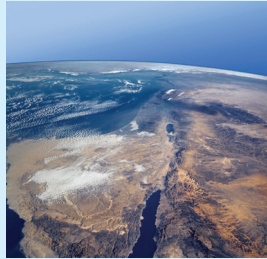


The Global Methane Initiative (GMI)

The Global Methane Initiative (GMI) is a voluntary, multilateral partnership that aims to reduce global methane emissions and to advance the abatement, recovery and use of methane as a valuable clean energy source. GMI achieves this by creating an international network of partner governments, private sector members, development banks, universities and non-governmental organizations in order to build capacity, develop strategies and markets, and remove barriers to project development for methane reduction in Partner Countries.



Launched in 2004, GMI is the only international effort to specifically target the abatement, recovery and use of the greenhouse gas (GHG) methane by focusing on the five main methane emission sources: agriculture, coal mines, landfills, municipal wastewater, and oil and gas systems. The Initiative works in concert with other international agreements, including the United Nations' Framework Convention on Climate Change, to reduce GHG emissions. Unlike other GHGs, methane is the primary component of natural gas and can be converted to usable energy. The reduction of methane therefore serves as a cost-effective method to reduce GHGs and increase energy security, enhance economic growth, improve air quality and improve worker safety.

Why Target Methane?

Methane (CH₄), the second most important manmade greenhouse gas (GHG) after carbon dioxide (CO₂), is responsible for more than a third of total anthropogenic climate forcing. It is also the second most abundant GHG accounting for 14 percent of global GHG emissions. Methane is considered a "short-term climate forcer," meaning that it has a relatively short lifespan in the atmosphere, approximately 12 years. While methane is in the atmosphere for a shorter period of time and is emitted in smaller quantities than CO₂, its ability to trap heat in the atmosphere, which is called its "global warming potential," is 21 times greater than that of CO₂.

Methane is emitted during the production and transport of coal, natural gas and oil. Emissions also result from the decay of organic matter in municipal solid waste landfills, some livestock manure storage systems, and certain agro-industrial and municipal wastewater treatment systems. Methane offers a unique opportunity to mitigate climate change and simultaneously increase available energy supply. However, without more stringent measures to reduce sources, methane emissions are expected to increase approximately 45 percent to 8,522 million metric tons of carbon dioxide equivalent (MMTCO₂E) by 2030.¹ GMI Partner Countries represent approximately 70 percent of the world's estimated anthropogenic methane emissions and include the top 10 methane-emitting countries. Cumulative methane emission reductions that can be attributed to GMI total nearly 128.3 MMTCO₂E.

➔ What is Landfill Gas?

Landfill gas (LFG) is created from the decomposition of organic matter in a municipal solid waste (MSW) landfill. This gas consists of about 50 percent CH₄, about 50 percent CO₂, and a small amount of non-methane organic compounds (NMOCs). Instead of allowing LFG to escape into the air, landfill owners, businesses and governments are increasingly capturing, converting and using the gas as an energy source. Using LFG helps to reduce odors and other hazards associated with LFG emissions, and helps

prevent methane from migrating into the atmosphere and contributing to local smog and global climate change.

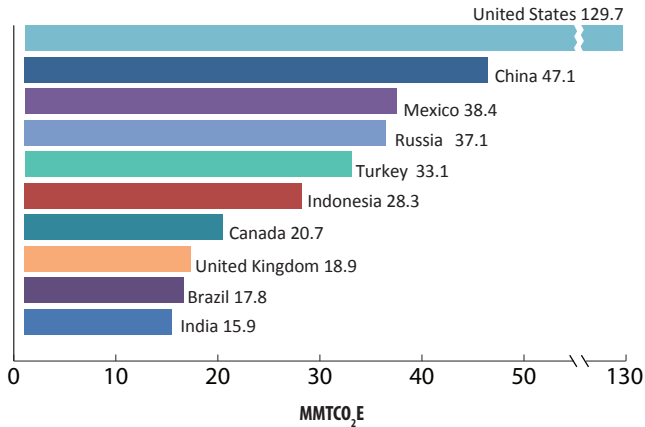
Globally, landfills are the third largest anthropogenic source of methane, accounting for approximately 11 percent of estimated global methane emissions or nearly 799 MMTCO₂E in 2010.² Figure 1 presents methane emissions from the landfill sector in selected GMI countries.

¹U.S. EPA, 2011. *DRAFT: Global Anthropogenic Emissions of Non-CO₂ Greenhouse Gases: 1990–2030* (EPA 430-D-11-003), www.epa.gov/climatechange/economics/international.html.

²ibid.

Figure 1: Estimated Global Methane Emissions From Landfills in Top Ten GMI Countries, 2010*

*The countries depicted in the below figure had the highest landfill methane emissions in 2010. Total landfill methane emissions in 2010 was 799 MMTCO₂E.



In Partner Countries with growing consumer economies and high population growth, such as China and Brazil, waste disposal rates are increasing. Further, a trend toward improved solid waste management in many of these countries is leading to the design and construction of more sanitary landfills, which provide the anaerobic environment necessary for methane production.

➔ Converting LFG to Energy

LFG has a heating value of approximately half that of natural gas and can often be used in place of conventional fossil fuels in certain applications. It is a reliable local source of renewable energy because it is generated 24 hours a day, 7 days a week from household and commercial wastes that are continuously deposited in landfills. By using LFG to produce energy, landfills can significantly reduce their emissions of methane and can help offset the need to generate energy from fossil fuels, thus reducing emissions of CO₂, sulfur dioxide, nitrogen oxides and other pollutants from fossil fuel combustion.

LFG is extracted from landfills using a series of wells and a blower/flare (or vacuum) system (Figure 2). This system directs the collected gas to a central point where it can be

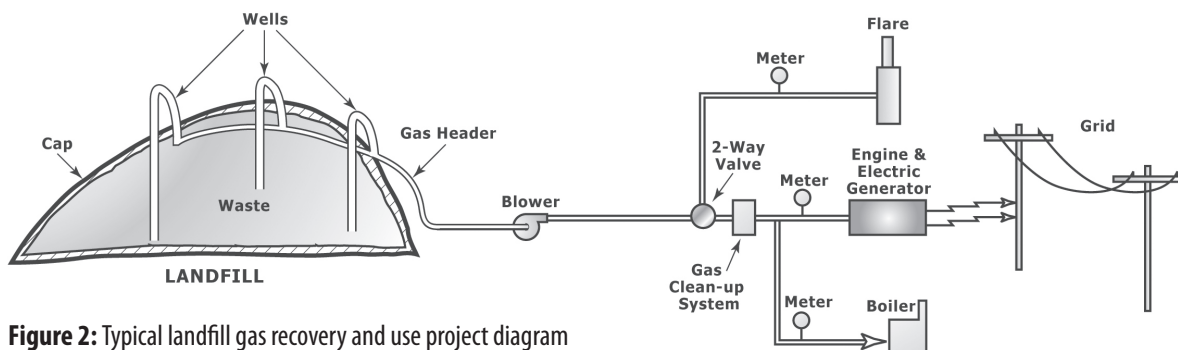


Figure 2: Typical landfill gas recovery and use project diagram

processed and treated, depending on the ultimate use for the gas. From this point, the gas can be flared, used to generate electricity, replace fossil fuels in industrial and manufacturing operations, or upgraded to pipeline-quality gas that can be used directly or processed into an alternative vehicle fuel.

➔ GMI at Work

GMI brings the collective resources and experience of partners together to facilitate technology transfer and demonstration, policy support, capacity building and market development necessary to implement LFG energy projects and increase LFG emission reductions. Specifically, GMI's Landfill sector has been working to reduce the barriers to LFG energy project development in Partner Countries, which include a lack of in-country technical expertise; inadequate identification or evaluation of suitable candidate landfills; a lack of demonstrated technical and economic feasibility of proven technologies and practices in local contexts; and other financial, informational, and institutional obstacles.

Highlights of the GMI Landfill sector's efforts include:

- **Country profiles and country-specific strategies** to help overcome the barrier of limited information on landfill and LFG management practices in each country.
- **Preliminary studies and demonstrations** to evaluate the technical and economic feasibility of implementing LFG energy projects, including efforts for pre-feasibility studies and assessments in 17 Partner Countries. Grant awards have also been made in these countries to develop landfill inventories, conduct pre-feasibility studies and hold technology demonstrations.
- **Workshops and operator training sessions** to focus on landfill operations, LFG modeling, and advancing LFG projects for landfill operators, government officials and financiers. In 2009 to 2010 alone, nearly 20 events were held in Partner Countries.
- **Modeling and data collection** to assist with the identification of candidate landfills and potential LFG project development opportunities (see "Additional Tools and Resources" on page 4).

➔ The following examples showcase the types of activities undertaken by GMI and its Partner Countries.

Gaoantun Landfill (China)

Gaoantun Landfill is a sanitary landfill owned and operated by the Beijing Chaoyang District Garbage Innocent Disposal Center. In 2007, the U.S. Environmental Protection Agency (U.S. EPA) conducted a pump test to estimate the quantity of LFG available to recover and produced a pre-feasibility study on the potential to expand LFG utilization at this site. In 2010, U.S. EPA provided follow-up technical assistance and monitoring of the gas collection system to identify how the site could improve gas collection efficiency to increase the amount of gas that could be utilized for energy. As of August 2010, the gas collection system consisted of 150 extraction wells which were converted from passive vents. The owners originally installed a 500-kilowatt (kW) reciprocating engine to generate electricity for the on-site leachate treatment plant in 2007 and added a second 500-kW engine in 2008. The current project is annually reducing GHG emissions by 37,100 tons of CO₂E from electricity generation and 500 tons of CO₂E through direct use. Two additional engines will be added and come online in January 2011, bringing the total electric generating capacity to 2.5 megawatts (MW). The owners plan to ultimately increase the power generating capacity to 4 MW by the landfill closure date.



Landfill gas-fired boiler in operation at Gaoantun Landfill, China

Mariupol Landfill (Ukraine)

The closed Mariupol Landfill is located in the city of Mariupol, Ukraine, and is owned by the Mariupol City State Administration. The landfill is located in a mixed-use area with residential, agricultural, commercial and industrial uses. Until its closure in 2008, the landfill accepted domestic and commercial waste from the city of Mariupol. During its active phase, certain landfill management practices led to significant leachate production, storm water runoff and unintended fires.

In August and September 2008, U.S. EPA conducted pump tests at this landfill which yielded a LFG recovery rate capable of supporting a flare and/or electricity project. In February 2009, the Mariupol City Council awarded the LFG capture and utilization project at two of the city's landfills to TIS Eco Company. GMI Project Network members TIS Eco Company, in partnership with Scientific Engineering Center (SEC) Biomass, began construction activities at the first landfill in June 2009. The system was commissioned in February 2010. In August 2010, the National Environmental Investment Agency issued a Letter of Approval to the "Collection and recycling of methane from solid waste landfills, Mariupol, Ukraine" for a Joint Implementation project.

The collected LFG is being directed to a cogeneration plant, where up to 1.25 MW of electricity is expected to be generated and supplied to a distribution network. Some of the electricity produced will also offset the needs of the LFG collection and distribution system. Heat energy generated at the plant will provide an alternative energy source for a nearby greenhouse and brick manufacturing facility using an infrared heater or a kiln. Surplus LFG will be flared. The project is estimated to annually reduce EPA GHG emissions by approximately 40,000 to 75,000 tons of CO₂E.



Landfill gas flare in operation at the Mariupol Landfill, Ukraine

São João Landfill (Brazil)

The São João Landfill is located near the municipality of São Paulo, Brazil's largest city and a producer of 15,000 tons of daily waste. Between its opening in 1992 and its closing in 2008, the São João Landfill accumulated over 24 million metric tons of waste. The landfill generated large quantities of LFG since its inception, but most of the gas was lost to the atmosphere through passive venting.

In June 1996, U.S. EPA conducted a feasibility study which indicated that the São João Landfill could support a LFG electricity project. In April 2006, the Municipality of São Paulo applied to register the project under the United Nations Framework Convention on Climate Change's (UNFCCC's) Clean Development Mechanism (CDM) in order to procure project funding. São Paulo selected Biogas, a Brazilian company specializing in LFG recovery, to manage the LFG capture project. Biogas commenced construction in May 2007 and began building the LFG-to-electricity power plant in June 2007. The project became operational in 2008.

In 2009, the São João Landfill generated approximately 11,555 m³/h of LFG, which was captured by a series of 160 extraction wells and pumped to the on-site power plant. The plant combusts the LFG in 16 engines, each with a 1.54 MW capacity, and has a total electricity production capacity of 22.4 MW. Three flares destroy any LFG not used to generate electricity.

In 2009, the project's methane destruction and electricity production reduced GHG emissions by 876,797 metric tons of CO₂E. The project also benefits the environment and surrounding communities by reducing volatile organic compounds, which contribute to air pollution and odors.

➔ Additional Tools and Resources

The following tools and resources have been developed to assist GMI Partner Countries advance LFG projects:

- **GMI International Landfill Database (ILD)** contains information on more than 700 landfills worldwide, helping address the need for country-specific information on landfills, LFG management, and project development opportunities.
- **GMI Guide to Online LFG Resources** is a downloadable/searchable database of existing LFG documents, tools, and other resources that can be filtered by topic, type of resource, applicable country or region, and authorizing organization.
- **U.S. EPA Landfill Methane Outreach Program (LMOP) LFG Models** help landfill owners/operators and other interested parties evaluate the feasibility and potential benefits of collecting and using LFG for energy recovery. LFG models are currently available for Central America, China, Colombia, Ecuador, Mexico, Philippines, Thailand and Ukraine.
- **International Best Practices Guide** (forthcoming) focuses on landfill operations and maintenance, LFG modeling, design and operation of LFG collection and flaring systems, an overview of energy recovery technologies, how to develop a request for proposal for LFG projects, an overview of regulatory barriers and incentives that help promote the use of LFG as an energy resource, and how to finance LFG projects. The guide will also highlight case studies of successful LFG projects in GMI Partner Countries.

For additional information,
please visit the GMI website
www.globalmethane.org

Administrative Support Group (ASG)
Global Methane Initiative
Tel: +1-202-343-9683
Fax: +1-202-343-2202
E-mail: ASG@globalmethane.org