



**Methane to Markets**

**Third Annual Report**  
**The U.S. Government's Methane to Markets**  
**Partnership Accomplishments**

November 2008



# Contents

|   |           |
|---|-----------|
| <b>The Methane to Markets Partnership .....</b>                       | <b>2</b>  |
| <b>U.S. Government Leadership in Reducing Methane Emissions .....</b> | <b>9</b>  |
| Agriculture .....   | 13        |
| Coal Mines .....  | 15        |
| Landfills .....   | 18        |
| Oil and Gas Systems .....   | 21        |
| <b>Looking Forward .....</b>  | <b>25</b> |

For additional information, please visit [www.epa.gov/methanetomarkets](http://www.epa.gov/methanetomarkets) and [www.methanetomarkets.org](http://www.methanetomarkets.org).

**Third Annual Report**  
**The U.S. Government's Methane to Markets**  
**Partnership Accomplishments**  
November 2008

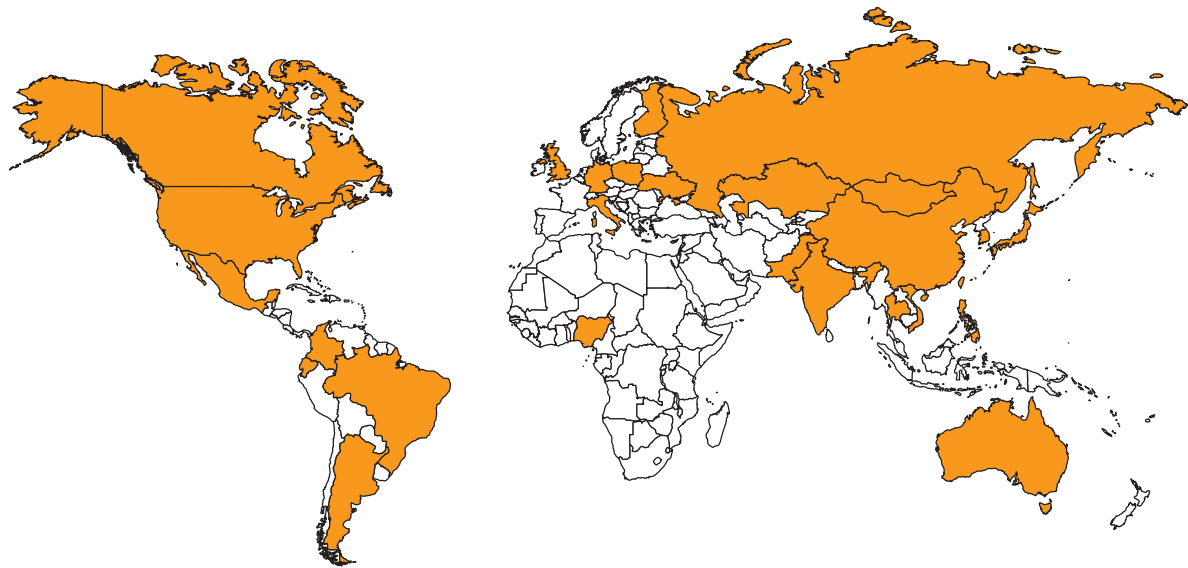


**USAID**  
FROM THE AMERICAN PEOPLE





# The Methane to Markets Partnership



- |           |                     |         |            |             |                                 |                          |
|-----------|---------------------|---------|------------|-------------|---------------------------------|--------------------------|
| Argentina | China               | Finland | Japan      | Nigeria     | Republic of Korea (South Korea) | United Kingdom           |
| Australia | Colombia            | Germany | Kazakhstan | Pakistan    | Russia                          | United States of America |
| Brazil    | Ecuador             | India   | Mexico     | Philippines | Thailand                        | Vietnam                  |
| Canada    | European Commission | Italy   | Mongolia   | Poland      | Ukraine                         |                          |

*Methane to Markets Partner Countries account for more than 60 percent of the world's anthropogenic methane emissions.*

Climate change is a serious environmental challenge that will require all countries around the world to realize significant reductions in greenhouse gases (GHGs). Methane, second only to carbon dioxide in its importance as a GHG, is of particular importance given its atmospheric properties and the suite of currently available, cost-effective reduction options. As such, focusing mitigation efforts on methane can yield near-term climate benefits along with major economic, air quality, and energy benefits (see sidebar on page 3).

In 2004, the United States joined with 13 other countries to focus global attention on the importance of methane emissions by launching the Methane to Markets Partnership. Methane to Markets is a multilateral initiative uniting public and private interests to fight climate change by advancing the recovery and use of methane as a clean energy source. By engaging public and private sector partners, this initiative brings together the technical and market expertise, financing, and technology necessary for methane capture and use project development.

The Partnership focuses on developing projects in four major methane emissions source areas: agriculture, coal mines, landfills, and oil and gas systems. In each of these sectors, cost-effective methane emission reduction technologies and practices are currently available to capture and use the methane gas as a fuel for electricity generation, onsite energy needs, or offsite gas sales. However, despite the availability of proven technologies and the associated environmental and financial benefits, methane recovery and use is not widespread. In many countries, financial, institutional, informational, regulatory, and other barriers have impeded project development. The Partnership is working to identify and address these barriers to combat climate change and deliver clean energy to markets all around the world.

### Origins and Structure of the Methane to Markets Partnership

The Methane to Markets Partnership is modeled on the United States' suite of domestic methane emission reduction programs. Since 1993, the U.S. Environmental Protection Agency (EPA) has operated four highly successful public-private partnerships: AgSTAR, the Coalbed Methane Outreach Program (CMOP), the Landfill Methane Outreach Program (LMOP), and Natural Gas STAR. These programs have engaged stakeholders, disseminated information, and catalyzed partnerships to remove barriers to project development and achieve significant on-the-ground results for more than a decade. As of 2005, they have helped to reduce annual U.S. methane emissions to 11 percent below 1990 levels.

## Why Is Methane Important?

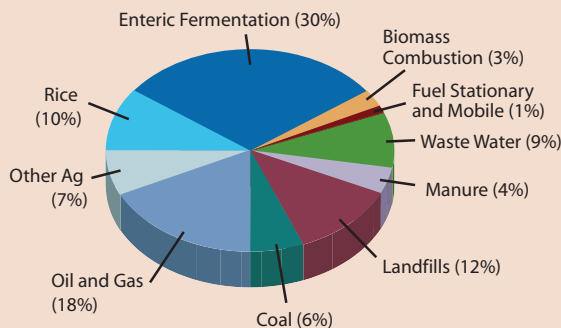
Methane is a hydrocarbon and the primary component of natural gas. It is also a potent GHG that is more than 20 times as effective at trapping heat in the atmosphere as carbon dioxide (CO<sub>2</sub>). Methane has a much shorter atmospheric lifetime than CO<sub>2</sub> (about 12 years, compared to about 200 years for CO<sub>2</sub>).

As a result, reducing methane emissions can achieve significant near-term climate, energy, and economic benefits. Identifying and capitalizing on cost-effective opportunities to reduce methane emissions lowers the cost of GHG abatement over the long term and allows time for the development of alternative technologies. Also, studies indicate that feasible reductions in methane and other non-CO<sub>2</sub> GHG emissions can help slow global warming over the next 50 years on the same scale as similar reductions in CO<sub>2</sub> emissions. In addition, methane contributes to the growing global background concentration of tropospheric ozone, a greenhouse gas and an air pollutant associated with premature mortality. Thus, reducing methane emissions decreases surface ozone everywhere, yielding

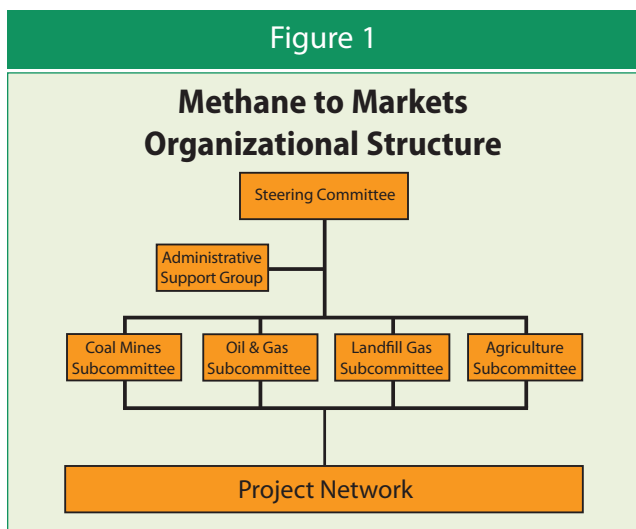
additional climate benefits as well as improvement in local air quality.

Methane accounts for 16 percent of all GHG emissions globally, with about 60 percent of these emissions coming from anthropogenic (human-related) activities.

**Estimated Global Anthropogenic Methane Emissions by Source, 2005**



Source: Global Anthropogenic Emissions of Non-CO<sub>2</sub> Greenhouse Gases, 1990-2020 (EPA Report 430-R-06-003)

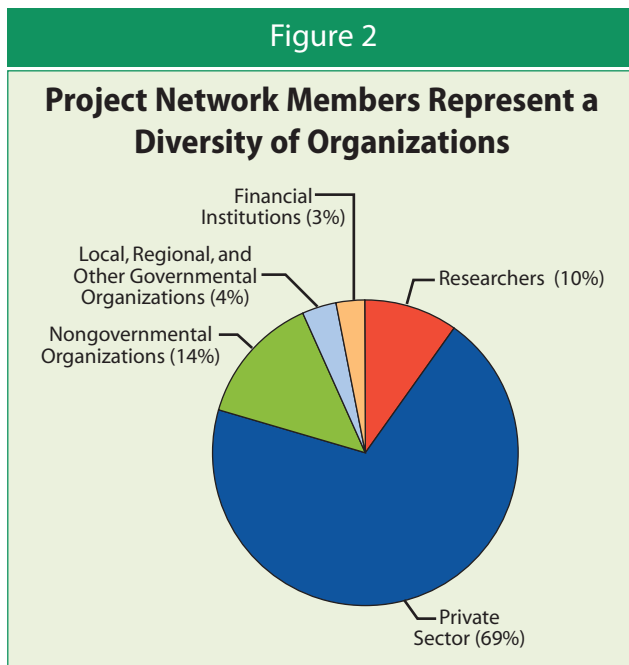


Using a similar approach, Methane to Markets brings together industry, nongovernmental organizations (NGOs), national governments, and other stakeholders to advance project development around the world. The Partnership is structured around the Steering Committee, the Administrative Support Group (ASG), four subcommittees, and the Project Network (see Figure 1). The Steering Committee guides the work of the Partnership and is supported by the ASG, or secretariat, which is currently housed at EPA. The subcommittees (Agriculture, Coal Mines, Landfills, and Oil and Gas Systems) are responsible for the technical work in each of the Partnership’s target sectors. Each subcommittee operates as a partnership of government representatives and the Project Network. The Project Network is an engaged community of industry, nonprofit organizations, international financial institutions, and other expert stakeholders who actively participate in meetings and activities as a means of building capacity, transferring technology, and promoting private investment.

*The Project Network: Bringing Expertise to International Project Development*

The Project Network plays a vital role in the financing, development, and operation of methane capture and use projects. The Methane to Markets Partnership established the Project Network to ensure that national governments pursuing methane emission reductions would be able to leverage the project development knowledge, experience, and resources of these critical stakeholders around the world.

Today hundreds of individuals and organizations participate in the Project Network from countries in Africa, Asia, Australia, Europe, North America, and South America. These diverse organizations (see Figure 2) identify and implement cost-effective methane recovery and use projects globally; address the informational, technical, and institutional barriers to project development; and contribute to capacity-building and technology transfer activities. At the same time, these organizations can increase profits, expand their businesses, distinguish themselves in the marketplace, and more successfully achieve their strategic goals—all while helping to address the critical issue of climate change.



Active participation by the Project Network is critical to the success of the Partnership, and facilitating Project Network member involvement is a top priority for the Partnership. Methane to Markets invites and encourages Project Network members to participate in as many of the Partnership-sponsored meetings, events, and activities as possible.

### *Growth of the Partnership*

The Methane to Markets Partnership has grown in size, scope, and influence. Since 2004, the Partnership has:

- **Expanded from 14 initial Partner Countries to 27** including the European Commission, with Finland, Kazakhstan, Mongolia, Pakistan, the Philippines, and Thailand being the most recent additions in 2008. Together, these 27 Partners represent more than 60 percent of the world's anthropogenic methane emissions.
- **Recruited more than 800 Project Network members** from around the world, including some of the most well-respected financial institutions, NGOs, manufacturers, project developers, and consultants in the industry.
- **Added agriculture as a fourth sector**, creating a subcommittee to focus on facilitating methane recovery and use projects for live-stock waste and manure management systems to start. (The Partnership is currently expanding into other agricultural waste sources.)
- **Tracked the development of more than 140 methane emission reduction projects** in Methane to Markets Partner Countries around the world.
- **Held 41 events in 13 countries**, bringing together methane professionals from a broad range of technical disciplines, countries, and sector interests to share experiences and best practices.

- **Organized the first Partnership Expo**, in Beijing, China, in 2007. The Expo brought together more than 700 members of the international methane community and showcased over 90 potential methane capture and use projects from around the world (see Partnership Expo sidebar on page 6). The event's success has resulted in the Partners planning a second Partnership Expo to be held in 2010.

### *Dismantling Barriers and Advancing Project Development*

The success of the Methane to Markets Partnership Expo and the growth of the Partnership demonstrate the continued success of Partner Countries and Project Network members in removing barriers and advancing methane recovery and use projects around the world. Through the Partnership's subcommittees, both public and private sector partners have successfully developed comprehensive Action Plans for each target methane sector along with country-specific strategic plans to better identify specific barriers to project development within each country. These plans have already guided the development of over 140 projects and activities aimed at delivering near-term methane emissions reductions through training and capacity building, technology demonstration, market development, and direct project development support.

Perhaps one of the most important barriers that the Partnership is effectively addressing across all projects and methane sectors is overcoming informational and technology barriers. Methane to Markets has developed a wide array of tools and services that provide accurate and targeted information to the international methane community, helping to catalyze project development. All of these tools, which are made widely accessible through the Methane to Markets Web site (see sidebar on page 7),

## 2007 Methane to Markets Partnership Expo

### Methane to Markets Convenes World's Largest Gathering of Methane Experts

In October 2007, the Methane to Markets Partnership convened the world's largest gathering of methane professionals in Beijing, China. Together with China's National Development and Reform Commission (NDRC), EPA co-hosted this three-day event, which brought together investment, project development, and government professionals to network and collaborate on advancing new methane capture and use projects. In all, the Expo attracted more than 700 attendees from 34 countries and more than 20 corporate sponsors from a cross-section of industries and trades. These sponsors included turbine and equipment manufacturers, alternative energy companies, investment banks, project developers, and consulting firms.

The Expo featured concurrent technical tracks for the agriculture, coal mines, landfill, and oil and gas systems sectors. For each track, breakout sessions gave attendees the opportunity to review and discuss case studies of methane projects, technological advances, financing, and country-specific policy and regulatory barriers and solutions. The Methane to Markets Steering Committee and subcommittees also met in conjunction with the Expo to discuss the implementation of sector-specific subcommittee action plans and other Partnership business.

One of the most significant aspects of the Partnership Expo was the Project Showcase, at which project developers and other parties highlighted potential projects in need of funding and/or technical assistance to move forward. Ninety-one potential methane capture and use projects from 11 countries across all four Methane to Markets sectors were showcased (see Figure 3). The United States provided key technical or financial support to more than a third of these projects. If fully implemented, these 91 projects are estimated to yield annual methane emission reductions of 11.5 million metric tons of carbon dioxide equivalent (MMT<sub>CO<sub>2</sub>E</sub>) by 2015.



The Expo's proceedings also featured presentations and round table discussions on issues relevant to international methane project development. Opening remarks were delivered by Xie Zhenhua, Vice Minister of China's NDRC, and Clark T. Randt, Jr., U.S. Ambassador to the People's Republic of China. "China faces arduous tasks in dealing with climate change but the potential for reducing greenhouse gases is tremendous, and so are business opportunities," said Xie, who is also the Deputy Director of the National Leading Group of Work Responding to Climate Change. Bindu Lohani, Vice President of the Asian Development Bank (ADB), gave the keynote speech ("Importance of Methane Projects in Global Carbon Markets and as a Source of Clean Energy"), while John Beale, Deputy Assistant Administrator of EPA and Co-Chair of the Partnership Steering Committee, spoke about some of the Partnership's recent accomplishments.



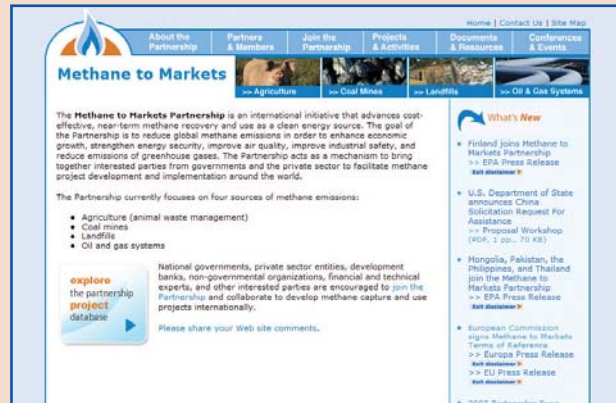


## www.methanetomarkets.org

The Methane to Markets Web site features easy-to-use navigation bars to provide quick access to country-specific resources, Partnership administrative information, records of Partnership meetings and activities, and online applications to join as a Partner Country or a Project Network member. The Web site also houses:

- Pages for the Partnership's four sectors (agriculture, coal mines, landfills, and oil and gas systems) that contain all relevant sector information and resources.
- Documents and resources, including funding opportunities, fact sheets, news, information on the Steering Committee, and relevant links.

- Project Network member information, searchable by geographic area of interest and description of services.



provide critical data and information on project opportunities and technologies. Some of these tools include:

- **Project Tracking Database.** This database allows users to submit information for ongoing or proposed methane capture and use projects. For each project submitted, the database contains information such as a project description, anticipated benefits and outcomes, estimated annual GHG emission reductions, and primary contacts. The database is intended to connect a variety of stakeholders and to help promote the development of new projects. It contains information on more than 100 ongoing and 40 proposed projects.
- **International Landfill Database.** Developed by EPA to facilitate the development of landfill gas energy projects, this database helps those looking to advance methane capture and use projects from international landfills. It houses key data for project development, including landfill location and contact information, landfill physical characteristics, gas collection system characteristics, waste characteristics, and landfill operations. Launched in September 2007, the database stores information from more than 250 landfills around the world.
- **International Coal Mine Methane Projects Database.** This database, designed by EPA, stores critical data for coal mine methane (CMM) projects such as a mine's name and location, physical characteristics, type of methane drainage system, thermal and electric capacity, annual GHG emissions avoided per year, and contact information. It contains information on more than 215 CMM recovery and utilization projects that are operating, in development, or planned in 13 countries.
- **Coal Mine Methane Technology Database.** Compiled by Australia's Department of Tourism, Industry, and Resources, this database provides information, contacts, and case studies for a range of CMM recovery and utilization technologies. It contains information on a number of different technologies relating to methane combustion, drainage gas purification for pipeline or town gas, ventilation air methane (VAM) mitigation

and utilization via thermal oxidation, VAM mitigation and utilization via catalytic oxidation, enriching diluted methane, and measuring and monitoring methane. It also includes case studies that cover drilling, methane combustion, and VAM mitigation and utilization via thermal oxidation.

- ON TIME.** The government of Canada developed this new online tool to provide policymakers, project developers, financiers, and other important stakeholders easy-to-access, credible information on cost-effective technologies and practices that reduce methane emissions in the oil and gas sector (see Figure 4). The tool displays interactive flow diagrams of the oil and gas industry, allowing users to navigate among different industry processes, from the extraction of oil and gas to its market delivery.

"The Methane to Markets effort is an excellent example of a public-private partnership that is combining the best from both government and industry."

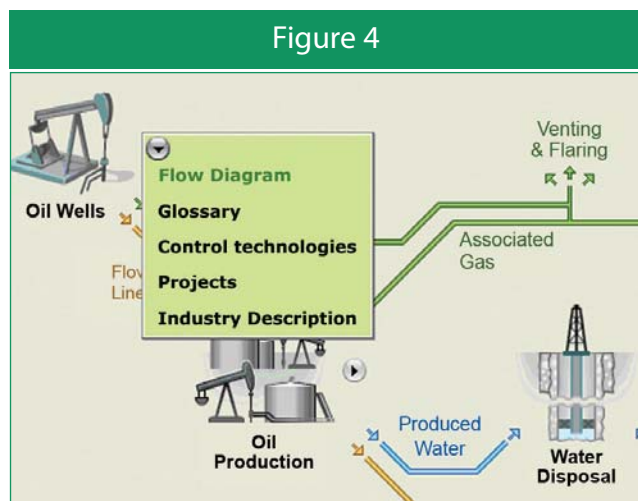
Neil Hirst, Director  
International Energy Agency  
November 2007

within 10 years, the Partnership has the potential to deliver estimated annual reductions in methane emissions of more than 180 MMTCO<sub>2</sub>E. This is the equivalent of recovering more than 760 billion cubic feet of natural gas, the annual emissions from 50 million cars, or the annual emissions from 76 500-megawatt (MW) coal-fired power plants. If achieved, these reductions could lead to stabilized or even declining levels of global atmospheric concentrations of methane.

A forthcoming report, *The Methane to Markets Partnership Accomplishments Report*, will be published before the 2010 Partnership Expo. It will summarize the collective accomplishments of the Partnership and its global impact since inception.

### Partnership Efforts Are Yielding Results

The Partnership expects to achieve significant economic, environmental, and energy benefits. The United States estimates that



This flow diagram from ON TIME shows the “Oil Well” drop-down menu. Users click on the different menus to access additional information on oil well-related activities.

# U.S. Government Leadership in Reducing Methane Emissions

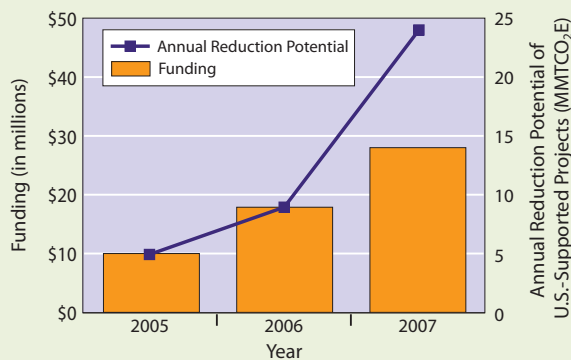
In support of the Methane to Markets Partnership, the United States has pledged up to \$53 million over a five-year period to facilitate the development and implementation of methane projects in developing countries and countries with economies in transition. As this funding is committed, it is supporting a broad range of efforts through the Partnership, such as the export of the successful U.S. voluntary programs, training and capacity-building, market development, feasibility assessments, and technology demonstrations. Leveraging the efforts of fellow Partner Countries along with the expertise and investment of the United States and the international private sector is central to the U.S. commitment.

## EPA Grants for Methane Projects

The United States, for the second year, held a grants competition to support projects that identify, characterize, or implement methane capture and use opportunities in developing countries or countries with economies in transition that are Methane to Markets Partners. Institutions from 16 Partner Countries submitted more than 80 proposals, seeking a combined \$35 million in project support. After reviewing all the submissions, EPA awarded more than \$4.5 million to 20 applicants from Argentina, Brazil, China, Ecuador, India, Korea, Mexico, Mongolia, Nigeria, Poland, Thailand, and Ukraine. These awards build significantly on the solicitation from last year, in which \$2.9 million was awarded to applicants from 11 Partner Countries to fund nearly 30 proposals. EPA's Web site ([www.epa.gov/methanetomarkets](http://www.epa.gov/methanetomarkets)) provides more details on this program and other methane-related activities.

Figure 5

### U.S. Government Funding for Methane to Markets and Annual Reduction Potential, 2005–2007



U.S. government contributions were critical in making 2007 the most successful year of the Partnership to date. U.S. government funding for the Partnership in fiscal year (FY) 2007 was \$10.2 million, bringing the total U.S. financial commitment to the Partnership since its inception to \$28.5 million (see Figure 5). These resources continued supporting pre-feasibility and feasibility studies at potential project sites, while addressing market, institutional, and other barriers to project development and building capacity through technology transfer and training

## A Multi-Agency Effort

U.S. government efforts under the Methane to Markets Partnership are led by EPA and involve the collective efforts of the following major agencies and departments of the federal government:



**EPA** is the lead U.S. agency and, as host of the Administrative Support Group, coordinates and administers Partnership activities both domestically and internationally. EPA builds on the success of its voluntary methane reduction programs, which have been instrumental in reducing U.S. methane emissions in 2005 by more than 11 percent below 1990 levels.



**USAID**  
FROM THE AMERICAN PEOPLE

**U.S. Agency for International Development (USAID)** provides technical expertise in the economic reform of energy sectors to create markets that support private sector projects in developing countries and those with economies in transition.



**U.S. Department of Agriculture** lends technical expertise in the animal waste management sector.



**U.S. Department of Energy** contributes expertise in natural gas and CMM technologies.



**U.S. Department of State** leads international climate change policies and activities and supports the development of methane projects.

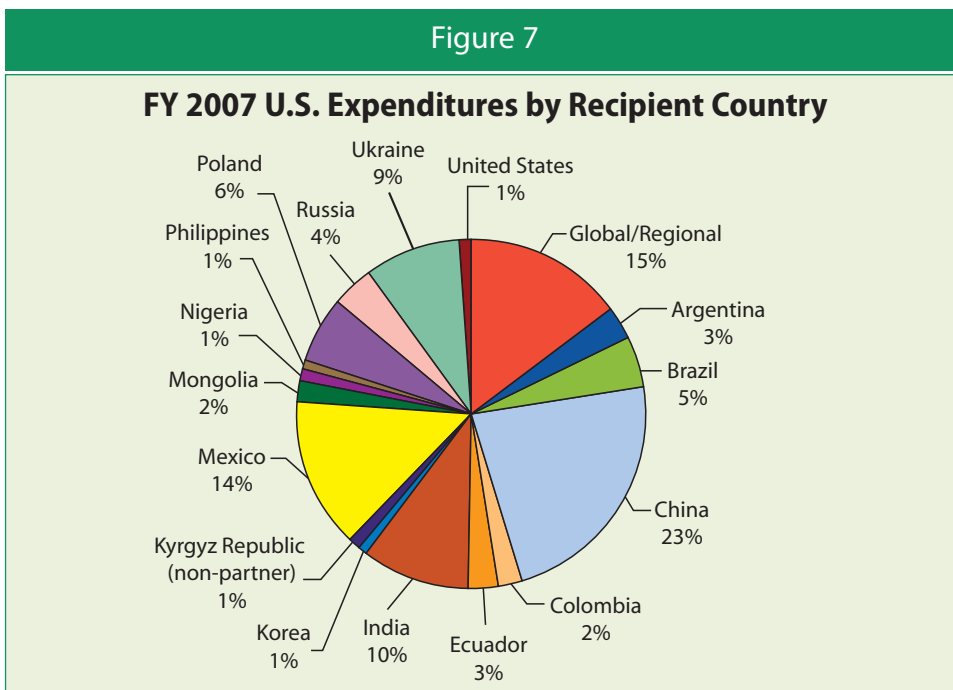
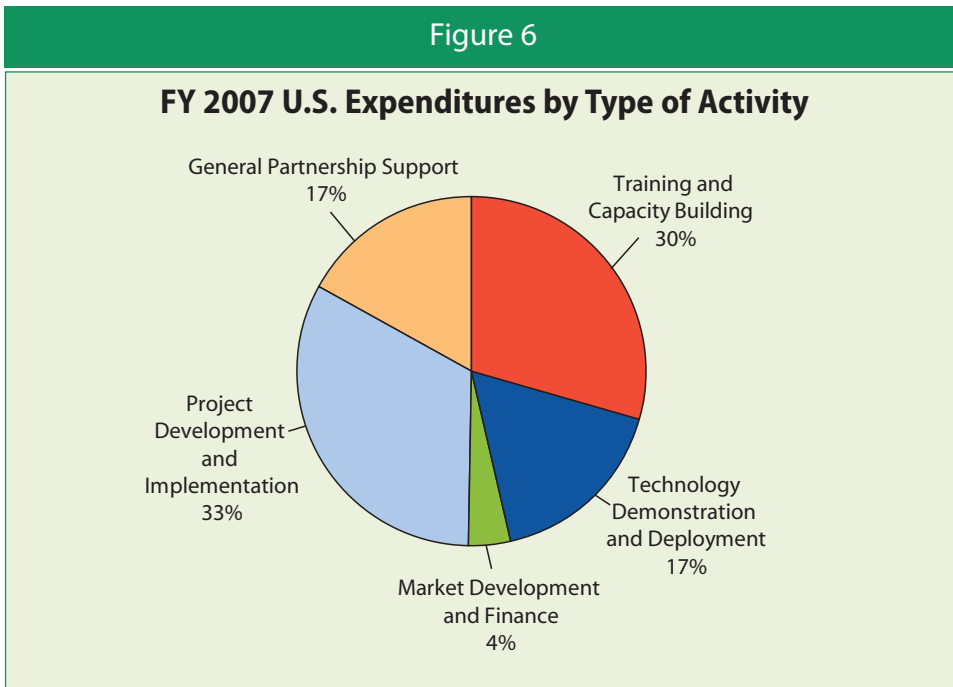


**U.S. Trade and Development Agency** facilitates development in emerging markets by promoting U.S. partnerships in high-priority overseas projects.



(see Figure 6). The United States expends these resources across more than a dozen Partner Countries and regions (see Figure 7). These efforts are directly leading to the development of full-scale projects in many Partner Countries.

When fully implemented, these projects will deliver estimated annual emission reductions of more than 24 MMTCO<sub>2</sub>E. This is nearly triple the results from activities undertaken in 2006.



U.S. government expenditures continue to leverage funding from other sources (see Figure 8). For example, EPA awarded the Thai Ministry of Agriculture a grant for \$700,000 to reduce methane from swine farms. This grant is leveraging \$7 million from the World Bank to deploy large-scale anaerobic digesters.

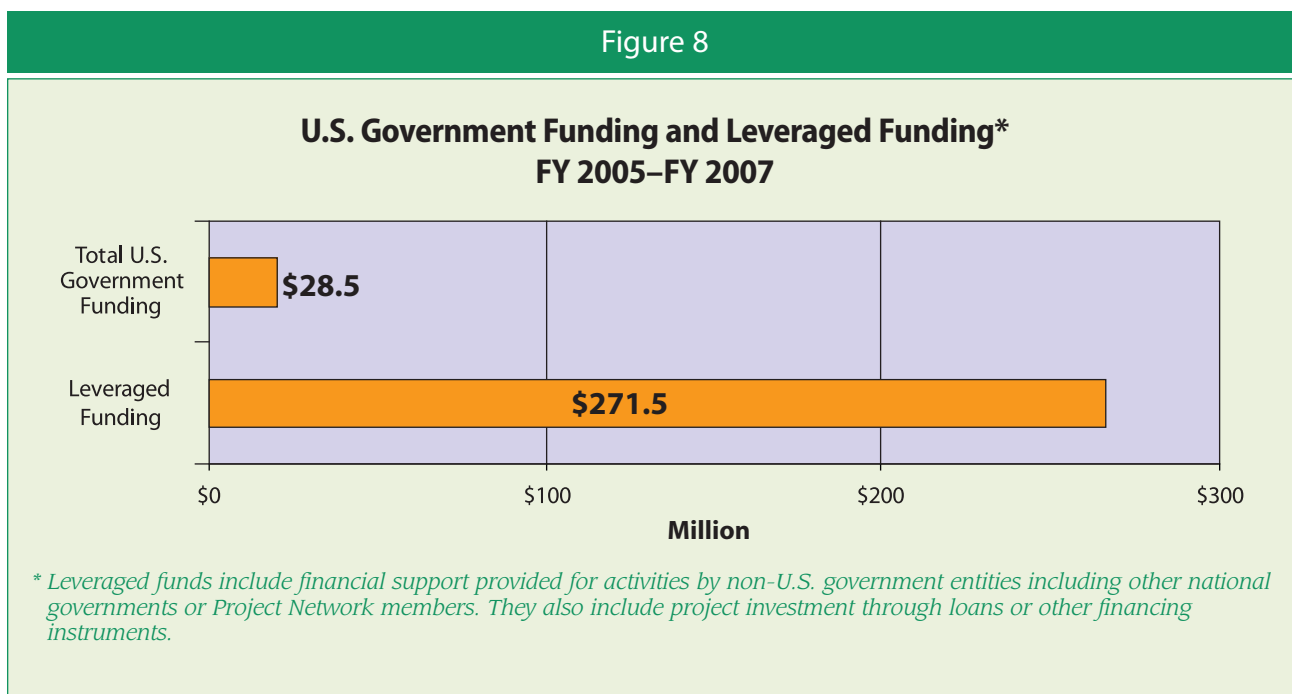
Most importantly, the Methane to Markets Partnership continues to deliver near-term results in addressing the global challenge of climate change and clean energy development. By conducting technology transfer, improving local capacity, and marketing project opportunities across borders and sectors, the Partnership is developing local,

clean energy resources while reducing GHG emissions.

The following sector-specific updates provide a brief overview of some of the most notable U.S.-government-sponsored activities in the Partnership's four sectors that were funded in 2007.

EPA also maintains [www.epa.gov/methanetomarkets](http://www.epa.gov/methanetomarkets), which details contributions and responsibilities of the six major federal agencies involved in the Partnership. The Web site also features basic information on methane capture and use, related EPA voluntary programs, and links to Partnership newsletters and press releases.

Figure 8





## Agriculture

**G**lobally, agricultural sources of methane emissions include enteric fermentation, rice planting, and livestock manure. Methane to Markets' agriculture activities focus on methane emissions from livestock and food processing wastes, though the Agriculture Subcommittee is exploring opportunities to expand to other methane sources. The methane produced and emitted during the anaerobic decomposition of livestock and food processing wastes can be reduced, captured, and used as clean energy with the implementation of anaerobic digestion technology.

In 2005, the global total amount of methane from livestock manure that could be used in this manner was estimated to be slightly more than 230 MMTCO<sub>2</sub>E. In this reporting year, the U.S. government spent more than \$1.5 million in support of activities through the Methane to Markets Partnership to help advance the recovery and use of methane at livestock manure management operations. Highlights of these and other activities are presented below.

Thailand is working with EPA to reduce methane from swine farms in three provinces near Bangkok. With support from the World Bank's Global Environmental Facility and Thailand's Department of Livestock Development and Energy Policy and Planning Office, 12 swine farms, raising nearly 200,000 pigs, are transitioning from open lagoons to anaerobic digestion systems that will generate electric power. With technical support from EPA, project engineers are expecting the project to reduce annual methane emissions by more than 90,000

metric tons of carbon dioxide equivalent (MTCO<sub>2</sub>E). Participating farmers will benefit from the project by using the methane as a local energy resource and the dried digestive sludge as a crop fertilizer.

### *Partnering with the World Bank to Improve Livestock Waste Management in Southeast Asia*

EPA and the World Bank have been supporting livestock waste management projects in Southeast Asia since 2004. The World Bank has provided \$21 million to develop affordable pollution control methods for livestock waste management in China, Thailand, and Vietnam, while EPA has provided technical assistance necessary to implement these projects. Through the deployment of anaerobic digestion technologies, the program mitigates water pollution from confined swine production and promotes institutional capacity-building and policy development and implementation. In addition, the program includes support for pollution reduction quantification. To date, two methane recovery systems are operational and six are under construction, with approximately 100 more in planning. 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 and have back-up flares. Smaller farms and village systems will produce biogas primarily for use as cooking fuel. These projects are estimated to achieve methane reductions of 500,000 MTCO<sub>2</sub>E.

### *Bringing Anaerobic Digesters to Rural China*

EPA is partnering with the Chinese Ministry of Agriculture on a number of initiatives to expand the use of improved village-scale digesters and technical training in rural areas. A market assessment of methane recovery and use opportunities in the livestock and agro-industrial waste sector is also underway in southern China, with an expected demonstration component to follow for medium and large farms. Similar efforts are also scheduled for Vietnam, the Philippines, Thailand, and Korea.

### *Transforming Distillery and Winery Wastes in India*

In India, EPA is facilitating the deployment of anaerobic digesters in the dairy sector by supporting market assessment of digester opportunities, identification of commercially proven and affordable technologies, targeted technical demonstration, education and extension, and



Anaerobic digester effluent lagoons are used in many confined animal operations for stabilization and temporary storage of manure wastes. This lagoon is located at the Santa Monica Farm in La Piedad, Michoacán, Mexico.

policies that promote the adoption of appropriate anaerobic digester technologies. In the past these efforts have focused both on small-scale operations (in order to offset cooking fuel use) and commercial-scale dairy and creamery operations (from which the methane can be used to generate electricity). In 2007, EPA and its Indian partners expanded their work to include wastes from the distillery and winery sectors.

### *Expanding Demonstration Programs in Mexico*

While much animal waste from large agricultural operations is managed in lagoons, there are also manure storages, or instances where manure is discharged directly into surface waters in Mexico. EPA and USAID have been working throughout Mexico to demonstrate methane capture and use from livestock waste management systems by implementing technology transfer mechanisms and demonstration projects, strengthening the capacity of local institutions, and developing policies that nurture the methane capture industry and reduce surface water-related pollution.

For example, over the past two years EPA has collaborated with SEMARNAT, Mexico's environmental protection agency, to develop a series of commercial-scale demonstrations at various swine farms to raise awareness and technical capability within Mexico. As a result of these demonstrations, EPA is helping SEMARNAT implement the next phase to advance the capacity of the Mexican anaerobic digester industry. The next phase of work will include verification of technology performance, development of national anaerobic digester technical standards, and an anaerobic digester technology supplier certification program in Mexico.





## Coal Mines

**M**ethane 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. In 2005, global methane emissions from coal mines were estimated to be nearly 400 MMTCO<sub>2</sub>E. The United States is a leader in the recovery of CMM and continues to work with international partners through Methane to Markets to share information, expertise, and technology to promote CMM project development. In this reporting year, the U.S. government has supported these initiatives with more than \$1.7 million in funding. Major activities from this sector are summarized below.

### *Supporting Technology Demonstration Projects in China and Mexico*

To facilitate and encourage the adoption of the latest technologies in the global marketplace, EPA is supporting demonstration projects to showcase available, cost-effective CMM technologies. In China, EPA is supporting a demonstration project featuring the use of engine technologies capable of producing power from low-quality methane. In Mexico, EPA is funding a demonstration project designed to convert CMM to liquefied natural gas (LNG).

### *Building Capacity and Overcoming Informational Barriers in China and India*

One significant barrier to developing effective CMM recovery and use projects is the lack of information on coal mines, common mining practices, and coal mine project opportunities.

To help project developers overcome this barrier, the United States is supporting several initiatives that will help to develop the on-the-ground awareness and technical expertise necessary for successful short-term and long-term project development.

For example, in 2007, EPA continued to support the work of the Coal Mine/Coalbed Methane (CBM) Clearinghouse in China. This clearinghouse provides project developers and investors with easily accessible in-country technical and regulatory expertise on CMM project development. To date, the clearinghouse has provided its services to a variety of international organizations, including the International Energy Agency, ADB, Asian Pacific Economic Cooperation, and the United Nations Development Program.

To further increase awareness and expertise at the provincial level, EPA is backing the CMM Recovery and Utilization Initiative in the Guizhou Province in China. With more than 2,000 coal mines producing a combined 100 million tons of coal each year, the potential for CMM recovery and utilization as a clean energy source in Guizhou is substantial, yet for most mines this source is not exploited because of information, communication, and other market barriers. Work in Guizhou is aimed at helping stakeholders overcome these barriers and connect viable CMM project sites with the international project development community. Specifically, the initiative will provide international project developers with free, focused, and current information regarding project development opportunities at 45 coal mines in Guizhou.

EPA, USTDA, and the Government of India have recently established a CBM and CMM Clearinghouse in India, the world's third largest producer of coal. The clearinghouse is similar to the national clearinghouse in China and is managed by India's Ministry of Coal and the Ministry of Petroleum and Natural Gas. EPA organized one introductory workshop and USTDA organized a kickoff event to inaugurate this work. India's coal production is predicted to dramatically increase in the near future; CMM emissions are expected to increase unless methane recovery and utilization projects are implemented.

### *Improving Mine Safety and Policy Incentives in Ukraine*

In Ukraine, USAID and the U.S. Department of Labor have provided in-depth, onsite training to coal miners at a mine in the Donbass coal region on the use of a U.S. horizontal coal seam drilling rig to remove methane from coal seams more effectively. This advanced technology and best practice will help reduce in-mine methane concentrations, improving mine safety and encouraging the recovery and utilization of high-quality methane gas as a clean energy source.

EPA is also promoting methane utilization at coal mines in Ukraine. EPA funded three technical workshops there; in addition, EPA and a Ukrainian NGO are investigating and raising awareness of the best policy and regulatory practices to help create incentives and reduce barriers for CMM project development. After an initial exploratory phase, a roundtable is planned for key government stakeholders to share initial policy recommendations.

### *Overcoming Financial Barriers in Russia and Eastern Europe*

The United States supported the United Nations Economic Commission for Europe's (UNECE's) work in Russia and Eastern Europe to minimize financial barriers to CMM projects.

### **Providing Technical Assistance to the World's Largest CMM Project**

The United States has been instrumental in helping to implement the world's largest power generation project fueled with CMM. Located at the Sihe Mine in Shanxi Province, China, the Jincheng Anthracite Mining Group operates a 120 MW power generation project that uses Caterpillar engines. The project also recovers heat to produce hot water and steam (i.e., combined heat and power) for mining operations. The electricity generated serves an estimated 90,000 households in addition to local commercial and industrial facilities. Over the project's 20-year lifetime, it is anticipated that 40 MMTCO<sub>2</sub>E emissions will be avoided.

The total project investment of \$235 million has been financed by Japan Bank for International Cooperation, ADB, the Jincheng municipal government, and the World Bank Prototype Carbon Fund. USTDA provided a \$500,000 technical assistance grant to develop specifications for the power generation equipment. Additionally, EPA provided training for a Chinese delegation from the Jincheng Anthracite Mining Group on advanced U.S. methane degasification technologies.



Construction of the world's largest CMM-generated power project (120 MW capacity) at Sihe Mine, Jincheng, Shanxi Province, China.

Technical and financial experts conducted missions to identify potential project opportunities in Russia and Kazakhstan. They provided support to develop bankable documents, which project proponents can use to apply for financial support

## Supporting Pre-Feasibility and Feasibility Studies in Partner Countries

Pre-feasibility and feasibility studies are key steps in project development. Pre-feasibility studies help developers determine whether a project has the potential to succeed financially and technically. This information is necessary to raise needed capital and generate interest to move the project forward to the next stage of development: the feasibility study. The feasibility study provides developers with more detailed analysis on costs, challenges, and expected results based on project parameters. Undertaking either type of study can be challenging and expensive.

The United States has funded several pre-feasibility and feasibility studies for projects in the coal sector to help advance project development in China, India, and Nigeria. These studies provide important information that accelerate project implementation at the study sites. For example, in 2007:

- In China, EPA launched initiatives to work with Chinese coal mines by conducting three full-scale feasibility studies at the Liuzhuang mine in Anhui Province, a group of six mines in the Songzao coal basin in Chongqing, and a group of six mines in the Hebi region of Henan Province. The studies will assess the technical and economic viability of implementing methane recovery and utilization projects. The results will be summarized along with project implementation recommendations in three comprehensive final reports. These projects could yield significant benefits. For example, the Hebi project plans to utilize CMM to power 22 internal combustion engines, each capable of generating 500 kW of electricity, and could deliver up to 250,000 MTCO<sub>2</sub>E in emission reductions annually.
- Also in China, EPA has funded a feasibility study for an innovative technology that mitigates dilute

methane from coal mine ventilation shafts at the Tiefa Mine in Liaoning Province.

- In India, EPA funded a study quantifying the dilute methane emissions from underground coal mine ventilation shafts (known as ventilation air methane or VAM) from the Moonidih Mine in Jharia, Jharkland, and the Chinakuri Mine in Ranigani, West Bengal.
- In Nigeria, EPA supported a pre-feasibility study at the Okpara Mine. Mining here is expected to recommence in 2010 after several years of inactivity, with the mine producing up to 400,000 tons of coal annually. Project developers are planning to capture and use drained mine methane to generate 1.24 MW of electric power, which will then be sold to the mine.

EPA provided technical support to help develop preliminary analyses and profiles of 20 project opportunities for CMM projects in China, India, Mexico, Nigeria, Russia, and Ukraine. These project opportunities were showcased at the 2007 Methane to Markets Partnership Expo in Beijing.



Pumping station at a mine under study in China. The station extracts methane from the underground coal seam in advance of and during mining.

and complete project-specific business plans to attract investor interest. These efforts culminated in a road show to showcase a preliminary investment study about the opportunity to develop a CMM recovery and utilization project at the Krasnogorskaya Mine in Russia to six interested investors in London. Also as part of this effort, UNECE developed a business plan

template in Russian and English and conducted three finance-focused workshops in Russia and Switzerland as well as technical workshops in Poland and Ukraine. Lessons learned from this initiative were disseminated at several meetings of the UNECE Ad Hoc Group of Experts on Coal Mine Methane and at the 2007 Methane to Markets Partnership Expo in Beijing.



## Landfills

Landfills produce methane when organic matter in the landfill decays under anaerobic conditions. Landfill gas (LFG) is composed of about 50 percent methane, and, when captured, it can also be a source of clean energy. LFG can be used to generate electricity, used as a substitute for direct fossil fuel consumption, or refined and injected into the natural gas pipeline. Capturing and using LFG in these ways can yield substantial energy, economic, environmental, air quality, and public health benefits.

In 2005, global methane emissions from landfills were estimated to be nearly 750 MMTCO<sub>2</sub>E. The United States has been a leader in recovery of LFG and, in this reporting year, has spent more than \$2.4 million to expand the productive use of LFG through Methane to Markets. Highlights of these efforts are summarized below.

### *Co-Hosting the Ecuador LFG Project Expo*

In collaboration with the Ecuadorian Ministry of Environment, EPA organized and co-hosted a project expo, "Exploring Opportunities for Landfill Biogas in Latin America," in Guayaquil, Ecuador. More than 40 developers, investors, and technology providers joined with representatives from 13 municipalities to participate in the workshop and learn about the results of landfill assessments and pre-feasibility studies conducted by EPA at 14 landfills in Argentina, Colombia, Ecuador, and Mexico. If all of these projects were implemented, they would result in annual methane emission reductions of 1.5 MMTCO<sub>2</sub>E over the projects' lifetimes. After the

Expo, EPA continued to provide technical assistance to several of these landfills to advance project development.

### *Providing Operations and Maintenance Landfill Operator Training in Ukraine*

EPA piloted the first operations and maintenance (O&M) training course for landfill operators in Ukraine. Qualified landfill operators from the United States delivered the training at Kiev and Rivne landfills, with 20 landfill managers, operators, city officials, and other personnel in attendance. The training presented best practices in landfill O&M and site conditions to enhance the prospects for landfill gas recovery, including working face management (including landfilling methods and compaction), equipment and well-field maintenance, LFG recovery, and health and safety. EPA plans to deliver this course in other Methane to Markets Partner Countries.

### *Building Capacity Through LFG Energy Workshops in Brazil, China, and Colombia*

In conjunction with a seminar sponsored by Colombia's National Association of Public Services Companies entitled "Climate Change and Its Impact on Public Services," EPA conducted a training workshop for Colombian solid waste officials on LFG energy.

Approximately 40 participants attended the workshop, including landfill and solid waste officials representing several municipalities. The workshop covered the basics of LFG capture, estimating gas recovery potential, and energy utilization technologies.



Attendees of EPA-CETESB workshop touring Bandeirantes Landfill Gas Project in São Paulo.

In Brazil, EPA co-organized a similar workshop with the São Paulo State Environment Sanitation Agency (CETESB). More than 125 participants from government, the non-profit sector, and universities attended, including representatives from municipal landfills. The seminar included basic information on LFG utilization, monitoring methane emissions from landfills, and the status of LFG projects in the United States.

In Shenzhen and Beijing, China, EPA assisted with two LFG energy workshops on Methane to Markets and the basics of landfills, beneficial use, the solid waste market in China, and carbon finance for projects. Attendees represented the solid waste, engineering, and academic sectors as well as project developers.



Gaoyan Landfill in Guiyang City, China: site of a U.S.-funded assessment report that was displayed at the Partnership Expo in Beijing .

### *Pre-Feasibility and Assessment Studies in Brazil, India, and Korea*

Pre-feasibility and assessment studies estimate LFG availability, evaluate a range of energy recovery technologies, and make a preliminary assessment of a LFG energy project's economic feasibility. These studies accelerate project implementation by outlining important project data for developers and investors.

- EPA completed assessment studies for 11 landfills in Brazil. Next, EPA will attend and coordinate stakeholder meetings at three to four of the landfills with the most project potential. At these meetings, EPA will report its findings and engage potential end-users of the gas, local government officials, financiers, and other project stakeholders in the project opportunities.
- After receiving a grant from EPA, the Korean District Heating Corporation conducted pre-feasibility studies for three Korean landfills. The studies recommended the installation of reciprocating engines ranging from 0.6 to 2 MW of electric generating capacity at each of the three landfills. The studies also recommended that developers discuss green power premium pricing with the Korea Electric Power Company for these projects.
- EPA conducted two pre-feasibility studies for the Pirana and Pune landfills in India. These studies explored the economic viability of several project alternatives, including electricity generation, flare-only, and a pipeline to a nearby industry. The studies are intended to provide the necessary data to issue a request for proposals for a methane capture and use project at each site.

### *Partnering with the International Energy Agency (IEA)*

EPA and the IEA developed a case study titled “Turning a Liability into an Asset: Landfill Methane Utilization Potential in India.” At present, India is transitioning from open dumps to more managed landfills. The study concluded that new landfills should consider LFG management and capture efficiencies as part of the initial landfill design process. In order to launch a LFG energy industry in India, the study recommended, utilities should offer green power premium pricing for LFG-generated electricity and landfills should take advantage of existing government subsidies for LFG energy.

### *Refining Country-Specific Landfill Models for Mexico and Ecuador*

LFG modeling plays a very important role in evaluating potential project opportunities. These models more accurately assess how local climates, waste streams, and landfilling practices in developing countries affect LFG generation. EPA continues to develop and refine country-specific models for Mexico and Ecuador in order to expand the use of LFG in these countries.

- EPA updated the LandGEM LFG model for Mexico with data collected from recent pumping trials sponsored by EPA and USAID. These data enable users to produce typical LFG generation and recovery rates for landfills located in various regions of Mexico.
- EPA created a LandGEM LFG model for Ecuador using local climate and waste stream data. EPA also calibrated the model using data from recent pumping trials at the Las Iguanas and Pichacay Landfills. The model accounts for several local landfill



Extraction well monitoring at the Uruli Devachi Landfill in Pune, India.

conditions including excess rainfall infiltration (as a result of permeable cover and capping), high leachate levels, shallow waste depths, and high percentages of food wastes. EPA also created a matrix of model inputs to account for various moisture levels across different landfills in Ecuador.

### *Sharing U.S. LFG Expertise with International Stakeholders*

Delegates from Argentina, Brazil, Colombia, and Ecuador attended EPA's LMOP conference in Washington, D.C. These delegates attended technical sessions covering a variety of innovative LFG energy projects. Before the conference, delegates also toured the I-95 Landfill in Fairfax, Virginia. During the tour, the delegates asked questions about landfill operations and maintenance, LFG collection, and LFG energy. The I-95 Landfill uses LFG to generate electricity, fuel infrared heaters in its maintenance facility, and dehydrate sludge from the adjacent wastewater treatment plant.



## Oil and Gas Systems

**M**ethane emissions from oil and gas systems can be the result of normal operations, routine maintenance, and system disruptions. Reducing fugitive emissions can reduce product losses, enhance energy security, lower methane emissions, and increase revenues. In 2005, global methane emissions from oil and gas systems that could be utilized were estimated at nearly 1,170 MMTCO<sub>2</sub>E.

The United States has collaborated with the Methane to Markets Partnership to encourage Partner Countries to implement proven, cost-effective technologies and practices that improve operational efficiency and reduce emissions. In this reporting year, the U.S. government has spent more than \$2.6 million to support the deployment of these measures. Some of the U.S. government's notable 2007 accomplishments and ongoing activities are discussed below.

### *Assessing Emission Reduction Opportunity at PEMEX*

Since 2006, USAID and EPA have supported several project activities with Mexico's state-owned oil company, Petróleos Mexicanos (PEMEX), including measuring and analyzing emissions, installing dry seals at the Ciudad PEMEX Gas Processing Center, and supporting an emission reduction program at select facilities. In addition, PEMEX reviewed and quantified emissions along the Cardenas Pipeline Sector and found PEMEX's maintenance program to be effective at minimizing fugitive emissions from the pipeline operations.

### **Natural Gas STAR International: Reducing Methane Emissions and Delivering More Gas to Markets**

In 2006, EPA launched Natural Gas STAR International, a global partnership with oil and gas companies. Natural Gas STAR International builds on the success of the domestic Natural Gas STAR Program, which has partnered with U.S. oil and gas companies since 1993 to promote cost-effective methane emission reduction activities.

The partnership started with seven charter partners (ConocoPhillips Canada Ltd., Devon Energy Corporation, Enbridge Inc., ExxonMobil Corporation, Marathon Oil Corporation, Occidental Oil and Gas Corporation, and TransCanada), which were soon joined by the Oil and Natural Gas Company of India Ltd. (ONGC) and Comgas, a natural gas distribution company in São Paulo, Brazil. ONGC is the first state-owned oil and gas company; ONGC and Comgas are the first non-North America-based companies to join.

These partners' efforts are already yielding significant results. Natural Gas STAR International partners have reduced methane emissions by 2.68 MMTCO<sub>2</sub>E in 2007 and 4.4 MMTCO<sub>2</sub>E since 2006.



Collectively, these efforts have yielded significant methane emission reductions and increased PEMEX's interest in expanding methane emission reduction program efforts. EPA is currently working with PEMEX to integrate the analysis results into a broader, PEMEX-wide methane emission reduction program and to support the design of a PEMEX-funded \$22 million program to install dry seals on more than 40 compressors. Working together, EPA and PEMEX have identified next steps for the program, to be implemented in calendar year 2008, including specialized training, developing pilot measurement protocols, improving emissions inventory data, developing facility- and operations-specific action plans, providing technical support, and gaining internal and external support for expanded emission reduction program activities.

### *Improving Leak Detection and Repair in Ukraine*

Ukraine is the largest natural gas transit country in the world by volume. Emissions from Ukraine's natural gas system are very large, a function of both the design and age of the system. Since 2000, several U.S. government agencies have been working with Cherkasytransgas, a large Ukrainian branch company of Ukrtransgaz, on methane emission reduction initiatives involving detecting and measuring leaks, developing and implementing leak repair plans, confirming methane reductions with post-repair measurements, and summarizing successes.

Building on the success of Cherkasytransgas, EPA began a four-year project in 2007 to engage the U.S. Embassy, Ukrainian government organizations, Cherkasytransgas, Ukrtransgaz, and Naftogaz Ukrainy (the large, state-owned holding company of which Ukrtransgaz is a subsidiary). The main goal



PEMEX engineer takes a measurement of newly installed dry gas seals at facility in Mexico City, Mexico.

of this effort was to establish more formal technology transfer and information-sharing networks to promote methane mitigation projects in the Ukrainian natural gas transmission sector. EPA also funded the purchase of sealants as part of a project to further reduce methane emissions from valves in Cherkasytransgas's system, which reduced emissions by approximately 720,000 cubic meters.

As a result of this collaboration, the Ukrainian Ministry of Fuel and Energy developed a working group to discuss potential finance options for implementing methane mitigation projects in the Ukrainian natural gas transmission system. In addition, Ukrtransgaz held the first-ever methane mitigation technology transfer seminar (co-led by Cherkasytransgas) for all six of its subsidiaries; the seminar was well attended and resulted in recommendations to promote methane mitigation projects. As a next step, EPA will continue to build on this collaboration. In particular, Naftogaz and Ukrtransgaz are researching options for large-scale system-wide methane mitigation measures. Through its collaboration with EPA, Cherkasytransgas has set a goal of reducing methane emissions by 3.7 million cubic meters by 2010.



### *Reducing Emissions from Oil and Natural Gas Assets in India*

EPA has launched an extremely successful partnership with India's Oil and Natural Gas Corporation (ONGC). In September 2008, the ONGC Chairman directed his personnel to pursue implementation of cost-effective technologies and practices that could reduce ONGC's methane emissions by an estimated 10 million cubic meters per year, potentially saving \$740,000 worth of natural gas. The declaration was the direct result of a year-long collaboration between EPA and ONGC, in which EPA provided support for onsite methane emission measurement studies to identify and measure major methane emission sources that could then be paired with established mitigation technologies and practices. The recommended mitigation activities cover only four out of the many facilities operated by ONGC, so this first effort is just the start of the significant volume of methane emission savings that can ultimately be achieved. ONGC is also planning to form an internal measurement team to institutionalize the leak evaluation strategies applied during the collaboration with EPA.

### *Developing and Implementing Reduction Strategies in Poland*

EPA is working with GAZ-SYSTEM SA, Poland's largest state-owned natural gas transmission company, to provide technical information and assistance in implementing methane mitigation measures at compressor stations and pipelines. GAZ-SYSTEM has identified a list of major emissions sources and activities to be addressed (such as reducing vented emissions from compressors and pipelines), and EPA is providing technical information and assistance on cost-effective measures to address these sources and activities, including expected methane emission reductions, implementation cost data, and economic benefit analyses to help prioritize



PEMEX engineer descends scaffold tower after taking wet seal measurements at a PEMEX gas processing center.

measures. In addition, EPA and GAZ-SYSTEM developed a broader strategy to achieve methane reductions with EPA's continued involvement in identifying and prioritizing opportunities and providing technical information on cost-effective technologies and practices.

### *Partnering with Gazprom, the World's Largest Natural Gas Producer*

Russia is the largest emitter of methane emissions from oil and natural gas operations worldwide. Its state-owned natural gas company, Gazprom, is the world's largest natural gas producer and possesses the world's largest natural gas reserves. EPA is working with Gazprom to plan a joint technology transfer workshop and technical training in Russia in fall 2008, which will feature EPA and industry experts. The goal of the workshop and training is to learn about Gazprom's current methane mitigation activities and to share information on other cost-effective technologies and practices Gazprom might consider using to reduce emissions.

EPA also awarded a multi-year grant to the Russian Academy of Sciences to identify methane emission reduction project opportunities in the distribution sector. The Academy collaborated with various Russian companies and sector experts to bring projects before the Russian government for possible government certification under Russian climate initiatives.

### *Identifying Methane Emission Reduction Opportunities at Chinese Oil and Gas Companies*

EPA has been working with several partners, including Environment Canada and the China National Petroleum Corporation (CNPC) to identify methane emission reduction opportunities at the Changqing Oilfield Company (a subsidiary of CNPC). Preliminary audits revealed that improvements to flaring and venting practices at facilities at the oil production facilities and the control of casing gas flaring and venting and flashing losses from storage tanks could yield significant methane emission reductions. Additional field audits will be conducted in late 2008. EPA and the CNPC Environmental Engineer Technology Center are collaborating to draft corporate emission reduction guidelines and to plan a series of tours for CNPC officials to visit North America and meet with relevant technology vendors.

### *Studying Pipeline and Compressor Station Methane Leak Detection in the Kyrgyz Republic*

EPA has launched a project aimed at studying leak detection, measurement, and analysis at gate and compressor station facilities on a 116-kilometer natural gas transmission system of the Tashkent-Bishkek-Almaty pipeline in the Kyrgyz Republic. Project partners include KyrKazGaz, KyrGaz, and ADB—a Methane to Markets Project Network member and multilateral financial institution whose mission is to help member countries reduce poverty and improve quality of life by providing project funding, offering technical assistance, and building knowledge capacity. The goal of the project is to identify feasible methane emission reduction projects while providing training and technology transfer to the pipeline operator. Upon completion, the project is expected to yield annual emission reductions of 25,000 MTCO<sub>2</sub>E.



## Looking Forward

**M**ethane is a potent GHG, with a relatively short atmospheric lifetime. Reducing methane emissions is thus an important component of the United States' climate action strategy, since reductions will slow warming in the short term while delivering near-term economic, environmental, and energy benefits. The Methane to Markets Partnership has made tremendous progress over the last four years in removing the barriers to cost-effective methane emission reductions around the world. As the Methane to Markets Partnership continues to grow, the United States will remain strongly committed to supporting its success. Over the next few years, the United States will focus on several key areas of participation in the Partnership, including:

- **The 2010 Partnership Expo.** The United States is eager to play a leadership role once again in the upcoming Partnership Expo, tentatively scheduled for early 2010. The Partnership Expo has proven to be an effective means of matching project development opportunities with relevant skills and resources, and U.S. government agencies will aggressively promote partnerships to bring these opportunities to fruition.
- **Partner country-specific action plans in each sector.** The Partnership achieves its goals principally through commitment and action on the part of its Partner Countries. The United States is looking forward to working with all of the Methane to Markets Partner Countries over the coming year to discuss the potential for new methane reduction

strategies in the context of country-specific action plans. The United States is committed to continuing its support of the Partnership's technical subcommittees, creating roadmaps for project development, and charting opportunities for developers, financiers, and policy-makers alike.

- **Technical assistance and financial support for project development in all four Methane to Markets sectors.** The United States will continue its active support for methane reductions in all four sectors of the Partnership. The United States has already committed more than \$10 million in FY 2008. Several U.S. government agencies will be continuing to conduct trainings, provide grants, support pre-feasibility and feasibility studies, and undertake other activities to build on their multi-year initiatives already underway.

The Partnership has been extremely successful in raising awareness about the importance of focusing global efforts on methane. More importantly, Methane to Markets has engaged the private sector along with 27 Partners from all over the world. These actions have not only led to real GHG emission reductions but also have proven to be a good complement to efforts under the Kyoto Protocol—providing technical assistance and capacity-building essential to ensure long-term project development success. Next year, the United States will work with Partners to secure a continued and expanded commitment to the Partnership, with a mind to enabling greater efforts to reduce methane emissions in support of existing and post-2012 climate frameworks.



## **Methane to Markets**

November 2008

To learn more, visit [www.methanetomarkets.org](http://www.methanetomarkets.org)



Recycled/Recyclable—Printed with Vegetable Oil Based Inks on 100% Postconsumer, Process Chlorine Free Recycled Paper

Printing was provided by the U.S. Environmental Protection Agency.