Global Environment Facility
Proposal for Project Development Funds (PDF)
Block B Grant

Country:	**México**
Project Name:	**Methane Gas Capture and Use at a Landfill Demonstration Project**
Requesting Agency:	**World Bank**
Executing Agency:	**SEDESOL & BANOBRAS**
Estimated Cost:	**US$ 12.9 million**
Financing Plan (tentative)[1]:	**GOM- US$ 2.0 million** **IBRD- US$ 6.9 million (Ln. 3752-ME)** **GEF- US$ 4.0 million**
Project Duration:	**14 months**
PDF Block B Funds Requested:	**US$ 300,000**
PDF Co-Financing:	**US$ 200,000 (GOM & IBRD [Ln.3752])**

Background

1. As is the case with many other developing nations, México faces serious difficulties in the management of urban refuse and solid waste. It is estimated that over 82,000 tons of solid waste is generated in the country every year. Yet, there is a generalized lack of proper treatment and disposal facilities; institutional capacities are weak; and financial conditions, at a local, municipal level, frequently adverse. The problem continues to compound, exacerbated by: a) the sustained growth of population; b) the high rate of rural migration to urban settings; and c) an increased degree of industrialization and associated local consumption patterns. For example, during the last several decades, México has been urbanizing rapidly (currently, approximately 60% of the population of 92 million[2] live in cities with over 15,000 inhabitants[3]). Per capita generation of urban refuse has also increased. It is estimated that 0.7-1.3 kg of solid waste is generated per person-day, with an average organic content of about 45%[4]. Regrettably, of all the solid waste generated, only 77% is collected (62 thousand tons) and less than 35% is disposed under sanitary conditions (29 thousand tons).

2. Improper waste management practices contribute to serious health and safety problems in the communities it affects, has a negative impact on property values and has been linked to the contamination of aquifers and surface waters caused by percolation and runoffs of leachates. On the other hand, the waste that is deposited in landfills

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[1] To confirm pending results from PDF

[2] Estimate of 1997 population size, annual growth rate 2%

[3] National Communication of México, available on the Climate Change Commission Homepage

[4] Perfil de Proyecto. Proposal submitted to World Bank by SEDESOL September 1998

decomposes, and produces landfill gases (LFG), which are customarily 50% methane. Methane is a greenhouse gas, contributing to smog, global warming and considered an explosion risk if not properly controlled.

3. Methane emissions from landfills are estimated as the source of 10% of total methane emissions in México[5]. The reduction of methane emissions is a critical part of a strategy to control emission of greenhouse gases. Methane has 21 times, on a weight basis, the albedo effect of CO_2 (each ton of methane emitted into the atmosphere has the equivalent warming impact of 21 tons of carbon dioxide over a 100-year period[6]) and hence is a powerful global warming agent.

4. Mindful of the long-term costs of improper solid waste management, the Government of México 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 conducing to more effective practices and incentives; and b) assist in the development of sustainable solid waste management practices. This program is assisting selected communities (those committed to policy, institutional reform and the implementation of sustainable practices) in their 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.

5. Parallel to these initiatives, and as part of the Government's efforts for controlling the emission of greenhouse gases, there is an attractive opportunity to internalize concerns about methane emissions at landfills (in the context of efforts to address improper waste management). This could be done through properly designed systems to capture and utilize landfill gas, at facilities being developed under the existing program. Implementation of these systems would prevent the escape of methane to the atmosphere while at the same time address issues of local air pollution and safety of operations at the landfills. Adding a methane capture component to the 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.

6. **Related Bank Support for Climate Change**. The Bank is currently in the process of expanding its program of assistance to the GOM in the area of climate change. Last September, the Bank through the IDF[7] channeled financial and technical assistance resources to support the strengthening of the Mexican Office for Climate Change Mitigation. The objective of the IDF support is the consolidation and strengthening of institutional capacity for implementation of the commitments made by the Mexican Government before the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, in particular as this relates to the future Clean

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[5] Avances en el desarrollo de indicadores para la evaluacion del desempeño ambiental en México 1997, Institución Nacional de Ecologicá, SEMARNAP

[6] "Turning Liability into an Asset: A Landfill Gas-to-Energy Project Development Handbook," Landfill Methane Outreach Program, USEPA, September 1996

[7] Institutional Development Fund.

Development Mechanism. The Bank (with financial support from ESMAP) is also collaborating in the execution of the Energy-Environment Review (EER). The EER intends to review and assess the relationship between energy and the environment, and to develop an integrated, strategic vision of the interactions between the energy and environment sectors and its implications for the economy. In addition to these strategic exercises, the Government of México (GOM) has requested WB assistance to prepare and finance specific investment projects (see Annex 1).

National Climate Change Framework

7. As a signatory to the Framework Convention on Climate Change, México completed a national greenhouse gas inventory in 1996, and is currently updating it. The 1996 inventory results identified CO_2 and CH_4 as the principal sources of greenhouse gas emissions in México (more than 99% of total GHG emissions). On a sector level, the inventory identified that the energy sector constitutes the country's most important source of anthropogenic emissions. Methane from solid waste decomposition augments significantly the emissions levels (10% of total), and is a lost source of clean, renewable energy.

8. The First National Communication and Climate Change Action Plan, submitted as part of the GOM's obligations under the UNFCCC, outlined the support to the principle of common but differentiated responsibilities under the framework convention. The first communication provided an estimate of the total emissions of greenhouse gases, outlined programs for their control and reduction and identified some of the impacts anticipated as a result of climate changes. The communication explicitly identified the uncontrolled release of landfill gas as one of the sources of emissions of methane to the atmosphere and suggested measures to contain these emissions. The energy policy has been improved environmentally, by initiating the following measures: i) use of improved fuels; ii) fuel conservation; and, iii) energy conservation and efficiency. Other measures instigated for conservation of the environment and natural resources are: i) The Protected Natural Area Program; ii) The Forestry Program; iii) National Reforestation Program; iv) Integrated System for Environmental Regulation and Administration; v) various policies regarding industrial and urban pollution; and, vi) registration of emissions and the transfer of contaminants[8].

9. The past three years have also seen improved institutional, normative, and programmatic capabilities in the area of environmental control in México. In particular, the GOM has initiated reforms to enhance the participation of state and municipal governments in the provision of basic services and the protection of the environment. Collection, transfer and disposal of solid waste has improved in México over the past few years, in part supported by World Bank loans. The GOM strategy for halting environmental degradation and remedying past problems is articulated in its "Plan Nacional de Desarollo: 1995-2000" and its "Programa Nacional para la Protección del Medio Ambiente." More specifically, the GOM has established conditions to improve solid waste management through "La Norma Oficiál Mexicana" (NOM-083-ECOL-1996).

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[8] First National Communication to UNFCCC. GOM. 1997.

This approach taken by the GOM has lead to better collection, transfer and disposal of solid waste and initiated cost recovery for solid waste collection and disposal. The current proposal involves the utilization of the methane gas produced by current and future landfills. This would result in reducing methane emissions, reducing other fossil fuel need, reduce CO_2 emissions from fossil fuel burning, and would strengthen municipal solid waste management by making it more profitable. Such results are consistent with the GOM's objectives.

National Level Support

10. The proposed project is a priority for the Government and the executing agencies (SEDESOL and BANOBRAS). The GOM has indicated its endorsement through the Secretaria de Hacienda y Credito Publico (GEF national focal point) by letter dated November 16, 1998 (see attachment).

Project Objective

11. The proposed Methane Capture Project would provide additional support to an existing project on solid waste management (Second Solid Waste Management Project [Ln. 3752-ME]) to enable the internalization of the global dimension of landfill gas capture and use. Specifically, the GEF support would be used to provide the financial and technical assistance required to demonstrate self-sustaining modern waste management of municipal solid waste that includes capture and use of landfill gas.

12. The GEF project would demonstrate the technology and lay the foundations for widespread introduction of methane capture and use, as a proven technique in the Mexican market. This project would, in the process, identify policy, regulatory and institutional barriers at the Federal and local level that prevent capture and utilization of landfill gas and develop a strategic plan for addressing these barriers. The project would substantiate the feasibility of developing indigenous landfill gas at a selected site as an energy source, utilizing an otherwise constant emission of methane into the atmosphere and partially substituting a renewable energy source for imported fossil fuels used for electricity generation. Engineering templates, training programs, operations and maintenance manuals, and cost-benefit analyses will be executed.

Project Activities[9]

13. The activities to be supported as part of the project are:

A. ***Construction of the Plant for Methane Capture and Use.*** The project's key activity will be the actual construction of a pilot plant for Methane capture and utilization at a selected landfill. This will include measures to improve the adequacy of the landfill over its lifetime for Methane capture. This will include: i) remediation measures at the landfill; ii) set up of energy cells for enhanced

[9] The detailed project description will be confirmed as the results of the activities sponsored under the Block B are successfully completed.

degradation of the waste; iii) collection system for the gas; and iv) establishment of a gas use or supply system at the site.

B. ***National Barrier Analysis.*** The project will investigate barriers that hinder replication of methane capture investments on a broad scale within Mexico (including technical, institutional, policy, regulatory, financial and social barriers) and outline a strategic plan for dispelling these barriers.

C. ***Development and Dissemination of Technical Knowledge.*** Learning from previous applications can facilitate the successful implementation of a new technology. In order to achieve a technical level of proficiency in the design, construction, implementation, operation, maintenance and supervision stages, the following will occur: i) development of a conceptual model that enumerates specifications and highlights lessons learned; and ii) training of technicians and workers about LFG production to improve control and extraction.

D. ***Demonstrating Viability.*** In order to ensure replication of the demonstration project, the following will be prepared: i) detailed design specifications; ii) a methodological guide of the system will be developed applicable to other regions of the country; and, iii) a national campaign will be initiated promoting the construction of landfills as a national strategy for eliminating uncontrolled dumping and to reduce emissions of greenhouse gases (GHG), consistent with national goals. Depending upon the evaluation of the results of this pilot project, a second phase GEF/IBRD methane capture project may be proposed to support wider replication at the sector level.

Baseline and GEF Role

14. The baseline project's objectives are to: i) strengthen the capacity of BANOBRAS and SEDESOL to appraise and supervise solid waste projects and provide technical assistance to municipalities and states; ii) increase technical, administrative and regulatory capacity at state and local agencies to improve sector management and operations; iii) improve the legal and regulatory framework and cost recovery mechanisms of the sector and to safeguard the environment; and, iv) implement a pilot program of sustainable solid waste management practices at selected municipalities. Solid waste investments under the SEDESOL/BANOBRAS baseline pilot program would support sanitary landfills which meet accepted international standards, but would not be designed to maximize the rate of methane generation nor to capture and utilize the gas produced.

15. GEF funding will complement resources made available through Ln. 3752 and will be utilized to finance the incremental costs that will allow the internalization of global warming concerns into the sustainable solid waste management plan at a selected municipality. In addition to increasing use of a renewable energy technology and reducing global GHG emissions through the investment component, the proposed project includes capacity building and technical assistance components which will: i) enable a local engineering company to consult on future design, operations and maintenance of the technology; ii) improve local capacity to integrate LFG-energy into the power grid; iii)

help identify barriers that exist to future replications; and, iv) strengthen institutional capacity. The GEF-sponsored demonstration plant will catalyze new funding, encourage private-sector development of this renewable energy source, and help reduce existing barriers. The methane recovery system implemented under the proposed GEF project could serve as a paradigm for many municipalities throughout México.

Eligibility

16. México ratified the Framework Convention on March 11, 1993. The proposed project is consistent with GEF guidance for interventions in the Climate Change focal area in that it: i) is technically, environmentally and socially sustainable; ii) meets a national priority and is country driven; iii) will provide a cost effective means of abating greenhouse gases; iv) includes an essential transfer of technology through twinning arrangements and managerial assistance during project implementation; and v) would convert emissions of a powerful greenhouse gas into an indigenous energy resource. The proposed project is consistent with GEF criteria for investments submitted as Short-term Measures for reductions in emissions of greenhouse gas, as the anticipated cost per ton of carbon equivalent for this project would be around $5.40, well below the $10/ton cap for such interventions[10]. This figure is, however, a conservative estimate and does not include carbon emission savings resulting from eventual use of the methane in power generation.

Description of PDF Activities

17. The PDF Block B grant is requested to complement funds for project preparation. The PDF grant would finance the activities described below:

A. **Institutional Management Needs.** An assessment would be made of the institutional and management framework required for implementation of the proposed project. This assessment would identify the roles of project participants, evaluate the needs for achieving project success (e.g. training, professional development, and equipment), and recommend the management structure for project implementation.

B. **Identification of Barriers (technical, institutional, policy and regulatory) and preparation of a template for a power purchase agreement (PPA).** An analysis of barriers will be conducted and counter-measures mapped. These include:

i-Technical barriers (identification of technical parameters and suitable locations, cost of capture and use)
ii-Institutional barriers (institutional capacities, interagency coordination and mandates, entrepreneurial capacity)

[10] For purposes of calculation, a city with 480,000 inhabitants was assumed, with a per capita generation of waste of about 0.9 kilograms per day. It is estimated that in the lifetime of a landfill, 100 m^3 of methane is produced per ton of solid waste. Based on conservative assumptions, the Project will lead to a reduction in the uncontrolled release of 312 million m3 of methane over 20 years (225,000 tons of methane). As methane absorbs 21 times more energy than CO_2, the equivalent amount of carbon is 1.3 million tons.

iii-Policy and regulatory (policies and rules on methane generation and use) The possibilities of the power purchase agreement will be investigated.

iv-Financial. Financial incentives, availability of credit

v- Social. Acceptance and support of alternative energy sources will be assessed, as well as the local support of the development of a pilot project in the area.

In addition, a template for a power purchase agreement will be prepared that reflects adequate measures to address existing barriers and could be replicated for similar situations at a national level.

C. **Technical Pre-feasibility Report.** This would identify regions with the following aspects conducive to LFG recovery pilot plant development:

- technical (local, climate, generation, composition and state of solid waste);
- economic (supply and demand of energy market);
- social;
- institutional;
- legal;
- environmental; and,
- political.

D. **Feasibility Analysis.**

- site selection;
- comparison of investment and operational costs of extraction and treatment of LFG versus current fuels;
- economic feasibility of the project;
- field verification of the selected site;
- design of field work:
- - topographical , climatic and geophysical studies;
  - location of test wells, sampling of LFG and rubbish to test composition; and,
  - sample analyses;
- site preparation, test well sinking, and installation of equipment;
- sampling, surveying and laboratory analysis;
- analysis of results;
- LFG production rate estimation;
- analysis of available and appropriate technologies;
- analysis of technical feasibility of LFG extraction;
- physical inspection of units and selection for conversion;
- minimal conditions for selected method of conversion; and,
- estimation of efficiency of selected method of conversion based on current literature.
- estimate of incremental costs to be financed through the GEF.

E. **Conceptual Model Development.**

- basic engineering design (conceptual engineering design for extraction and treatment of LFG);
- evaluation of investment and operational and maintenance costs;
- supply and demand of methane study;
- identification of users; and,
- projection of generation/consumption of fuel.

F. **Cost Benefit Analysis.** A full GEF proposal would include detailed cost estimates and specifications for project implementation. This activity would involve the preparation of detailed cost estimates and procurement specifications for all project activities, together with a financing and investment plan needed to implement the project. The plan will include incremental cost analysis to identify expenditures that would be financed by GEF, and will identify alternative sources of co-financing to support other portions and "non-incremental" aspects of the project.

G. **Development of a Project Implementation Plan.**

- Produce a detailed implementation plan including a PERT table with the critical activities and sequence of steps for the demonstration pilot project

Justification for PDF Grant

18. The PDF will finance preparation only of those components of the project which are expected to have an entirely or largely global benefit. The PDF will enable the formulation of the project in detail and will assist in the identification of project implementation issues, anticipated benefits and risks. The items to be financed and the expected preparation costs are summarized in Table 1.

Table 1 – Methane Capture and Use at a Landfill
Preparation Activities
Financing Plan US$ [1]

Project Component	GEF	GOM/IBRD	Total
Institutional/Management Needs	10,000	50,000	60,000
Identification of Barriers, Development of Plan for Elimination	10,000	20,000	30,000
Pre-feasibility	60,000	20,000	80,000
Feasibility	80,000	20,000	100,000
Development of Conceptual Model	100,000		100,000
Cost Benefit Analysis	20,000	20,000	40,000
Project Implementation Plan	20,000	20,000	40,000
Contingencies		10,000	10,000
Supervision		40,000	40,000
Total	**300,000**	**200,000**	**500,000**

[1] Costs of developing the baseline sanitary landfill investments have not been included in this table; all costs presented relate exclusively to preparation of the proposed methane capture project (investments, capacity-building, etc.)

Timetable for Execution of the PDF.

19. Preparation will begin immediately after PDF approval, and is expected to be completed 10 months thereafter.

Annex 1
WB/GEF Climate Change Investment Projects
Identification/Preparation Stage

The Mexico climate change WB/GEF pipeline is at its initial stages of identification and preparation. Summary information is provided below as input into a general country program framework:

1. A Second Air Quality/Transport Management project has been identified and is in preparation, building on the experience gained under an on-going Air Quality and Transport Project. This new project will address energy and environment concerns in the Mexico City Metropolitan Area, including measures to address emissions of greenhouse gases. A request for GEF cofinancing may be submitted to cover the incremental costs of project preparation and implementation.
2. A Renewable Energy Technologies (RETs) for Agricultural Productivity Project has been identified by the Ministry of Agriculture (SAGAR) for potential GEF support. IBRD/GOM support for baseline project activities would focus on improving smallholder productivity by facilitating access to improved production techniques (including RET applications). GEF support would be targetted to barrier removal activities which would accelerate penetration of RETs in rural areas, such as training, capacity-building, dissemination, outreach, etc.
3. A Solar Thermal Cycle Project, with substantial private sector participation, is at an advanced stage of consideration by the Mexican sector authorities. GEF support for final preparation activities and to finance incremental costs of project implementation may be requested shortly.
4. A Medium Size Project pertaining to the exploitation of wind energy is under preparation, addressing the institutional, financial and market barriers that have prevented market penetration of wind farms in the country.
5. A Solar Water Heating project is under identification with Block A preparation resources. The Block A report and supporting documentation has just been received and the WB CMU/GEF teams are assessing what next steps might be most appropriate for advancing progress in this area.

In addition to these specific proposals, project concepts related to renewable energy/rural electrification and to energy efficiency are being explored.

GH 1

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Subdirección de Proyectos Ambientales y de Desarrollo Urbano

Oficio No. 393. III. 4.- 402

México, D.F., a 16 de noviembre de 1998

SR. OLIVIER LAFOURCADE
Director para México del Banco Mundial
Insurgentes Sur 1605, piso 24,
Colonia San José Insurgentes
C i u d a d

Me refiero a la propuesta del proyecto "**Aprovechamiento del biogas de los sitios de disposición final de residuos sólidos municipales**", que será apoyado con recursos del Fondo para el Medio Ambiente Mundial (**GEF**), a través del Banco Mundial en su carácter de Agencia Instrumentadora del mismo.

Sobre el particular, a través del presente me permito informar a usted que el proyecto de referencia cuenta con el aval tanto de esta Secretaría de Hacienda y Crédito Público como Punto Focal del GEF, como de la Secretaría de Desarrollo Social (**Sedesol**), por lo que le solicito atentamente que por su amable conducto, se inicien los trámites correspondientes ante el GEF con el objeto de contar con apoyo para el mencionado proyecto.

Mucho le agradeceré nos mantenga informados del trámite que guarden estas gestiones, y sin otro particular por el momento, aprovecho la ocasión para reiterar a Usted las seguridades de mi más atenta y distinguida consideración.

A t e n t a m e n t e.
SUFRAGIO EFECTIVO. NO REELECCION.
El Director de Organismos Financieros Internacionales

Ricardo Ochoa