



Landfills

Methane is produced from landfills when organic matter decays under natural anaerobic conditions.

Landfill gas (LFG) can be a source of clean energy, typically composed of about 50 percent methane. LFG can be used as a direct substitute for fossil fuel consumption to generate electricity, 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 MMTCO₂E. This year, the United States has been a leader in the recovery of LFG and has spent more than \$3.2 million to expand the productive use of LFG through Methane to Markets. Highlights of these efforts are summarized below.

Building Capacity Through Workshops and Training in Colombia, Ecuador, and Nigeria

At the International Renewable Energy Conference Africa, held annually in the Nigerian capital city, Abuja, EPA shared international developments in the LFG-to-energy sector and brought organizations together to stimulate project development at Nigeria's landfills. More than 100 people from Nigerian state and federal government agencies, the private sector, and academia attended as well as several participants from other African and European countries. The Nigerian landfill sector is now seeing a burst of activity. Developers are preparing a preliminary inventory of landfills,

planning to evaluate the feasibility of LFG energy at landfills, and working with other stakeholders in Nigeria's waste management sector, including the Waste Management Society of Nigeria, to identify opportunities.

In Colombia, as part of a national conference organized by the Colombian Association of Environmental and Sanitation Engineering, EPA held a workshop and training session on the basics of LFG capture, estimating gas recovery potential, and energy utilization technologies. Approximately 100 participants attended, including landfill and solid waste officials representing several Colombian municipalities.

In July 2008, EPA helped train approximately 150 representatives of Ecuadoran municipalities, including several mayors, in LFG energy project development. The workshop was interactive, allowing participants to share lessons learned and best practices.

Pre-Feasibility and Assessment Studies Conducted in Argentina, India, Mexico, and Ukraine

Thorough study and analysis are essential for launching successful LFG projects. Using a range of energy recovery technologies, engineers conduct pre-feasibility and assessment studies to generate important data, such as the availability of LFG, and determine the economic feasibility of a specific project. These data are vital in helping developers and investors decide if they want to take the project to full development.

- In Bahia Blanca, Argentina, a seaport city in the southeast portion of Buenos Aires Province with a population of approximately 300,000, EPA conducted a pump test for an LFG pre-feasibility study. EPA estimated that projected gas recovery potential in 2008, after installation of a gas collection system, was approximately 625 cubic meters per hour. EPA completed and presented the report to municipal officials in June 2008. A potential end-user has been identified and EPA continues to work with the municipality to advance this project.
- In Ahmedabad, India, EPA conducted a direct user assessment of five local industries around the Pirana Landfill. The local industries included a compost factory, cement factory, denim factory, dyeing facility, and a chemical facility. EPA collected information on the energy needs of these facilities as well as their distance from the landfill. EPA also conducted a feasibility study to determine whether LFG could be used as a source of LNG for vehicles in India. The final report will be released in late 2009.
- In Mexico City, EPA conducted a preliminary assessment of the potential for LFG recovery and utilization at the Bordo Poniente Landfill. With a capacity to hold 56 million tons of solid waste, the landfill is Mexico's largest and serves the 20 million residents of Mexico City. The Mexico City municipal government asked EPA to conduct this assessment to enable it to have an objective third-party evaluation with which to compare LFG studies that it and other organizations have completed. The assessment found that Bordo Poniente is a good candidate for an LFG recovery and utilization project. It would have the potential to reduce approximately 5.15 MMTCO₂E through 2012 and produce 14 MW of electricity at full capacity.
- In Mariupol, Ukraine, near the Sea of Azov, EPA conducted pump tests at a local landfill. Three vertical extraction wells, seven monitoring probes, collection piping, and an electric blower provided by an adjoining brick manufacturing facility were installed, and local Ukrainian engineers conducted the drilling. Based on the initial results, EPA estimated LFG recovery to be 290 to 408 standard cubic feet per minute, a robust estimate considering most landfills in the country are controlled but uncapped and uncovered. After finalizing the pump test, EPA examined various end users for the gas, including a flaring only option as well as direct use by the brick manufacturing facility. EPA will use data from this pump test, as well as a 2007 pump test conducted in Chernvtsi, to develop a Ukraine-specific LFG recovery model in 2009.



Constructing a test well for a pump test at the Bahia Blanca landfill in Argentina.

Landfill Data Collection Efforts in Argentina, Russia, Thailand, and the Philippines

EPA collaborated with Partner Countries in the collection of landfill data to explore the capture and use of LFG.

- In Argentina, working with the Asociación para el Estudio de los Residuos Sólidos (ARS) and Universidad Nacional del Centro de la Provincia de Buenos Aires, Olivarría (UNCPBA), EPA has launched efforts to collect landfill profile data on mid-size municipal landfills and controlled dumps (serving populations greater than 100,000) and to evaluate potential direct-use opportunities, respectively. To date, ARS has identified 40 landfills and is continuing efforts to collect additional profile data. Additionally, UNCPBA has evaluated 10 sites that are currently collecting gas but not using it for energy. Of those sites, two appear to have the potential for a direct-use project. EPA will be exploring direct-use opportunities at these sites in the future.
- In Novokuznetsk, in southern Siberia, EPA assessed candidate sites and assisted a local nonprofit organization, the Ecological Research Centre (ERC), with the first comprehensive landfill inventory in Russia. With funding from an EPA grant, ERC has collected data from more than 800 landfills representing 72 out of Russia's 83 regions. The data include critical information on landfill location, size, capacity, waste depth, and open and closure years. ERC completed the database and presented the results at Russia's biannual Waste-Tech Conference in Moscow in 2009.
- With EPA participation, the governments of Thailand and the Philippines took part in a scoping mission to gather data and information on their landfills. As part of this effort,

EPA Assessment Advances Recovery Options at Colombian Landfill

The Doña Juana Landfill, located in and owned by the city of Bogotá, Colombia, will soon be a source of clean, domestic energy. Thanks in part to a 2007 EPA grant, engineers were able to assess the landfill and find significant potential for methane capture and use. This led to the site being featured at the 2007 Partnership Expo in Beijing, China. Since then, landfill operators have installed a flaring system that began operating in early 2009, and they continue to research full methane generation potential and consider future options. While site conditions and leachate collection system limitations prevent recovery of all biogas at the site, EPA estimates the landfill could realize annual emissions reductions of more than 1.2 MMTCO₂E by 2016 when the landfill is anticipated to close with more than 48 million tons of waste in place.



Doña Juana Landfill in Bogotá, Colombia.

EPA met with LFG energy stakeholders and visited landfills to obtain additional site-specific landfill data.

Model Developed for Chinese LFG

EPA completed the first draft of the Landfill Gas Emissions Model (LandGEM) simulating waste and climate conditions in China. This model will allow users to produce typical LFG generation and recovery estimates for landfills located in various regions of China. EPA is anticipating a full launch of the model to take place in late 2009.