Agricultural Methane: Reducing Emissions, Advancing Recovery and Use Opportunities

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 (CH_4), the second most important manmade greenhouse gas (GHG) after carbon dioxide (CO_2), 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 CO_2, its ability to trap heat in the atmosphere, which is called its "global warming potential," is 21 times greater than that of CO_2.

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 ($MMTCO_2E$) 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 $MMTCO_2E$.

Background on Global Agricultural Methane

Methane is produced and emitted from the decomposition of livestock manure and the organic components in agro-industrial wastewater.[2] These wastes are typically stored or treated in waste management systems that promote anaerobic conditions (e.g., liquid or slurry in lagoons, ponds, tanks, or pits) and produce biogas, a mixture of about 70 percent methane, 30 percent CO_2, and less than 1 percent hydrogen sulfide.

Globally, manure management contributed an estimated 237 $MMTCO_2E$ of methane emissions in 2010, roughly 4 percent of total anthropogenic (human-induced) methane emissions. In certain countries, poultry is also a significant source of methane emissions. Estimates of the amount of global methane emissions from agro-industrial wastewater are not currently available. Figure 1 represents methane emissions from manure management in selected GMI countries.

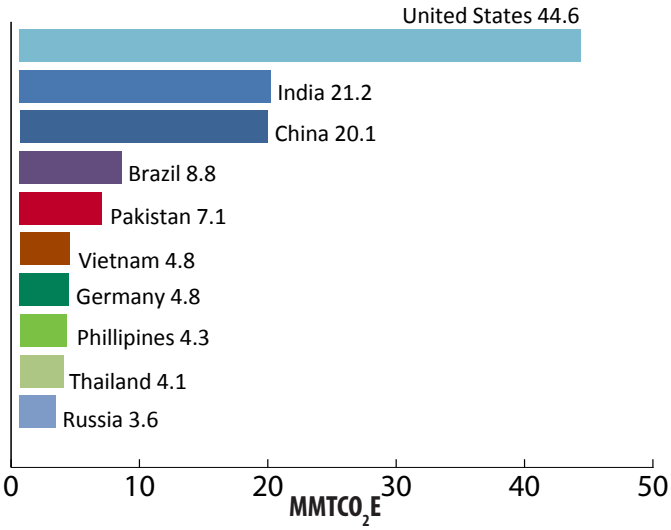
[1] U.S. EPA, 2011. *DRAFT: Global Anthropogenic Emissions of Non-CO_2 Greenhouse Gases: 1990–2030* (EPA 430-D-11-003), www.epa.gov/climatechange/economics/international.html.

[2] Agricultural methane sources also include rice cultivation and eructation from the digestive processes of ruminant animals (enteric fermentation). This fact sheet focuses on livestock and agro-industrial wastes.

[3] Ibid.

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

*The countries depicted in the below figure had the highest manure methane emissions in 2010. Total manure methane emissions in 2010 was 237 $MMTCO_2E$.



Abatement, Recovery and Use Opportunities

Methane emitted from manure and agro-industrial waste management systems can be captured using anaerobic digestion (AD) technology. A variety of AD technologies are available, including small-scale digesters, covered anaerobic lagoons, plug flow digesters, complete mix digesters, and advanced digesters.

AD systems that recover biogas and use it to generate energy can be a cost-competitive alternative to conventional waste management practices. Moreover, AD systems can generate revenue and meet local energy needs by capturing and burning the produced biogas to generate energy for on-farm heating, cooling, and electricity needs. Surplus electricity can be sold to nearby operations or to the utility grid. Excess biogas can also be sold or fed into natural gas pipelines, provided it is sufficiently purified first.

AD projects developed at an agricultural site not only reduce GHG emissions and produce clean energy but also act to improve air and water quality, reduce odors, improve nutrient management, increase sanitation, stimulate rural economic development, and promote sustainable environmental development.

GMI Agricultural Program Development

Globally, it is common to find barriers to the deployment of AD technologies, including finances, utility policies, regulations, lack of credible technical information and proven designs, and poor operational track records of existing technologies. To help overcome these barriers, GMI uses a multiple-step methodology to help deploy AD technologies in participating countries. The first step is to develop an RA, which identifies and ranks agricultural methane emission sources based on waste handling methods, physical and chemical properties, emission intensity, scale and other key factors. The RA helps target the implementation plan or strategy toward the agricultural sectors and subsectors that emit the most methane.

Next, an evaluation of the sector- and scale-specific technologies, waste characteristics, income level, and country (public and private) capacity to deploy these technologies is conducted. The final step is to identify market barriers and areas where the country capacity needs strengthening to support the deployment process. Based on these findings, the Partner Country works with GMI to identify areas where support is needed to create an environment allowing projects to multiply by establishing the necessary capacity to provide, construct, and service appropriate AD technologies.

The number of potential agricultural projects in many countries is very large; the GMI agricultural program development process allows Partner Countries to allocate finite resources based on the prioritization of sectors with high potential to reduce methane emissions and generate renewable energy at low costs. Activities implemented under this approach often lead to job creation, such as in the construction and fabrication sector, and help reduce reliance on foreign technology developers. More importantly, they also tie into a country's rural sanitation, economic, and environmental development initiatives and increase quality of life.

Anaerobic Digester with Solids Dry Pit in the Foreground (Thailand)

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

Reducing Emissions from Swine Farms in Thailand

Construction of a digester at Phanus Amporn farm in Thailand

Swine farming is a major sub-sector of Thailand's livestock industry. As of December 2008, Thailand had approximately 8.5 million pigs managed through a combination of commercial farms (composed of about 3,400 operations representing 60 percent of the industry) as well as non-registered commercial and backyard farms (totaling more than 200,000 operations). In 2008, Thailand began working with GMI to reduce methane from swine farms in three provinces near Bangkok. With financial support from GMI and the World Bank's Global Environmental Facility and technical support from the Thailand Department of Livestock Development and the Thailand Energy Policy and Planning Office, 12 swine farms with a total of nearly 200,000 pigs installed biogas systems. Project engineers estimate that annual methane emission reductions will exceed 90,000 metric tons of CO_2E.

Demonstration projects help to promote AD technology because they educate others about the possibilities for AD technology implementation and use. These successful demonstration projects not only reduce emissions and create renewable energy, but also help disseminate AD technology by serving as examples for replication.

Capacity Building and Training in Philippines

In the Philippines, the agriculture sector contributes 33 percent of the country's GHG emissions and livestock manure accounts for approximately 4 percent of methane emissions. The Philippine Council for Industry and Energy Research and Development has hosted a series of technical trainings supported by a joint initiative between GMI and the World Bank to develop local technical capacity. The objective of these trainings is to develop an engineering-based group of certified technicians to design AD systems, manage system construction, and train AD operators in the operation, maintenance and trouble-shooting of these systems.

The workshops have covered a range of topics, including:

- Digester design based on estimates of standing pig population, process water use and potential energy reduction calculations.
- Digester financing and performance, including the quantification of certified emissions reductions.
- Hands-on fixed dome, stacked dome, and bag digester construction training.
- Hands-on flare installation and gas handling trainings.

Stacked fixed dome digester construction at Nueva Vizcaya, Philippines

The trainees are selected from a pool of private sector, public sector and academic applicants based on experience and other criteria. The training program is completed in a series of classroom and hands-on workshops that include the development of at least one commercial AD technology. The training could be used as part of a certification program for AD technicians. Training and certification ensures that an adequate support sector exists in countries implementing broad AD programs.

Development of Mexico AD Standards

Mexico's federal environmental agency, Secretaría de Medio Ambiente y Recursos Naturales, has developed technical standards for the design, construction, installation, operation and maintenance of covered lagoon anaerobic digesters. *The Covered Anaerobic Lagoon National Standard* was created after a review of existing technical standards for covered lagoons, as well as the operational status and vendor qualifications for covered lagoons currently in use in Mexico. AD standards are a key technical component of GMI's support because some AD technology applications have had limited success. Standards provide a credible technical basis for the design and operation of low-risk, affordable and replicable AD technologies. The designs prescribed by these standards are based on proven AD systems from a wide array of scales of application, countries, waste types and waste management systems.

Australia's Agriculture Methane Research and Monitoring Program

Although much is known about GHG emissions and methane capture opportunities in the agricultural sector, there is more to learn. GMI supports the development of research programs to help broaden the knowledge base.

The Australian Methane to Markets in Agriculture Program (AM2MA) was established in 2007 and aims to reduce GHG emissions from Australia's intensive livestock industry by mitigating methane from manure management, replacing fossil fuels with renewable energy, and displacing synthetic fertilizer with recycled nutrients. The Australian government and industrial research organizations have invested generously in the program. Research topics include the development of AD technologies for intensive livestock operations, assessment of Australian biogas flaring standards, and analysis of the viability of producing and capturing methane from manure for conversion into energy. Other program activities include characterizing methane potential, modeling AD of livestock wastes, monitoring biogas production from covered lagoons, validating manure production prediction models, and quantifying feedlot manure output data. Continued research allows GMI to provide timely updates on advances in the agricultural AD field to its Partner Countries.

GMI at Work

GMI brings together the collective resources and expertise of the international community to address technical and policy issues and to facilitate AD projects in Partner Countries. It also serves to reduce the barriers to AD project development that commonly exist by raising awareness about AD technologies, assisting with project financing, and working directly with Partner Countries to address specific project-related concerns and needs (e.g., technical, financial).

The Agriculture sector collaborates on many initiatives:

- ***Country profiles and strategic plans*** are used to overcome the barriers of limited information and offer a strategic vision to Partner Countries to pursue AD projects.
- ***Resource assessments (RAs)*** are used to identify and characterize the sectors within each country that have the highest potential for incorporating various AD technologies to reduce methane emissions and to provide renewable energy.
- ***Capacity building and technology transfer*** are critical components of project development and enhance in-country capabilities. GMI has worked with international governments to help develop national and local methane emission reduction and recovery programs. GMI has also supported workshops and training sessions to provide information about AD technologies and resources.
- ***Performance evaluations of international AD systems processing livestock manure*** are conducted according to the *International Guidance on AD Systems for Livestock Manure* that was created by an international panel of experts, led by the GMI Agriculture Subcommittee, to provide a standard methodology for evaluating system performance and reporting these results.

Looking Forward

GMI's Agriculture sector continues to work to find new ways to promote AD and reduce GHGs. Some of the Subcommittee's ongoing efforts include:

- Expansion of the International AD Database as Partner Countries continue to provide information about operating and planned AD systems, allowing users to examine AD applications around the world.
- Evaluations of AD systems using the *International Guidance on AD Systems for Livestock Manure* are currently being planned and implemented in Partner Countries.
- Resource Assessments will be developed for additional countries to help identify potential sources for methane emission reductions and recovery.

The Subcommittee will continue to monitor international efforts on enteric fermentation and rice cultivation, the largest sources of agricultural methane emissions, to identify opportunities for collaboration in areas of methane emissions avoidance.

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

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