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Methane to Markets Partnership: A Strategy for Energy and Climate Change

ENERGY UPDATE

Is the bimonthly newsletter of the Energy Team, Office of Infrastructure and Engineering, Bureau for Economic Growth, Agriculture and Trade (USAID/EGAT/I&E/Energy Team).

IN THE NEXT ISSUE

"Teaching and Learning with EGAT: Resources for Energy, Water, and ICT"

SUBMIT ARTICLES

Initial submissions must be 500 words or less in length and include contact information.

The submission deadline is September 2, 2007. Please e-mail your articles to the Editor, Davida Wood (dwood@usaid.gov).

Articles are accepted for publication from employees of USAID, associated organizations, contractors, and other partners in development.

LETTER FROM THE GUEST EDITOR

Methane to Markets International Partnership: A Strategy for Energy and Climate Change

This issue of Energy Update introduces the international Methane to Markets (M2M) Partnership, a Presidential Initiative to promote the capture of methane gas for use as a clean energy source. The Partnership aims to simultaneously fight climate change and increase global energy supplies by promoting the recovery of methane gas, which would otherwise be wastefully vented to the atmosphere or flared. Currently, twenty countries actively participate in the Partnership, including the U.S., which is represented by a broad range of interested U.S. Government entities, including EPA, TDA, DOE, DOS, USDA and USAID. EPA plays the lead role and hosts the Secretariat for the Partnership. Developing and transition countries involved in the partnership are Brazil, China, Colombia, Ecuador, India, Mexico, Nigeria, Russia, Ukraine, and Vietnam. Other participating countries include Argentina, Australia, Canada, Germany, Italy, Japan, Poland, Republic of Korea, UK, and the USA.

While many climate change discussions primarily focus on CO_2, the Methane to Markets Partnership targets methane, which is over 21 times more effective at trapping heat in the atmosphere when compared to CO_2 over a 100-year time period. Methane is estimated to account for 16% of all greenhouse gas emissions resulting from human activities. The Partnership draws on successful U.S. domestic experience with promoting profitable opportunities for utilizing methane produced in the four key sectors responsible for methane emissions – oil and gas, agriculture, coal mines, and landfills.

The articles that follow cover the key issues encountered in promoting methane capture and utilization in each of the four sectors and track USG progress in its international efforts to advance global implementation of appropriate technologies and practices. First, the newsletter explores in greater depth the role and activities of the Partnership and then explains in more detail the approaches for controlling methane emissions in each of the four sectors. This is followed by an investigation of issues that cut across these sectors, including the necessary elements for creating and expanding markets for methane utilization and the technologies for converting gas to power, in particular combined heat and power.

The newsletter then presents the results of recently completed and active projects in Brazil, India, Mexico, and Ukraine, which received U.S. government support under the Partnership. These illustrate how emission reductions can be achieved in different country contexts and describe the different approaches taken in capturing and utilizing methane in the four sectors, the challenges faced, and the results achieved to date. A subsequent article highlights the results of EPA activities. The newsletter concludes with the Global Development Alliance call for public-private partnerships in support of Methane to Markets.

Additional information is available at www.methanetomarkets.org, including information on how countries can join the Partnership and how private sector and non-government organizations can participate. The next Partnership event will be the Partnership Expo, an international forum for promoting project opportunities and technologies in methane recovery and use, to be held in Beijing from October 30th-November 1st, 2007.

Mark Schlagenhauf P.E.
Global Oil and Gas Advisor
Energy Team
Office of Infrastructure and Engineering
Bureau for Economic Growth, Agriculture, and Trade
U.S. Agency for International Development
Email: mschlagenhauf@usaid.gov

Simone Lawaetz
Energy Advisor
Energy Team
Office of Infrastructure and Engineering
Bureau for Economic Growth, Agriculture, and Trade
U.S. Agency for International Development
Email: slawaetz@usaid.gov

Methane to Markets Partnership: A Strategy for Energy and Climate Change

Introduction to the Methane to Markets Partnership

On July 28th, 2004, President Bush announced that "the United States and seven other countries were forming the ***Methane to Markets Partnership***, a new and innovative program to increase energy security, improve environmental quality, and reduce greenhouse gas emissions throughout the world. Under the Partnership, members will work in coordination with the private sector to share and expand the use of technologies to capture methane emissions that are now wasted in the course of industrial processes and use them as a new energy source. The important benefits of this international partnership include improved energy security and air quality from the use of clean-burning methane as natural gas; improved coal mine safety; enhanced economic growth; and reduced greenhouse gas emissions of methane."

How far we have come since this humble beginning. Today this partnership has grown to twenty countries, ministerial meetings have been held in Washington DC and Argentina, and a wide array of Methane to Markets projects are completed or under implementation. In addition, significant project development and methane reduction outreach and education activities are now being conducted in all four methane sectors to advance the recovery and use of methane as a clean energy source.

EPA hosts the Secretariat for the Partnership and chairs the Steering Committee, while also pursuing project development as part of the U.S. Government's commitment to the initiative. USAID has played a key role in the Partnership, both in planning and in implementing important methane reduction programs around the world. DOE, DOS, TDA, and USDA are also active U.S. Government participants in the partnership.

In addition to the successes highlighted in this newsletter, a recent significant achievement is the $235 million Methane to Markets project at the Jincheng coal mine in China's northern province of Shanxi, which will produce 120 megawatts of electricity and reduce 40 million metric tonnes of carbon equivalent over its 20-year lifetime. The project developer, Jincheng Anthracite Coal Group Co. Ltd., will capture coal mine methane and use it for power generation at the Sihe coal mine in Jincheng city, to be fed into the local power grid.

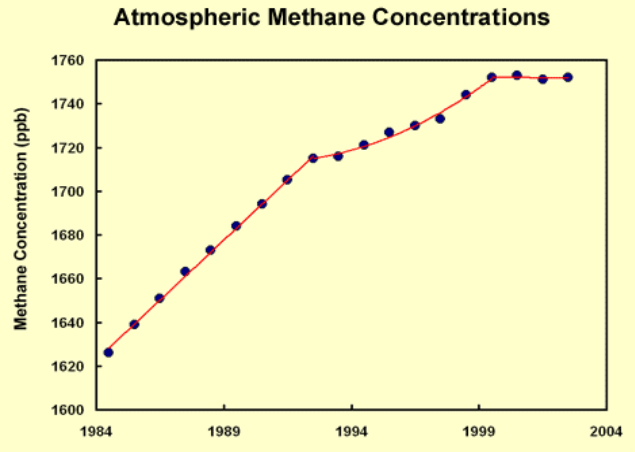
Why Methane is Important

Methane (CH_4) is a principal component of natural gas and a clean burning form of low carbon energy. It is formed and released to the atmosphere by biological processes occurring in anaerobic environments. Once in the atmosphere, methane acts as a greenhouse gas as it absorbs terrestrial infrared radiation that would otherwise escape into space.

Methane is about 21 times more powerful at warming the atmosphere than carbon dioxide by weight and its chemical lifetime in the atmosphere is approximately 12 years. Significant near-term results in mitigating global warming can be achieved through methane emission reductions.

The historical record, based on analysis of air bubbles trapped in ice sheets, indicates that methane is more abundant in the Earth's atmosphere now than at any time during the past 400,000 years. Since 1750, global average atmospheric concentrations of methane have increased by 150 percent from approximately 700 to 1,745 parts per billion by volume (ppbv) in 1998. Over the past decade, although methane concentrations have continued to increase, the overall rate of methane growth has slowed. In the late 1970s, the growth rate was approximately 20 ppbv per year. In the 1980s, growth slowed to 9-13 ppbv per year. The period of 1990 to 1998 saw variable growth of between 0 and 13 ppbv per year. A recent study shows that atmospheric methane has been at a steady state of 1751 ppbv between 1999 and 2002 (Figure 1).

Figure 1



Source: EPA,
http://www.epa.gov/methane/scientific.html

Once emitted, methane is removed from the atmosphere by a variety of processes, frequently called "sinks". The balance between methane emissions and methane removal processes ultimately determines atmospheric methane concentrations, and how long methane emissions remain in the atmosphere.

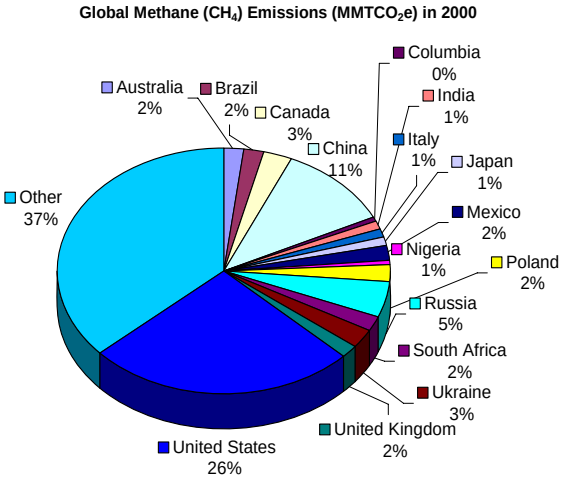
In the U.S., two organizations monitor atmospheric methane levels. There are the U.S. Global Change Research Program, which maintains global monitoring sites and the National Oceanic and Atmospheric Administration, which makes measurements from aircraft, land and sea surface sites as well as continuously monitors gas concentrations at baseline observatories and towers. The Carbon Dioxide Information Analysis Center collects and analyzes atmospheric measurements of methane, carbon dioxide and other radiatively active gases.

For more information go to
www.epa.gov/methane/scientific

The World Is Not Running Out Of Solid Waste: Landfill Gas Energy Opportunities

While concerns have been expressed over the long-term supply of conventional energy resources such as oil, gas and coal, no one is worried about future supplies of waste. Each day millions of tons of municipal solid waste are disposed of in sanitary landfills and dump sites around the world. However, if disposed of properly, solid waste can be a valuable source of energy, as landfill gas (LFG) consists of about 50% methane. Globally, landfills account for about 13 percent of methane emissions from all sources or over 818 million metric tonnes of carbon dioxide equivalent annually. As shown in Figure 2, the U.S. and China are the leading emitters of LFG.

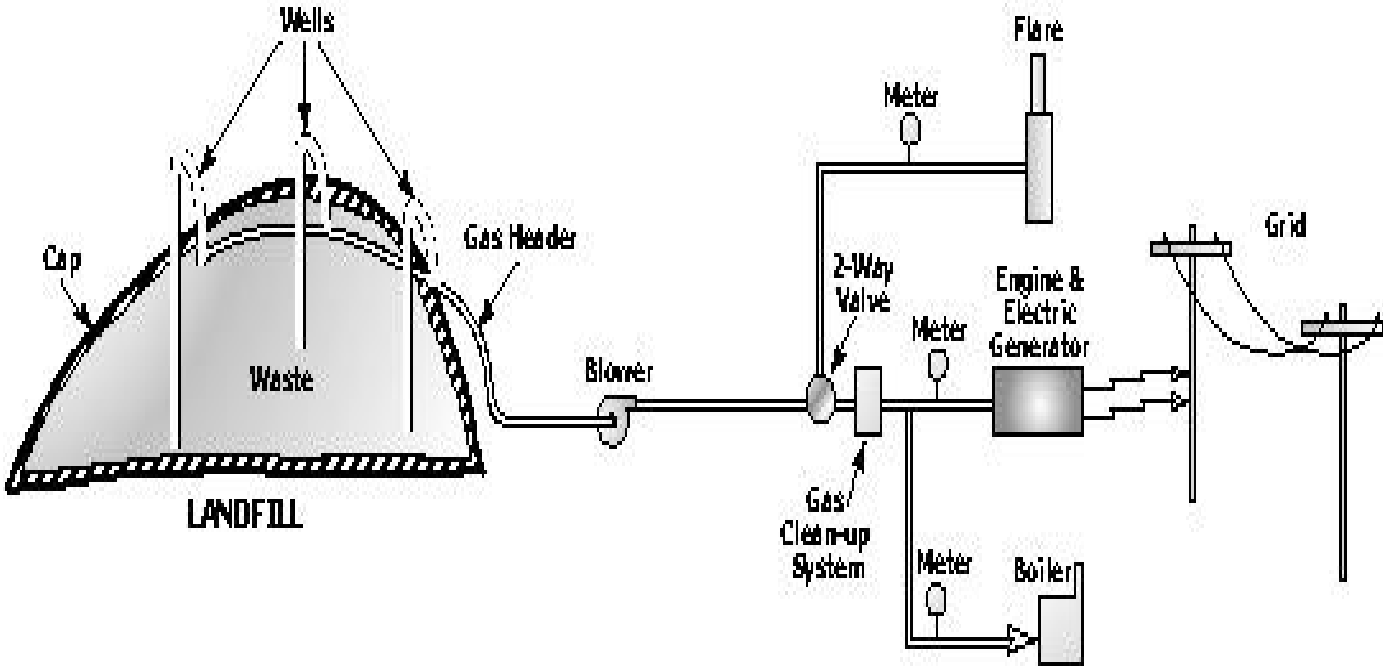
Figure 2: Global Methane Emissions in 2000



Source: Methane to Markets,
http://www.methanetomarkets.org/landfills/landfills-bkgrd.htm

A common method of controlling methane emissions from landfills is to install a gas collection system in the landfill to collect and convey the methane to a gas control system. Landfill gas is extracted using a series of wells and a blower (or vacuum) system (see Figure 3). This system directs the collected gas to a central point where it can be destroyed by a flare or processed and treated for use as a renewable energy supply.

Figure 3: Illustration of Landfill Gas Collection System



LFG is currently extracted at over 1,200 landfills worldwide for a variety of energy purposes, such as: 1) generation of electricity with engines, turbines, microturbines, and other emerging technologies; 2) processing for use as an alternative fuel by local industrial or commercial customers; and 3) creating pipeline quality gas or alternative vehicle fuel. As a rule of thumb, about 432,000 cubic feet per day of LFG is produced from every 1 million tons of municipal solid waste (MSW) placed in a landfill. However, LFG volumes are variable and depend on the local mix of wastes and other factors. This can generate about 0.8 MW of electricity. Moreover, LFG is produced 24 hours per day, 7 days per week, so landfill gas energy projects are typically running and producing energy over 90% of the time.

Government policies on energy and solid waste management can promote or hinder the beneficial use of LFG. An uncertain regulatory environment is often a concern to potential investors. For example, project developers can be subject to different and sometimes conflicting laws at the local, regional and national levels. Moreover, a lack of regulations governing landfills and LFG energy projects (i.e., no requirement or incentive to collect and combust LFG) and inappropriate pricing structures can inhibit project development.

In the area of landfills, the Methane to Markets Partnership focuses on identifying landfill sites for methane recovery and on promoting cost-effective electricity generation or direct use of the resource.

Activities include the identification of barriers to project development, the improvement of enabling legal, regulatory, and institutional conditions, and the creation of efficient energy markets. The active involvement by private sector entities, financial institutions, and other non-governmental organizations is considered essential to build capacity, transfer technology, and promote private investment that will ensure the Partnership's success.

For more information contact Brian Guzzone, Landfill Methane Outreach Program, Office of Air and Radiation, EPA, email: guzzone.brian@epa.gov, Gil Jackson, USAID/EGAT/I&E/Engineering, email: gijackson@usaid.gov, and Mark Schlagenhauf, USAID/EGAT/I&E/Energy Team, email: mschlagenhauf@usaid.gov

Solving the Problems of Livestock Waste

The key factors driving methane emission increases from the agriculture sector in the developing world are the growth in livestock populations necessary to meet the expected worldwide demand for dairy and meat products and the trend towards larger, more concentrated commercialized livestock management operations. These larger and more intensive operations typically utilize more liquid-based manure management systems (liquid manure is any manure to which water is added in the collection, storage or treatment processes), which produce higher methane emissions. Over half of human-related methane emissions come from the agriculture sector.

While larger scale livestock operations can lead to economies of scale, there is a significant drawback that must be addressed: what to do with the large quantities of manure? An economic solution to solving this waste management issue is the use of biodigesters that support the anaerobic breakdown of manure into biofertilizer and biogas and provide environmental benefits of odor control and improved water and air quality.

The biogas can be used for heating, electricity generation, or both, such as in combined heat and power systems that maximize energy efficiency. Or, it can fuel gas-fired equipment such as engines, boilers or chillers to meet a portion of the farm's energy requirements. An important by-product of anaerobic digestion is biofertilizer; digested solids and liquids that can be used to fertilize and improve the physical properties of agricultural lands.

Biodigester technologies that can be considered include covered anaerobic lagoons, plug flow digesters, complete mix digesters, and small scale digesters. Biogas from an anaerobic digester typically contains 60-70% CH_4, 30-40% CO_2, 1-2% H_2O, and small amounts of toxic gases such as H_2S, which is why biogas produced should be cleaned using appropriate scrubbing and separation techniques.

Anaerobic digestion can be cost-competitive when compared to conventional waste management practices. When the gas is utilized as an energy supply, the pay back period for these systems can be as short as three to seven years as opposed to conventional waste systems, which represent sunk costs to the farm enterprise.

According to the U.S. National Sustainable Agriculture Information Service, key factors to be explored in the planning process are:

- The specific benefits to be derived.
- The number and kind of animals to be served.
- Where the system might be placed.
- How the manure and other inputs will be collected and delivered to the system.
- How the required temperatures will be maintained.
- How all the risks associated with the process will be mitigated.
- How the outputs will be handled.
- The amount of monitoring and management time required.

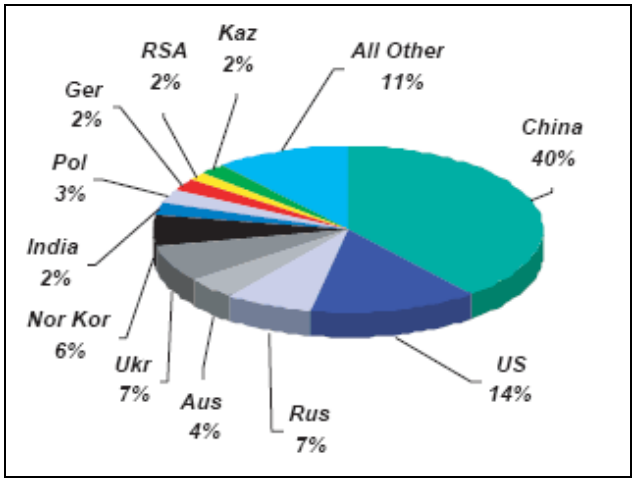
Additional information can be obtained at www.methanetomarkets.org/ag and www.epa.gov/agstar/

For more information contact Mark Schlagenhauf, USAID/EGAT/I&E/Energy Team, email: mschlagenhauf@usaid.gov, Patrick Smith, Global Climate Change, USAID, email: pasmith@usaid.gov, William Hohenstein, Director, Global Change Program Office, email: whohenst@oce.usda.gov, and Kurt Roos, Manager, AgSTAR Program, EPA, email: roos.kurt@epa.gov

Coal Mine Methane Provides Opportunity for Power Generation, Combined Heat and Power Projects

Methane, a primary component of natural gas, is an explosive gas that is found in coal seams as a byproduct of coal formation. Coal mine operators must ventilate or drain methane gas away from the face of the mine to keep levels well below the explosive range. Although it is viewed primarily as a nuisance and a hazard to miners, coal mine methane (CMM) also has beneficial uses; it is a clean energy resource that can be captured and used to offset electricity needs or to generate revenue. CMM constitutes approximately 8 percent of all global human-related methane emissions. As shown in Figure 4, the leading emitters of CMM are China, the United States, Russia, Ukraine, North Korea, and Australia.

Figure 4:
Global CMM emissions in 2000 = 120 MMTCE



Source: Methane to Markets, http://www.methanetomarkets.org/coalmines/coalmines-bkgrd.htm

Many coal mines with gassy coal seams find that they are unable to keep in-mine methane concentrations at a safe level using a ventilation system alone. Therefore, some of the gassiest coal mines install degasification systems to remove methane from the coal seams ahead of or during coal mining. Degasification may take place in advance of mining ("pre-mine drainage") which can produce very high quality gas with concentrations of methane that can exceed 90 percent. Alternatively, gob (or "goaf") wells may be drilled from the surface into the zone where the seam has collapsed after mining. Gob wells generally produce lower-quality gas due to entrained air and other impurities.

Usage of CMM depends on the ability to recover CMM from degasification systems (if any) and on the gas quality (methane concentration and contaminant levels), local infrastructure, and market opportunities. Current uses for CMM include power generation, natural gas pipelines, vehicle fuel, feedstock for industrial processes, boiler fuels, fuel for home, local district, and industrial space heating. Depending largely on the regional electricity prices and regulations, the power generated can be sold to the electric grid if there are existing transmission lines nearby, or it can be used onsite to offset the mine's power use for mine equipment, conveyor belts, ventilation fans, and coal preparation.

Power generation is the most extensively employed use of CMM around the world. Totaling more than 400 MW, over 70 CMM power generation projects at both active and abandoned (closed) coal mines are operating in Australia, China, Germany, Poland, Russia, the United Kingdom, Ukraine, and the United States. Some projects generate power for the electricity grid, while many are used to meet onsite electricity demands or are combined heat and power (CHP) projects in which the heat is captured and used by the mine.

The two technologies most commonly used for generating electricity from drained CMM are internal combustion (IC) engines and gas turbines. In addition, a new technology is being developed to convert dilute ventilation air methane (VAM) into power. The most important factors to be considered in the design of a CMM power generation system include the projected production volume of drained coal mine methane, the average and range of methane concentration, estimated lifetime for gas production at the mine, and the appropriation of sufficient onsite space and site accessibility for installation.

Globally, IC engines are the most popular technology choice for electricity generation from CMM. Gas turbines are not yet extensively used as they are more suitable for larger power installations (10 MW or more), whereas many CMM power generation projects consist of one or more relatively small units (3 MW or less). IC engines are inherently modular; they are relatively easy to install in individual units, so that projects can begin at a modest scale and be incrementally expanded. IC engines are able to accommodate gas streams with a wide range of methane concentrations and quality that are typical of CMM, especially gob gas that is contaminated with air. According to EPA estimates, over 70 IC engines systems around the world run on CMM from active or closed (abandoned) coal mines.

In recent years, there have been exciting new developments in harnessing the dilute methane in coal mine ventilation exhaust systems, although project developers face technological, operational, and financial challenges. The operational challenges of VAM-to-power projects lie in their ability to address the concerns of regulators about the system's compatibility with mine operations and safety considerations. Finally, the capital costs for installing VAM power generation systems are relatively high.

The current installed capacity of CMM-fueled power and heat generation projects pales in comparison to global generation of power and heat from conventional fuels such as natural gas and coal.

Yet today's projects represent only a fraction of the global potential for such projects, particularly if more are employed in developing countries or economies in transition, such as China or Russia. With numerous CMM-to-power projects being planned or developed today, and with the active engagement of the international community through the Methane to Markets Partnership, use of this unconventional energy source has a vibrant future.

Source: Franklin, Ogunsola and Doernberg, "What lies beneath - coal mine methane provides opportunity for CHP projects," Cogeneration and On-Site Power Production, Vol 8 Issue 3 May 2007
For the full article, please see www.cospp.com

For more information contact Pamela M. Franklin, EPA, email: Franklin.Pamela@epamail.epa.gov and Jayne Somers, EPA, email: Somers.Jayne@epamail.epa.gov, Olayinka Ogunsola, DOE, email: Olayinka.Ogunsola@hq.doe.gov, and Andres Doernberg, USAID, email: adoernberg@usaid.gov

Greener Production of Oil and Gas

The world's economy today depends on an affordable and reliable supply of oil and gas. They are also critical commodities for the economic growth of developing countries and support even the most basic humanitarian assistance efforts. For example, all food assistance from USAID is transported from the U.S. to refugee camps and other locations using petroleum products such as heavy fuel oil, diesel, and gasoline. But we want to produce and process oil and gas in the most beneficial, economic, and environmentally friendly way. For this reason, the Methane to Markets Partnership has a special subcommittee dedicated to the unique issues of the oil and gas sector.

There are two basic components to best practices for methane recovery and use in the oil and gas sector. For countries with extensive infrastructure for the production, transportation, and processing of oil and gas, methane emissions can be saved by detecting and eliminating fugitive emissions in these systems. This not only helps the environment but also improves safety, since methane is a flammable gas. Typically, if the gas prices are world market prices, such as found in the U.S. and Mexico, the costs of the interventions can quickly pay for themselves many times over. The financial benefits of a USAID demonstration project in Mexico were so great that PEMEX, the Mexican State oil company, went on to invest a further $1.4m in additional pipeline compressor modifications. (See Mexico article below for additional information)

In cases where infrastructure is less well-developed, an issue unique to the oil and gas sector arises: utilization of associated gas. Liquid oil, when brought from pressurized depths of the wells to the surface, releases gas at the lower surface pressure. This gas is called 'associated gas.' Since oil is a valuable liquid that can be easily transported, it can be sold at world market price. But what about the associated gas? While some associated gas can be used to fuel nearby equipment, often the quantities produced are much greater than needed at the production area. This is another dilemma the Methane to Markets Partnership tries to answer. Markets need to be developed for the associated gas, a valuable energy source. If markets for the gas are not developed, this resource will be wasted through venting or flaring, such as in Nigeria. In the following article, "Developing Energy Markets to Fuel Economic Growth," options to address this issue are covered in more detail.

If the economic markets provide incentives, the oil and gas companies will take the initiative and invest in ways to monetize the associated gas either by investing to transport it to markets in gaseous form through pipelines, converting the gas to power, compressing it so it can be transported more easily (CNG-compressed natural gas), liquefying it at low temperatures (LNG-liquefied natural gas), or by liquefying it (GTL-gas to liquids). Several large LNG plants are being planned for Nigeria, and the existing Bonny plant in Nigeria has expansion plans.

For more information contact Mark Schlagenhauf, USAID/EGAT/I&E/Energy Team, email: mschlagenhauf@usaid.gov, Roger Fernandez, GasStar Program, Office of Air and Radiation, EPA, email: fernandez.roger@epa.gov, and Christopher J. Freitas, Office of Natural Gas and Petroleum Technology, DOE, email: christopher.freitas@hq.doe.gov

Developing Energy Markets to Fuel Economic Growth

Although methane is a valuable energy source, if there is no ready market for the gas, it is frequently wasted by either being vented to the atmosphere or flared. Stranded gas (gas with no market) is one of the oldest problems in the oil and gas industry.

The development of markets for gas utilization is one of the most important elements of the Methane to Markets Partnership, and one of the areas where USAID plays a leading role.

There are a number of issues that must be addressed to catalyze gas markets and promote their growth. First, economic incentives must exist to support the investments needed in producing, capturing, transporting, and utilizing methane. Secondly, property rights often need to be recognized and clarified. In the U.S., it took a Supreme Court decision to determine who owned the methane found in coal, and other countries suffer from ambiguities in their legal framework which prevent investment from going forward.

Lack of access to pipeline transportation is another issue that can prevent utilization of produced methane. In the U.S., the Federal Energy Regulatory Commission (FERC) adopted policies designed to promote pipeline open-access and to prevent undue discrimination in primary and secondary markets for natural gas transmission capacity. Prior to open-access, natural gas pipelines functioned as merchant carriers that were required to bundle together gas and its transportation. Under the system of open access, pipelines carry gas for their customers as contract carriers. Contract carriage gave pipeline customers direct access to transportation and created a connected pipeline grid. Open access enabled pipeline customers and natural gas brokers to exchange and combine transportation rights. By exchanging and combining transmission rights on several connecting pipelines, gas buyers and sellers were able to create connected topologies over which they could trade natural gas.

Power sector regulatory issues can play a similar role in discouraging methane use for power generation. If the electricity produced can't be sold to the grid and there are no local markets, then no one will invest in a methane-to-power project. Increasingly, laws and regulations are being changed to give small power producers access to the grid so they can sell their power at a fair price. Appropriate pricing is central to establishing the right economic incentives for project developers and allowing for the recovery of capital and operating costs.

How does USAID help develop energy markets? Market design and the regulatory framework are important factors influencing investor's perceptions of risks. A good example of USAID's approach to developing energy markets is the West Africa Gas Pipeline, where USAID-funded technical assistance to the governments of Ghana, Benin, Togo, and Nigeria resulted in over $600 million of private sector investment. At the inaugural Ministerial for the Partnership in Washington DC, then Administrator Natsios called the West African Gas Pipeline one of the most important environmental and development projects in Africa today. This pipeline will take wasted gas from Nigeria and transport it to Benin, Togo, and Ghana, where it will initially replace heavy fuel oil used in power generation. USAID continues to support development of gas and energy markets in West Africa through our programs with the National Association of Regulatory Utility Commissioners, the Center for Energy Economics at the University of Texas at Austin, and Nexant.

For more information contact Mark Schlagenhauf, USAID/EGAT/I&E/Energy Team, email: mschlagenhauf@usaid.gov

Gas to Power

Once methane from landfills, agricultural waste, coal mines, or oil and gas systems is captured, how can it be used? One of the central tenets of the international Methane to Markets Partnership is the use of methane for productive purposes such as generating electricity. Inadequate power supply, particularly in developing countries, is a major constraint on economic growth. Unlike wind, which doesn't always blow or the sun, which doesn't always shine, methane can be constantly produced, generating a reliable supply of power.

An efficient way for utilities to use larger amounts of methane for power generation is in a combined-cycle system, which combines two means of producing electricity. Hot gases from the combustion chamber spin the gas turbine and the generator to make electricity. The system then pipes the still-hot exhaust gases leaving the combustion turbine to a 'waste heat' steam boiler where heat produces steam. The steam turns a turbine, connected to a second generator, to produce electricity. Condensers convert the steam to water that returns to the boiler to repeat the cycle.

If methane is captured near energy demand it is especially suitable for the most efficient form of generation, combined cooling, heating and power (CHP). CHP refers to generating electricity at or near the place where it is used and then "recycling" the waste heat and using it for space heating, water heating, process steam for industrial steam loads,

humidity control, air conditioning, water cooling, product drying, or for nearly any other thermal energy need. The end result is significantly more efficient than producing each of these separately. Due to their capture of useful energy both as electricity and thermal output, CHP systems should always be able to exceed the total fuel efficiency of even the best central power plants.

For more information contact Mark Schlagenhauf, USAID/EGAT/I&E/Energy Team, email: mschlagenhauf@usaid.gov

India: Advancing Methane to Markets (M2M)

India is the world's third largest emitter of methane. There are enormous opportunities for capturing and utilizing methane from its largest anthropogenic sources – landfills, oil and gas production, coal mines, rice cultivation and cattle. To take advantage of this potential, USAID/India launched a M2M program in October 2006. This umbrella program encompasses four activities, described below, that support the implementation of viable methane reduction projects that generate environmental protection, economic growth and social benefits in India.

Two of the M2M activities explore the potential for using cattle waste to produce methane-powered energy services for rural economic development. In Uttar Pradesh, USAID is working with community-run 'Gaushalas' (old-age homes for non-productive, scrub cattle) to construct biogas plants for the conversion of cattle waste to thermal and electrical energy. This energy will be provided to the community on a user-fee basis to run micro-enterprises such as a milk-chilling plant and flour mill and to power irrigation systems and the delivery of drinking water. The waste slurry will be used as high quality organic compost.

To date, three Gaushalas have been selected, beneficiary groups identified for energy off-take, blueprints for the plants developed through a multi-stakeholder participatory process, and an application made to the Ministry of New and Renewable Energy for a subsidy. Challenges remain though, including the development of a larger market for organic compost, leveraging additional funds to support energy-utilizing entrepreneurial activities, and handling the seasonal demand for energy. The program also targets the dairy industry for the capture and use of methane gas. Three dairies located in the state of Maharashtra, with diverse management structures, have been identified for piloting anaerobic digestion. They are the Warana Milk Cooperative near Kolhapur, Bharat Agro Industries Federation near Pune and Chitale Dairy near Sangli. They represent the cooperative, research and development, and private sector dairies, respectively.

In addition to electricity generation, the project will help address a cattle waste problem and reduce pollution levels in dairy wastewater. A unique aspect of this activity is the planned development of a large scale standardization/dissemination initiative such as the EPA AgStar. Similar to the EPA AgStar initiative, the Indian program will develop a process of standardization and benchmarking of the dairy wastewater treatment (through anaerobic digestion and solids separation) and productive use of methane (direct-fire in boilers and/or installation of micro-turbine/internal combustion engine for electricity generation) in participating dairies. The standardization process will be moderated through a network of research and development institutes in the Indian dairy sector.

Gaushala

In the oil and gas sector, USAID will demonstrate cost-effective approaches to reducing methane leaks in system equipment. Planned for the fall of 2007, USAID will train oil and gas operators on techniques for identifying, measuring, and prioritizing leaks for repair. This leak detection and measurement campaign, using state-of-the-art infrared camera technology, will be undertaken at a selected upstream crude stabilization facility and an end use natural gas compressor station. The repairs are expected to bring environmental benefits, improvements in the safety of operations, and product recovery.

The rich, fertile areas of Baidyapur Village in West Bengal, India support rice cultivation by local communities. Left-over 'rice straw' and 'agri-waste products' are usually left to decay in paddy fields, thus releasing methane gas into the atmosphere. Under the M2M program, USAID will test a Plug-Flow Biogas Digester (PFBD) that will convert this rich source of biogas to electrical power and energy services to meet the energy and livelihoods requirements of rural community projects. This includes the commercial production of bricks and tiles, delivery of arsenic-free potable water and domestic lighting.

In the landfill sector, USAID aims to recover and utilize landfill gas from the Gorai landfill in Mumbai. This activity supported the preparation of a pre-feasibility study to assess 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 landfill gas and could be candidates for the Clean Development Mechanism, an arrangement under the Kyoto Protocol through which industrialized countries can invest in emission-reduction projects in developing countries as an alternative to more costly projects in their own countries.

In 2006, USAID, DOS, and the EPA partnered with the Federation of Indian Chambers of Commerce and Industry, the Ministry of Urban Construction, and the Municipal Corporations of Mumbai, Hyderabad and Ahmedabad to host a cross-sector workshop for coal mines, oil and gas systems and landfills. The meeting attracted more than 100 participants.

For more information contact Mahesh Patankar, email: mpatankar@iiec.org, Lisa Campbell, email: Lisa_Campbell@URSCorp.com, Manoj Kumar Mahata, email: manoj_mahata@rediffmail.com, and Subhrankar Mukherjee, email: subra@engr.colostate.edu

India: Redesigning a Municipal Solid Waste System in West Bengal

Since 2005, USAID/India has been working through its Financial Institutions Reform and Expansion (FIRE D) program to assist the Government of West Bengal to address the critical Solid Waste Management (SWM) problems in the Asansol urban area. The original project concept, described in the report 'Municipal Solid Waste Management in Asansol Urban Area' details methods for the collection and transport of waste for composting at three locations as well as the design of a regional landfill site for the disposal of non-biodegradable waste and other material that are not suitable for recycling nor for biological processing. The project aims to address the principal Municipal Solid Waste (MSW) problems presently facing the Asansol urban area that can be characterized as poor overall MSW management, including absence of cost recovery, indiscriminate disposal of waste along the roadside (50-70% of waste is not collected), ineffective transportation system and inadequate, unscientific MSW treatment and disposal facilities. Now, with additional USAID/EGAT funding for M2M activities, the original project design is being reviewed to explore options for methane capture, assess their economic and technical feasibility and modify the system design accordingly. The system covers five urban local bodies, comprising the municipal corporations of Asansol and Durgapur and the municipal councils of Raniganj, Kulti, and Jamuria. It is one of the few in the country that proposes the use of the private sector and adopts a regional approach for the treatment and disposal of waste.

The ongoing M2M appraisal is proposing an alternative design of three transfer stations and the development of one centralised compost plant in conjunction with the landfill. A key feature of this design is the controlled disposal versus the normal practice of indiscriminate dumping of mixed municipal solid waste into the landfill. The landfill will operate as a bioreactor to maximize methane production. A bioreactor landfill is a sanitary landfill that uses enhanced microbial processes to transform and stabilize readily decomposable organic waste within 5 to 10 years.

Ideally the decomposition process is preceded by some pre-processing operations, which can involve separation of large non-biodegradables or inerts shredding, and blending of required nutrients and additives. Moisture content is the single most important factor that promotes accelerated decomposition of deposited waste and methane capture. Bioreactor technology relies on maintaining optimal moisture content within a range of 35-45%, which often requires the addition of water/wastewater from external sources to maintain this percentage.

This landfill system design will make use of the vast expanse of uninhabited land available for the sanitary landfill as well as its convenient central location near a national highway. Furthermore, a number of industries are located in the vicinity of the landfill and they could directly utilize the gas for thermal applications. This offers the potential for greater energy utilization efficiency and possibly higher carbon credits compared to its use in electricity generation.

Proposed site for the sanitary landfill at Mangalpur

One major hurdle to be overcome is the current lack of compliance of the alternative landfill design with the existing Government of India Municipal Solid Waste Rules, 2000. Therefore, one of the principal objectives of the activity is sensitizing the concerned agencies to the benefits of the methane capture pilot and securing their approval. As a first step, the appraisal report outlining the design of the alternative landfill is being finalized for submission to the GOI's Ministry of Urban Development, the national nodal agency for SWM, for review and discussion.

For more information contact Rebecca Black, USAID/India/EG, email: rblack@usaid.gov, or Lee Baker, Chief of Party, Indo-USAID FIRE (D) Project, email: lbaker@vsnl.com

Brazil: The Fortaleza Initiative

The Fortaleza Initiative is a demonstration project in Fortaleza, the capital of Ceará State in the northeast of Brazil, which puts landfill gases to commercial use, thereby avoiding methane emissions. Concurrently, the project explores opportunities for participating in carbon markets and implementing social actions that can contribute to the local achievement of Millennium Development Goals (MDGs).

With funds from the M2M Partnership, USAID worked closely with the United Nations Development Program (UNDP), the Institute for Sustainable Development and Renewable Energy, the municipal government of Fortaleza and local NGOs to implement the project during 2005 and 2006. Activities were designed and implemented so that the values, models and methodologies can be replicated by other municipalities, linking local social development with commercial opportunities.

The Fortaleza Initiative supported a technical assessment of the Caucaia Landfill to investigate the potential use of landfill gas to run a thermal power plant. In addition, contacts have been facilitated between the municipality of Fortaleza and carbon traders such as the UN's MDG Carbon Fund to explore potential carbon credit transactions from the use of methane from the Caucaia Landfill. Local scavengers living close to the landfill and the Jagurunssu city dump took advantage of vocational training offered under the Initiative to improve their job opportunities.

Caucaia Landfill Site

Community Training

Project highlights include:

- Preparation of technical, economic and commercial evaluations of the use of methane emissions from the Caucaia Landfill;
- Development of commercial and legal options to facilitate municipally-owned landfills being used commercially for thermal-electric generation under public-private partnerships with Independent Power Producers;
- Development of a framework (including a model for competitive bidding under Brazilian law) to support the city of Fortaleza with the legal, technical, financial, economic and social options for leveraging public and private investments to make the best use of the landfill;
- Vocational training of 64 community leaders living close to the landfill and city dump; and
- Establishment of the Parque Santa Rosa Recycling Cooperative.

Completed in May 2007, the results of the Initiative inspired three other municipalities in Brazil's northeast to assess the potential for replicating the project in their cities.

For more information contact Alexandre Mancuso, USAID/Brazil, email: amancuso@usaid.gov

Mexico: Developing Cost-Effective Methane Recovery Models

Since 2005, USAID/Mexico has worked closely with the EPA to support the Ministry of Environment and Natural Resources (SEMARNAT) in Mexico to develop activities under the Methane to Markets (M2M) Initiative. This work has focused on three methane emission reduction areas: assistance to the National Oil Company Petróleos Mexicanos (PEMEX) in reducing emissions in the oil and gas sector; landfill gas projects with SEMARNAT; and emissions reductions from animal waste in the agriculture sector with SEMARNAT and SAGARPA (the Agriculture Ministry).

Methane Emission Reductions with PEMEX

Elevated oil storage tanks and bank of compressors at PEMEX Natural Gas Processor Center

USAID provides support to the PEMEX Methane to Markets Committee to identify, review, and prioritize methane emissions reduction projects in PEMEX. Assistance has focused on the measurement of fugitive emissions from pipelines and replacement of wet seals with dry seals on natural gas compressors. Results to date include:

- Investment by PEMEX of approximately US$1.4 million in new dry seals for three compressors. Installation is expected to be completed in the summer of 2007. USAID has planned a post-installation measurement campaign to confirm the emissions reductions.
- Updating PEMEX's inventory of methane emissions, using the data from a baseline measurement campaign. In addition, USAID presented SEMARNAT and PEMEX with an estimated savings potential of over US$1 billion, taking into account both energy and methane savings.
- PEMEX participated in two international Methane to Markets meetings over this period, and continues to successfully co-chair the International Oil and Gas Subcommittee under the M2M Partnership.

Landfill Methane Emissions

As part of its ongoing assistance to the Landfill Methane Subcommittee, led by SEMARNAT, the USAID team helped Mexican entities prepare a pre-feasibility study of the potential utilization of methane gas from the Nuevo Laredo landfill for electricity generation.

This included a detailed financial analysis of two options available to the municipal government: 1) the municipality securing a loan and implementing the project; and 2) development of specifications by the municipality for an international bidding process. The pre-feasibility study demonstrated a number of attractive ways the electricity could be utilized. Using criteria developed with SEMARNAT, the U.S.-Mexico M2M team developed a short-list of candidate municipalities for a second pre-feasibility study.

EPA and USAID worked together with SEMARNAT, the North American Development Bank (NADB), and the Border Environmental Cooperation Commission to explore opportunities for landfill gas capture and use projects along the border. In support of this work, EPA completed a pre-feasibility study at a landfill site in Ensenada which was just presented to

Standard open sky dump site at a medium size city in Mexico before M2M technical assistance

the Mayor of Ensenada and other project stakeholders on June 14 with positive results. The city wants to continue moving forward and is going to apply for a grant from NADB to pay for the remediation of the landfill cover which is necessary before any type of landfill gas to energy project can begin.

Animal Waste Methane Emissions

USAID worked with the Animal Waste Subcommittee, which is led by SEMARNAT, and SAGARPA to prepare a draft country profile study to analyze the swine and dairy farm distribution and size throughout Mexico and develop an estimate of the market size and potential for biodigester applications. This profile is currently under review by SEMARNAT and the M2M team.

Construction of a pilot biodigestor in a small swine farm in central Mexico

The technical team installed two small-scale biodigestors on swine farms (<500 animals) and is in the process of completing the installation of a third biodigester. The installations were completed by local installers and equipment providers in Mexico, under the guidance of U.S. experts. Lessons learned will be documented in a final report and in training course materials.

M2M efforts also include a detailed analysis of the EPA FarmWare software for biodigester sizing and performance so as to adapt it as closely as possible to the Mexican context. Inexpensive tubular biodigesters will be installed at two to three small farms. With additional funding from EPA, SEMARNAT will initiate 2-3 more pilot projects on large farms. Monitoring of the biodigesters will be carried out by SEMARNAT and the Mexican National Institute of Forestry, Agricultural and Animal Research (INIFAP). Co-funding is being sought from the Shared-Risk Trust Fund (FIRCO) for methane recovery and use on pig farms.

For more information contact Jorge Landa, USAID/Mexico, email: jlanda@usaid.gov

Ukraine: Improving Coal Mine Safety through Underground Methane Capture

Thousands of Ukrainian miners have lost their lives in coal mining accidents, many of which are due to methane gas explosions. To reduce the number of accidents in Ukraine, the U.S. Department of Labor (U.S. DOL) launched a coal mine safety program to address the major factors that cause such accidents. A key component of the program is introducing and demonstrating the effectiveness of new equipment and techniques to reduce accidents. One program segment introduces horizontal directional drilling to capture methane, remove it from the operating area, and consume the methane on the surface.

Under the program, a horizontal directional drill, now certified by the Ukranian labor safety regulators, was installed in the Belozerskaya Mine. The drill is designed to be disassembled into pieces and lowered down mine shafts. In this way, it can be moved from one mine to another. This is especially useful given the slow rate of longwall advance and development work in Ukraine coal mines. Longwall mining is an automated form of underground coal mining characterized by high recovery and extraction rates, feasible only in relatively flat-lying, thick, and uniform coalbeds. A high-powered cutting machine is passed across the exposed face of coal, shearing away broken coal, which is continuously hauled away by a floor-level conveyor system.

Belozerskaya miners learn about new horizontal drilling techniques

After its work is completed at one mine, its mobile design allows it to be moved and utilized at another mine.

The program encompasses extensive training of a drill crew that can operate the drill at other mines after the drilling has been completed at the Belozerskaya Mine. The training encompasses drill operations, including guiding the down hole motor, operating the steering rod, and using various methods to determine the location of the drill head. Methane extracted from the mine will be used as an energy source for the boilers.

For more information contact Stephen Marler, DOL, email: Marler.Stephen@dol.gov or Andres Doernberg, USAID, email: adoernberg@usaid.gov

M2M Project Highlights from the EPA

Coal Mine Methane (CMM) Information Center in India

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 developers in overcoming this barrier, the United States has helped to established information centers in India to promote the development of CMM projects and make CMM resources publicly available. EPA is also funding CMM technology demonstration projects and CMM feasibility studies in India, Mexico, and Nigeria.

OIL & GAS

Launching Natural Gas STAR International

EPA expanded the successful U.S.-based Natural Gas STAR Program by launching Natural Gas STAR International with seven charter partners: ConocoPhillips Canada Ltd, Devon Energy Corporation, Enbridge Inc., ExxonMobil Corporation, Marathon Oil Corporation, Occidental Oil and Gas Corporation, and TransCanada. EPA is working with these companies to actively identify, analyze, promote, and track methane emission reduction projects from their world-wide operations.

Following a technical transfer workshop held in Colombia in October 2005, EPA undertook a pre-feasibility analysis for a methane capture and use project for two oil production fields in Colombia and is actively monitoring resulting activities in these fields. EPA is also currently working with another oil and gas company in Colombia to conduct an analysis of their methane emissions, including proposals for relevant methane emission mitigation technologies and practices.

(Contact: Carey Bylin, EPA, email: Bylin.Carey@epamail.epa.gov)

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 work entails holding discussions with several companies to promote identification, cost benefit analysis, and implementation of methane emission reduction projects and membership in Natural Gas STAR International.

Leak Detection and Repair

Cherkasytransgas, a Ukrainian branch company of Ukrtransgas, matched grant funding from the U.S. Department of Energy's International Utility Efficiency Partnership (IUEP) program and USAID's Eco-Links program with its own funds and finished a methane emissions reduction project. This project included leak detection and measurement, development of the leak repair plan, repairing the leaks, and then summarizing the successes.

The total methane emission reductions achieved were 5.931 million cubic feet (MMcf) per year. Cherkasytransgas plans to conduct measurements at all compressor stations, gas distribution stations, and linear valves and create a database for all of the discovered leaks. (Contact: Roger Fernandez, EPA, email: fernandez.roger@epa.gov)

LANDFILLS

Sponsoring Workshops and Developing Tools

In 2006, the United States and its partners held capacity-building workshops in Russia and Turkey. The landfill technical sessions focused on LFG collection systems and gas modeling and several municipal representatives in India also presented on prospects for LFG energy at their landfills. The United States has taken the lead in developing a suite of tools that will help landfill owners and operators collect the data they need to determine the feasibility of their sites and potentially market them more efficiently to project developers. These tools include:

LFG Generation Model. EPA has finalized the Mexico landfill gas generation model, and it is available in both English and Spanish on the EPA Web site. EPA plans to calibrate this model to specific meteorological and landfill site conditions in Argentina and Ecuador. EPA is also helping to collect and analyze LFG energy potential data in Argentina, China, Colombia, Ecuador, India, Mexico, and Ukraine.

Data Gathering Template. Together with Australia and Project Network members Carbon Trade Inc. and SCS Engineers, EPA compiled and distributed a template for Partner Countries to use for evaluating their landfills.

Project Development in Brazil, Colombia, Russia, and India

Conducting data analysis, site screening, pre-feasibility and feasibility studies are essential steps that ultimately lead to project development.

EPA summarized data on more than 400 MSW facilities in Brazil landfills to identify 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 (CETESP) to select six to seven top sites for further evaluation. In Colombia, EPA, in cooperation with the Colombia Ministry of the Environment, is evaluating landfill methane recovery and use projects and is currently finalizing Assessment Reports for four sites.

In Russia, EPA has begun collecting contacts and baseline data at top Russian landfills with a plan to conduct pre-feasibility studies at identified landfills. EPA recently held an M2M Landfill Workshop in Moscow. In Ukraine, EPA has made presentations at conferences and conducted a one-day landfill methane use workshop. In addition, EPA recently identified a suitable landfill in Ukraine and will soon undertake a pre-feasibility study and conduct up to three additional desk-top landfill assessment studies in three cities.

EPA's Landfill Methane Outreach Program (LMOP) and the Clinton Climate Initiative (CCI) are partnering on several near-term activities to recover and use landfill methane from nine cities in Methane to Markets countries (Delhi, Mumbai, Lagos, Rio de Janeiro, Bogota, Mexico City, Buenos Aires, Beijing, Sao Paulo). The initial focus is on Mexico City and Rio and will expand to additional cities over the coming months. (Contact: Victoria Ludwig, EPA, email: ludwig.victoria@epa.gov)

ANNOUNCEMENT!

USAID Call for Public-Private Alliance Proposals for Methane to Markets Partnership

USAID's Bureau for Economic Growth, Agriculture and Trade (EGAT) is making a special call for the submission of concept papers related to the President's announcement on the International Methane to Markets Partnership.

USAID seeks to develop alliances that bring innovative approaches, promising measurable impact to support the core activities of the Partnership.

These core activities include:

• Identifying and promoting areas of bilateral, multilateral, and private sector collaboration on methane recovery and use.

• Developing improved emissions estimates and identifying the largest relevant emission sources to facilitate project development.

• Identifying cost-effective opportunities to recover methane emissions for energy production and potential financing mechanisms to encourage investment.

• Improving the legal, regulatory, financial, institutional and other conditions necessary to attract investment in methane recovery and utilization projects.

• Identifying and implementing collaborative projects aimed at addressing specific challenges to methane recovery, such as raising awareness in key industries, removing barriers to project development and implementation, identifying project opportunities, and demonstrating technologies.

• Developing collaborative action plans that outline a series of concrete activities and actions that directly support the core goals and functions of the Partnership.

• Developing and implementing a process for evaluating progress and reporting results.

Project proposals that address these core activities in USAID supported Methane to Market Partner countries may be submitted under USAID's Annual Program Statement (APS) No. GDA-05-001.

The Methane to Market Partnership countries for which USAID is soliciting proposals are Brazil, Columbia, Ecuador, India, Mexico, Nigeria, Russia and Ukraine.

While the Methane to Markets Partnership is in effect for five years, proposals for funding during the current fiscal year must be submitted before the close of the fiscal year on September 30, 2007. Proposals submitted after September will require submission under the 2008 APS.

Submit proposals to goweynand@usaid.gov and the contact at the relevant Mission listed on the GDA Web site at: www.usaid.gov/gda.

STAY TUNED: This fall the Office of Infrastructure and Engineering will offer a 4-day course with a strong focus on infrastructure in rebuilding and developing countries.

For more information please contact Ellen Dragotto at edragotto@usaid.gov

NOTES FROM THE FIELD

Mural in Liberia illustrating the transition in Monrovia "from darkness to illumination"

Liberia: Small Light Today, Big Light Tomorrow!

After 14 years of darkness due to the devastating civil war, the lights literally came on in Liberia's capital city in on July 26, 2006. President Johnson Sirleaf pressed a ceremonial button and turned on power in parts of Monrovia. Electric lights shone again on a major Monrovia thoroughfare, Tubman Avenue.

"The switching on of these lights today symbolizes our journey from darkness to illumination," the President told assembled dignitaries and residents, including U.S. Charge D'Affaires Lou Mazel and then USAID Mission Director Wilbur Thomas. "Small light today, big light tomorrow," she said.

The U.S. Government, working through the U.S. Agency for International Development, provided funding for the initial fuel supply for the first several months of operation. Under two companion USAID projects, the Emergency Power Program (EPP) and the Liberia Energy Assistance Program (LEAP), significant milestones have been achieved the year since that ceremonial throwing of the switch by President Sirleaf.

Liberia Electricity Corporation (LEC) is now a commercial operation. In July 2006 LEC had no electricity and therefore zero customers. LEC now has 470 metered customers on their two circuits, and generate about 700,000 kWh of electricity a month. In the past year their cumulative collections have reached nearly $2 million. Their success is attributable to technical assistance, Metering, Billing, and Collections system, computers, and IT personnel supplied by IRG through these USAID projects. Collection efficiency in June of 2007 was 91%. LEC carries a balance of a quarter of a million dollars in their Revenue Account, which was set up with IRG's assistance.

Most importantly, LEC reached sustainability in December of 2006, 5 months after re-starting operations. Since then they have been able to pay for their own fuel and Operations & Maintenance costs from their collections, with no outside donor assistance.

The mural above – Developed by Monrovia artist Leslie Lumeh – is part of a multifaceted communications, information and outreach component of the EPP and LEAP projects. Cartoons, radio jingles, information inserts in bills, community events and press releases all play a role in ensuring public understanding and support for the President's energy program and the U.S. Government's contributions.

For more information, contact Sharon Pauling (spauling@usaid.gov), USAID/Liberia, and Joan Ablett, International Resources Group, jablett@irgltd.com.