Agriculture

Methane produced and emitted during the anaerobic decomposition of organic material, such as livestock manure, can be reduced, captured, and used as clean energy with the implementation of anaerobic digestion technology. The U.S. government is working with the Methane to Markets Partnership to advance the recovery and use of methane at livestock manure management operations by supporting public-private sector alliances in countries all over the world.

Livestock Waste Management in Southeast Asia

Together, EPA and the World Bank have been supporting livestock waste management projects in Southeast Asia. The World Bank has provided $21 million to develop affordable pollution control methods for livestock waste management in China, Thailand, and Vietnam, and EPA has provided technical assistance to help implement these projects. The program promotes institutional capacity building and policy development and implementation. In addition, the program supports a measurement effort to quantify pollution reduction.

To date, five methane recovery projects are under construction, with approximately 12 more in planning stages. Each of these projects features systems designed to treat swine waste and recover methane (as biogas) for use as energy. For large operations, engine generators will be installed to produce electricity. Smaller farms and village systems will produce biogas primarily for use as cooking fuel.

Projected reductions from projects utilizing manure from 20,000 swine are estimated at approximately 5,000 tons of CO_2E annually.

Establishing Demonstration Projects in Mexico

Methane recovery is a relatively new concept in Mexico. Most animal waste from large agricultural operations is managed in lagoons, storage units, or discharged directly into surface waters. EPA and USAID are working throughout Mexico to capture and use methane from livestock waste management systems by promoting technology transfer and demonstration projects, strengthening capacity of local institutions, and developing supportive policies to nurture the methane capture industry.

EPA and USAID are creating demonstration projects to showcase the benefits of different methane capture and use technologies in various systems, farm sizes, and climates. The demonstrations operate

Table 1. *Methane Capture and Use Demonstration Projects in Mexico*

Project	Type of Farm	Number of Animals	Technology	Implementation Costs	Annual Emissions Reduction (TCO_2E)
Granja Pegui	Farrow-Finish	500	Bank-to-Bank	$35,000	130
Guadalupe	Farrow-Wean	180	Bank-to-Bank	$28,000	65
Paraíso	Farrow-Finish	170	Bank-to-Bank	$25,000	60
Santa Mónica	Farrow-Finish	5,200	Bank-to-Bank	$170,000	2,000
Granjas Carroll de México	Nursery	7,500	Modular Covers	$100,000	800

in two high-density swine regions on a variety of farms and provide the tools for selecting the right technology for each farm type (see Table 1).

Investigating Agriculture Waste Management Opportunities in Colombia

In Colombia, information is not readily available about animal waste management practices that have large emissions profiles. EPA recently partnered with Colombia's Centro Nacional de Producción Más Limpia y Tecnologías Ambientales to support grantees' efforts to investigate current livestock waste management practices and potential technologies for fermentation and energy generation. This work is expected to generate an inventory of the most valuable agricultural waste in Colombia. This inventory will be a key contributor toward future project development.

EPA and USAID are also developing institutional capacity within Mexican agencies responsible for agricultural, environmental, energy, and rural development, such as the federal Environment and Natural Resources Secretariat (SEMARNAT) and the federal Agriculture, Rural Development, Fisheries, and Food Secretariat. Through these efforts, EPA and USAID are educating decision-makers about the financial and pollution control benefits of anaerobic digestion and fostering the development of policies, technical standards, and financing opportunities for anaerobic digestion projects as part of an integrated livestock waste management strategy.

Based on current estimates, the replication of U.S.-supported demonstration projects throughout Mexico could lead to annual emissions reductions of 600,000 tons of CO_2E.

Coal Mining

Methane gas released from coal mining activities can be captured and used as a clean energy source, resulting in reduced GHG emissions, improved air quality, and enhanced mine safety. The United States is a global leader in recovery of coal mine methane (CMM) and continues to work with international Partners to share information, expertise, and technology to promote CMM project development. Some key U.S. activities and highlights in the coal mine sector follow.

Information Centers in India and China

One barrier to developing effective CMM recovery and use projects is lack of information on coal mines, common mining practices, and project opportunities. To assist project developers in overcoming this barrier, the United States has helped to establish information centers in India and China:

- EPA signed a Memorandum of Understanding with the Government of India to establish an information clearinghouse in India. Managed by India's Ministry of Coal and the Ministry of Petroleum and Natural Gas, the clearinghouse will promote the development of CMM projects and make CMM resources publicly available.
- EPA continues to support the development of the Coal Mine/Coalbed Methane Clearinghouse in China, housed at the China Coal Information Institute. EPA also provides funding, in-country technical and regulatory expertise, and consulting services for project developers and investors focusing on developing CMM project pre-feasibility studies.

Laying Foundations for Project Development

EPA is supporting numerous project development opportunities in collaboration with the government of China, such as:

- Continuing its work with the Asia Development Bank to develop two large-scale CMM projects in the Shanxi region of China.
- Bringing a delegation from Jincheng, China, to the United States to attend the

2007 International Coalbed Methane Symposium in Alabama and a tailored training program on advanced CMM drilling techniques in Maryland.

- Working with the Guizhou International Cooperation Center for Environmental Protection in Guizhou Province to conduct outreach to small and medium coal mines with significant methane emissions and resources. The goal of this effort is to overcome the information and communication barriers that many projects face and to ultimately connect viable CMM project sites with the international project development community.

Pre-feasibility and Feasibility Studies

EPA is funding CMM pre-feasibility and feasibility studies in conjunction with partners in several Methane to Markets countries. These studies are important because they provide information that can lead to more rapid implementation of projects at the study sites while also facilitating project development at additional locations. These studies include:

- The Mitigation and Utilization of Diluted Mine Methane by Using a Monolithic Catalytic Combustor at Tiefa, China
- The Quantification of Ventilation Air Methane Emissions From Two Gassy Underground Coal Mines in India
- Electricity Generation Utilizing Coal Mine Methane From a Nigerian Coal Mine
- A CMM and CBM Recovery and High BTU Monetization Technology Transfer Demonstration Project in the Sabinas Coal Basin of Coahuila, Mexico

Leveraging U.S. Assistance

Many U.S. government activities in the coal sector are leveraging technical and financial resources to generate additional funding commitments from other international agencies:

- EPA supplied a $140,000 grant to the United Nations Economic Commission for Europe to address financial barriers in the development, promotion, and sale of CMM recovery and use in Russia and Eastern Europe. These activities are attracting investor interest in CMM projects in the region as well as helping mine owners identify international investment funding for their CMM projects.
- EPA is funding a series of technical workshops in Ukraine to educate the coal industry about options for utilizing recovered methane gas in profitable and efficient ways. This activity builds on USAID grant funding totaling $3 million over two years for improved recovery of methane at coal mines by procuring and installing modern drilling equipment and providing training focused on drilling techniques and theory.

Developing Information Resources

EPA has developed critical information resources to enable key parties—from project developers to technology vendors—to get involved in the CMM industry and support CMM project development.

- *Coal Mine Methane Global Overview*. This study contains individual, comprehensive profiles of the coal and CMM sectors of 32 countries—18 Methane to Markets Partner Countries and an additional 14 coal-producing nations. In addition, an introduction section provides summary tables and statistics on coal reserves, coal production, methane emissions, and CMM project activity. This document is available for free on the Methane to Markets Web site at **www.methanetomarkets.org/resources/coalmines** and will be updated annually.
- *International Coal Mine Methane Projects Database*. This Web-based database contains information on more than 200 CMM recovery and utilization projects operating, in development, or planned around the world in both Methane to Markets Partner Countries and elsewhere. EPA will enhance the database over time so that the information is searchable and can be exported into spreadsheet format. It is currently housed on the Methane to Markets Web site.

EPA has developed white papers and other documents to address barriers to CMM project development around the world. Current and planned white paper topics include flaring safety and policy, coal and gas resource ownership regulations, and ventilation air methane utilization safety and policy.

Landfills

Methane from landfills often offers a local source of reliable energy with significant environmental and economic benefits. Unfortunately, many nations lack the technical expertise, policies, financing, and information needed to effectively tap landfills to meet energy needs. Through Methane to Markets, the United States is working with Partner Countries to break down these barriers that prevent landfill gas (LFG) from entering energy markets.

Training and Capacity-Building Workshops

In 2006, the United States organized capacity-building workshops in India, Russia, and Turkey. In India, USAID, the U.S. Department of State, and EPA partnered with the Federation of Indian Chambers of Commerce and Industry, the Ministry of Urban Development, and the Municipal Corporations of Mumbai, Hyderabad, and Ahmedabad to host a cross-sector workshop. The landfill technical session focused on LFG collection systems and gas modeling and also included presentations by several Indian municipal representatives on LFG energy prospects at their landfills.

In Russia, EPA organized a landfill methane capture and use workshop in Moscow in association with WasteTech 2007, Russia's largest waste management conference. In Turkey, EPA and the International Solid Waste Association delivered a landfill project development training event in Istanbul and sponsored participation by a group of Russian and Ukrainian delegates representing local governments, federal agencies, private industry, and academia. This enabled them to see an operating project, something that does not yet exist in either country.

Developing Tools to Advance LFG Projects

The United States has taken the lead in developing a suite of tools that help landfill owners and operators collect the data they need to determine the feasibility of potential

project sites and market them more efficiently to project developers. These tools include:

- **Country-specific LFG recovery models**. EPA has finalized the Mexico LFG generation model, which provides realistic estimates of projects' LFG energy potential. The model is available in both English and Spanish on the EPA Web site (**www.epa.gov/lmop**). EPA plans to calibrate this model to specific meteorological and landfill site conditions in Argentina and Ecuador. These modeling tools, along with ongoing and planned workshops on how to use and interpret modeling results, are providing Partners with better estimates of their LFG energy potential.
- **Gathering data to evaluate landfills**. Together with Australia and Project Network members, EPA compiled and distributed a template for Partner Countries to use in evaluating their landfills. The template facilitated data gathering on landfills in Argentina, Brazil, China, Colombia, Ecuador, India, and Ukraine.
- **International landfill database**. A Web-based, voluntary data repository to promote the development of LFG energy projects is being launched in September 2007 for data entry. The database can store information including general location and contacts, landfill physical characteristics, gas collection system characteristics, waste characteristics, and landfill operations. Members of the Landfill Database Task Force for the Methane to Markets Partnership Landfill Technical Subcommittee provided valuable input to the development of the database. The Partner Countries and Project Network members Carbon Trade, D'appolonia S.p.A, Deutz Corporation, Eastern Research Group, Inc., International Solid Waste Association's working group on sanitary landfills, SCS Engineers, Stratus Consulting, the Secretariat of Environment for Argentina, and the Ministry of Environment for Ecuador contributed to the database's development.

USAID Gorai Landfill Project

USAID supported the development of a LFG project at the Gorai landfill in Mumbai, India, upon completion of a landfill feasibility study. A pre-feasibility study assessed the technical and economic viability of the project. Later, site visits and interviews were conducted to assess the conditions of local populations, including landfill scavengers, and design a community development program. The municipality recently issued a request for Expressions of Interest for projects that utilize the LFG and could be candidates for the Clean Development Mechanism (CDM). The CDM is an arrangement under the Kyoto Protocol through which industrialized countries invest in emissions-reduction projects in developing countries as an alternative to more costly projects in their own countries.

Table 2. *LFG Energy Potential Projects Analyzed by EPA*

Assessment Reports	
Country	**Location**
Argentina	Bahia Blanca
	Neuquen
	San Nicholas
China	Jilin City
	Yongle
	Gaoyan
Colombia	Dona Juana
	La Pradera
	Navarro
	Los Cocos
Ecuador	El Valle Landfill, Cuenca
	Loja Landfill
	Chabay Landfill
India	Okhla
	Hyderabad
Russia	Dnitrovsky
Ukraine	Lviv
	Lutsk
	Poltava

Pre-Feasibility Studies	
Country	**Location**
China	Gaoantun
Ecuador	Las Iguanas Landfill, Guayaquil
	Pichacay Landfill, Cuenca
India	Ahmedabad
	Deonar-Mumbai
Mexico	Ensenada
	Nuevo Laredo
Ukraine	Cherivtsi

Identifying LFG Energy Project Opportunities

EPA is collecting and analyzing LFG energy potential projects in numerous countries (see Table 2). Reports and studies from these analyses will be presented at the 2007 Partnership Expo (see page 19). Conducting data analysis, site screening, and feasibility studies are essential steps that ultimately lead to project development. As seen in Table 2, the United States has engaged in multiple Partner Countries to accelerate LFG project development. Some highlights of this work follow.

- In early 2007, EPA and USAID, with the help of Mexico's SEMARNAT, completed the first official LFG pre-feasibility studies and pump tests to be conducted under the auspices of the Methane to Markets Partnership. The studies were undertaken at landfills owned by the cities of Ensenada and Nuevo Laredo in northern Mexico and indicate that the sites are good candidates for an energy project.
- EPA summarized data on more than 400 municipal solid waste facilities in Brazil and identified a minimum of 50 sites that could support at least a 500-kilowatt LFG energy project. Currently, EPA is working with the state environmental agency in San Paulo to select 12 top sites for further evaluation.
- USAID funded a pre-feasibility study for methane recovery in Buzios, Brazil, which has led to a local company, Marquise, securing the rights from the municipality to capture and use the landfill methane.

Promoting LFG Energy Project Opportunities

Promoting LFG energy project opportunities to municipal officials and local stakeholders has also been a priority. The United States has focused on sponsoring events at major international forums to achieve this goal:

- EPA sponsored and coordinated travel for representatives from the China Ministry of Construction and the Ecuador Ministry of Environment to attend the Carbon Expo Methane to Markets event. Delegates from China and Ecuador presented their in-country landfill opportunities and the advantages of participating in the Methane to Markets Partnership.
- As part of the Landfill Methane Outreach Program's Annual Conference and Project Expo, EPA sponsored a workshop on how to enter the Mexican LFG energy market and explained the services and assistance offered by the U.S. Department of Commerce and other agencies. The workshop included speakers from the U.S. Trade Development Agency (USTDA), EPA, U.S. Department of Commerce, the Export-Import Bank, Overseas Private Investment Corporation, and representatives from the first LFG electricity project in Mexico.

Oil and Natural Gas

The United States has worked hand-in-hand with the Methane to Markets Partnership's oil and gas stakeholders to pursue cost-effective methane emissions reduction opportunities to reduce product losses, lower methane emissions, and increase revenues. Some of the U.S. government's notable 2006 accomplishments and ongoing activities are discussed below.

Large-Scale Emissions Reductions Projects in Mexico

USAID supported several methane emissions reduction project activities with Mexico's state-owned oil company, PEMEX, including installing dry seals in the Ciudad PEMEX Gas Processing Center, conducting preliminary analyses of PEMEX Gas methane emissions at other locations, and identifying and quantifying fugitive emissions in the Cactus and Nuevo PEMEX Gas Processing Centers. PEMEX worked on eliminating fugitive methane emissions in the Cardenas Pipelines Sector of PEMEX Gas in Tabasco, Mexico. USAID and EPA are currently working with PEMEX to identify and implement more large-scale methane emissions reduction projects at additional facilities in 2007. PEMEX has spent approximately $1.3 million on methane emissions reduction efforts through 2006.

International Project Development Support

EPA continues to provide general outreach support, government and stakeholder engagement, and highly specific methane emissions reduction project identification and development support in Argentina, Brazil, China, Colombia, Ecuador, India, Russia, and Ukraine. This entails working with several companies to promote identification, cost-benefit analysis, and implementation of methane emissions reduction projects and membership in Natural Gas STAR International.

Leak Detection and Repair in Ukraine

Cherkasytransgas, a Ukrainian branch company of Ukrtransgas, matched grant funding from the U.S. Department of Energy's International Utility Efficiency Partnership

Launching Natural Gas STAR International

In 2006, EPA expanded the successful U.S.-based Natural Gas STAR Program by launching Natural Gas STAR International with seven charter partners: ConocoPhillips Canada, Devon Energy Corporation, Enbridge, Inc., ExxonMobil Corporation, Marathon Oil Corporation, Occidental Oil and Gas Corporation, and TransCanada. Soon after the program's launch, India's largest oil producer, The Oil and Natural Gas Corp. Ltd., also joined as a Partner. EPA is working with these companies to identify, analyze, promote, and track methane emissions reduction projects from their world-wide operations.

(IUEP) program and USAID Eco-Links to undertake a methane emissions reduction project. This project included detecting and measuring leaks, developing and implementing leak repair plans, confirming methane reductions with post-repair measurements, and summarizing successes. Cherkasytransgas plans to conduct measurements at all compressor stations, gas distribution stations, and linear valves and create a database of all discovered leaks.

Council on Environmental Quality Chairman James Connaughton addresses audience gathered for launch of Natural Gas STAR International.

Building on the IUEP and USAID work, EPA is supporting methane emissions reduction projects in Ukrainian natural gas transmission and distribution sectors. This work will focus on directed inspection and maintenance programs, such as those implemented in the IUEP and USAID work, which are proven cost-effective ways to detect, measure, prioritize, and repair equipment leaks to reduce methane emissions. Additionally, as part of this effort, EPA will organize a roundtable in collaboration with the Ukrainian government focused on possible policy measures to reduce emissions from the Ukrainian natural gas transmission system.

USTDA Ecopetrol Hydrocarbon Pipeline Safety and Security Project

This $500,000 feasibility study will help Ecopetrol S.A. address the safety, security, and integrity of Colombia's hydrocarbon pipeline system. The study, supported by USTDA, will involve a detailed assessment of the entire pipeline system and will focus on the development of a systematic plan aimed at reducing product losses by significantly improving physical and operational security throughout the system, including at various pumping and transfer stations.