formation, a precursor to smog. The power plant will burn these VOCs and thus reduce their emission and LFG combustion will also reduce odors associated with landfill gas. To maximize these environmental benefits, the plant will have a flare to combust captured LFG that is not combusted during

production of electricity.

The internal combustion engines used in the power plant will produce small volumes of NO_x (a smog-forming gas) and CO (a toxic gas). The reduction in emissions of VOCs from the combustion of landfill gas and the reduced emissions of smog-forming compounds from the fossil fuel energy sources that the landfill gas energy substitutes for, will more than offset the impacts of the smog-forming compounds produced by the engines and flare. The engine emissions will be mitigated through requirements (specified in the bidding documents) for low emission engines. These emissions will be in compliance with World Bank guidelines. In addition, the engine emissions will be monitored for compliance with local environmental laws as described in the EMP. To prevent increased emissions due to poor engine performance, it will be required that the engines be operated and maintained in accordance with the manufacturers specifications.

Explosion risk: The high methane content in landfill gas makes the gas potentially explosive when mixed with air. As the landfill gas plant will destroy a large proportion of the methane from the landfill under controlled conditions, the explosion risk on or near the landfill itself will be reduced. There will be some increased risk of explosion near the equipment used for the conveyance, pressurization and delivery of LFG to the engine. This risk is minimized by locating the compressors outdoors. An alarm system that detects methane leaks will be installed near the indoor equipment.

Liquid Wastes: The internal combustion engines produce waste oil and coolant that must be disposed of properly. Both of these wastes will be brought to a government approved hazardous waste treatment facility already used by SIMEPRODESO for similar wastes. Water that condenses in the gas collection system is somewhat similar in content to the landfill leachate and therefore can contain low concentrations of heavy metals and hydrocarbons. The condensate will be collected and as is currently done with the leachate, recirculated into the landfill. Given the dry conditions, the landfill will be able to absorb this excess water without any danger of migration or runoff.

Noise: As the proposed site of the plant is not adjacent to neighbors, noise from the engines is expected to be only an occupational safety problem for workers at the plant. To mitigate effects of noise employees will be required to use proper ear protection and the engine house will be located away from neighbors and constructed to reduce noise outside the building.

Construction-related effects: During construction there will be waste produced from the water used at the construction facilities and from the scrap construction materials. Construction activities will also increase noise, the suspension of particulates and vehicular emissions at the site. The bidding documents will specify that proper waste management practices be used during construction. In addition, construction practices that mitigate noise and pollution will be required.

Loss of Flora: The construction of the power plant and collection system will impact no flora as the areas proposed for construction currently are not vegetated.

Landfill Management Issues

Leachate control: The landfill gas plant will not increase the likelihood of groundwater contamination by leachate. The current practice of periodic pumping and recirculation of the leachate into the landfill has been adequate and will continue.

Methane migration: The migration of methane from landfills is an important issue because methane can diffuse into enclosed rooms in nearby houses and buildings and cause an explosion hazard. The project will reduce this risk through the collection and combustion of the landfill gas. In addition, because SIMEPRODESO currently does not monitor for methane migration, the environmental management plan requires a monitoring system to be put into place. Similar monitoring systems are effective at landfills in the US with more extensive neighboring communities than that found at the SIMEPRODESO landfill.

Occupational Health and Safety Issues

The criteria for selection of the Strategic Partner who will be responsible for construction, operation and training activities will include an evaluation of the companies environmental and safety record. Within the contractual agreements of the Cogeneration Company occupational and safety practices based on international standards will be specified.

Siting of Plant

The SIMEPRODESO landfill is located in a relatively unpopulated area. Immediate neighbors include several ranches, a junk yard and a squatter community. These neighbors will benefit from the reduced emissions and reduction in explosion risks associated with the project. The closed landfill cell borders a road and the power plant will be located in an area of the landfill that borders uninhabited private land. This will mitigate the potential effects of construction and operation on the local inhabitants.

11. Contact Point:

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Note: This is information on an evolving project. Certain components may not be necessarily included in the final project.