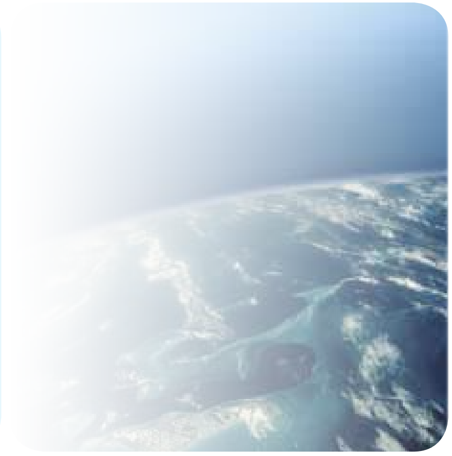
Global Methane Emissions and Mitigation Opportunities

Global Methane Initiative

Methane (CH_4) is a hydrocarbon and the primary component of natural gas. Methane is also a potent and abundant greenhouse gas (GHG), which makes it a significant contributor to climate change, especially in the near term (i.e., 10–15 years). Methane is emitted during the production and transport of coal, natural gas, and oil. Emissions also result from livestock and other agricultural practices and from the decay of organic waste in municipal solid waste landfills and certain wastewater treatment systems.

Methane is the second most abundant GHG after carbon dioxide (CO_2), accounting for 14 percent of global emissions. Though methane is emitted into the atmosphere in smaller quantities than CO_2, its global warming potential (i.e., the ability of the gas to trap heat in the atmosphere) is 25 times greater. As a result, methane emissions currently contribute more than one-third of today's anthropogenic warming.



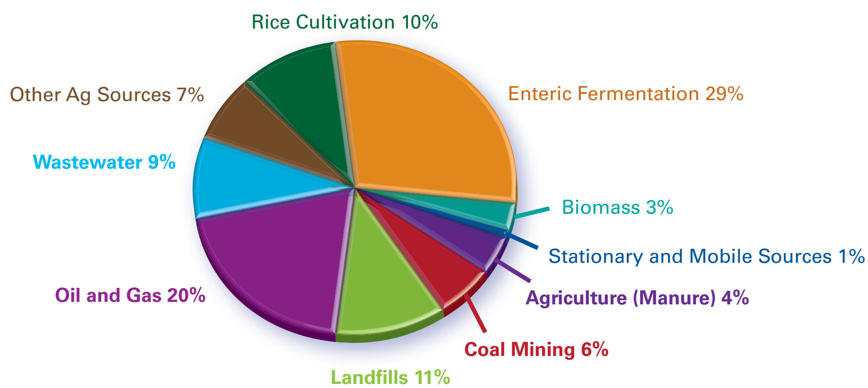
Global Methane Emissions by Sector

Global anthropogenic methane emissions for 2010 were estimated at 6,875 million metric tons of CO_2 equivalent ($MMTCO_2E$).[1] Approximately 50 percent of these emissions come from the five sources targeted by the Global Methane Initiative (GMI): agriculture, coal mines, landfills, oil and natural gas systems, and wastewater (see Figure 1).

GMI Partner countries (see www.globalmethane.org for complete list) represent approximately 70 percent of the world's estimated anthropogenic methane emissions and include the top 10 methane-emitting countries.

Partner countries' major methane emission sources vary greatly, and thus the opportunities for methane capture and use in each country also vary.

Figure 1: Estimated Global Anthropogenic Methane Emissions by Source, 2010

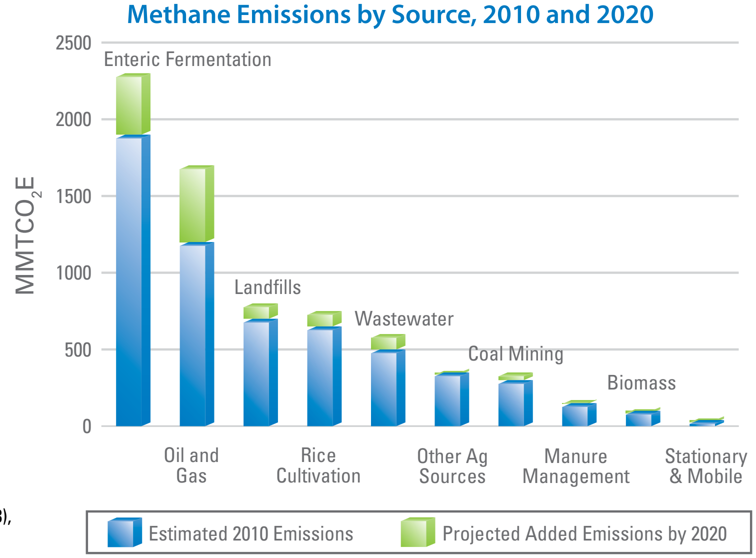


Global Emissions Projections

Global anthropogenic methane emissions are projected to increase by 15 percent to 7,904 $MMTCO_2E$ by 2020 (see Figure 2).

From 2010 to 2020, the relative contributions of the agriculture, coal mining, and landfill sectors are projected to remain relatively constant, changing by less than 1 percent of global anthropogenic methane

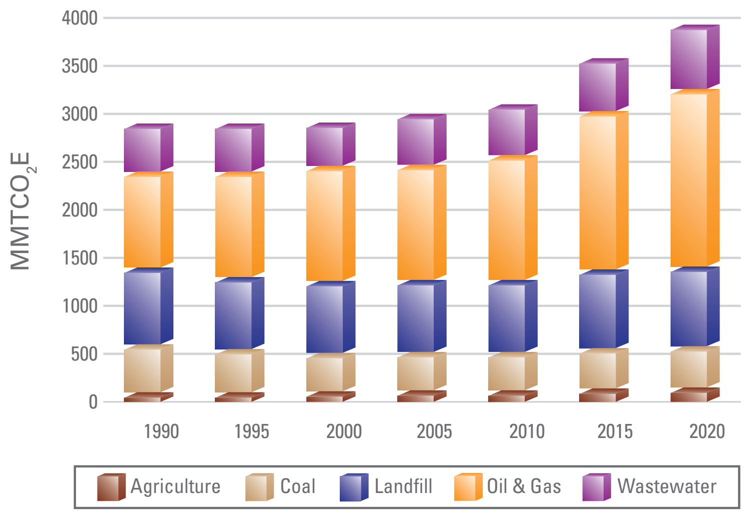
Figure 2: Estimated and Projected Global Anthropogenic Methane Emissions by Source, 2010 and 2020



[1] Unless otherwise noted, all data are from U.S. EPA's *Global Anthropogenic Emissions of Non-CO_2 Greenhouse Gases: 1990–2020* (EPA Report 430-R-06-003), www.epa.gov/climatechange/economics/international.html.

emissions or approximately 7 to 10 percent within each sector (see Figure 3). Methane emissions from wastewater treatment systems are expected to increase by nearly 12 percent. Oil and gas emissions, however, are expected to increase by nearly 35 percent from 2010 to 2020, and will account for 3 percent more of the projected global anthropogenic methane emissions annually.

Figure 3: Global Methane Emissions by Sector



Benefits of Methane Mitigation

Methane presents unique opportunities because cost-effective mitigation technologies and practices to address methane emissions from the largest anthropogenic sources are already widely available and in use all over the world. In addition to mitigating climate change, reducing methane emissions delivers a host of other energy, health and safety, and local environmental benefits. Many technologies and practices that reduce methane emissions also reduce emissions of volatile organic compounds, hazardous air pollutants, and other local air pollutants. This yields health benefits for local populations and workers. Because methane is an important precursor of tropospheric ozone, reducing methane also reduces ozone-related health effects.

Methane reduction projects at landfills and wastewater treatment plants also reduce odors; in the agriculture sector, they control manure protecting local waters and ecosystems. Capturing methane from gassy coal mines improves industrial safety by reducing the risk of explosions. The use of low-emission equipment and better management practices in oil and natural gas systems minimizes methane leaks, yielding health and safety benefits while increasing the amount of product that reaches the market, generating increased revenue.

For any project, producing energy from recovered methane provides a local source of clean energy that can spur economic development. It can displace higher CO_2- and pollutant-intensive energy sources such as wood, coal, and oil. Finally, recovered methane can serve as a new sustainable and abundant energy source for developing countries.

Overview of Mitigation Opportunities

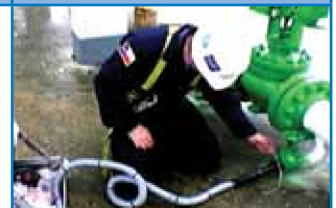
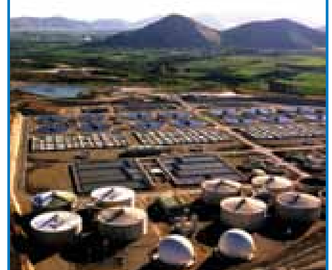
Many of the currently available methane mitigation opportunities involve the recovery and use of the methane as fuel for electricity generation, onsite uses, or offsite gas sales. Specific technologies and mitigation approaches, however, vary by emission source because of their different characteristics and emission processes. The matrix (on page 3) provides a brief summary of the mitigation opportunities by sector compiled from published literature and the work of the

The Global Methane Initiative

On 1 October 2010, 37 Partner governments and the European Commission launched GMI to urge stronger international action to fight climate change while developing clean energy and stronger economies. GMI builds on the success and structure of Methane to Markets, broadens the scope to include additional emission sources and new approaches to methane abatement, advances the development of national action plans, and brings new resources to expand international collaboration.

More than 1,000 public and private sector organizations are members of the GMI Project Network, and have helped the program to leverage nearly $480 million in investment from private companies and financial institutions. GMI will serve to build capacity and identify needs and opportunities for advancing reduction efforts, while providing a framework for ensuring coordination and maximizing the leveraging of its collective resources.

[2]The *Fourth Assessment Report of Working Group III of the IPCC* (www.mnp.nl/ipcc/pages_media/AR4-chapters.html) and the U.S. EPA report, *Global Mitigation of Non-CO_2 Greenhouse Gases* (www.epa.gov/climatechange/economics/international.html), both contain information on methane mitigation options.

Sources of Methane	Global Methane Emissions per Sector*	Mitigation Opportunities	Proven Mitigation Technologies
Oil & Gas Systems Emitted during normal operations, routine maintenance, and system disruptions in the oil and natural gas industry.	1,354.42 $MMTCO_2E$	• Technologies or equipment upgrades that reduce or eliminate equipment venting or fugitive emissions. • Enhanced management practices that take advantage of improved measurement or emission reduction technology. For more information from the Oil and Gas Subcommittee: www.globalmethane.org/oil-gas	 Leak Detection Equipment (Mexico)
Landfills Produced through the decomposition of organic waste under anaerobic conditions typically found in landfills and large dump sites.	760.63 $MMTCO_2E$	• Extraction using a series of wells and a vacuum system, which directs the collected gas to a point to be combusted in a flare or utilized for energy (e.g., electricity generation, boiler, dryers, vehicle fuel). For more information from the Landfills Subcommittee: www.globalmethane.org/landfills	 Landfill Gas Well (China)
Wastewater Produced by decay of organic material in wastewater as it decomposes in anaerobic environments.	594.04 $MMTCO_2E$	Installation of: • Anaerobic sludge digestion (new construction or retrofit of existing aerobic treatment systems). • Biogas capture systems at existing open air anaerobic lagoons. • New centralized aerobic treatment facilities or covered lagoons. • Gas capture and combustion systems to flare or utilize methane (e.g., onsite electricity or other thermal uses).	 Anaerobic Wastewater Treatment (Chile)
Coal Mines Emitted from active and abandoned underground mines and surface mines, and as a result of post-mining activities including coal processing, storage, and transportation.	407.56 $MMTCO_2E$	• Degasification, where holes are drilled and the methane is captured (not vented) in conjunction with mining operations. • Ventilation air methane (VAM) abatement, where low concentrations of methane are oxidized to generate heat for process use and/or electricity generation. For more information from the Coal Mines Subcommittee: www.globalmethane.org/coal-mines	 Degasification Pump Station (Ukraine)
Agriculture (Manure Management) Produced from decomposition of livestock and poultry manure stored or treated in systems that promote anaerobic conditions (e.g., liquid or slurry in lagoons, ponds, tanks, or pits).	243.95 $MMTCO_2E$	• Covered anaerobic lagoons collect and transmit lagoon-generated biogas to a dedicated point for transmission to some type of gas use device (e.g., engine). • Digesters (e.g., plug flow, complete mix) that compost or "digest" organic waste in the absence of oxygen, thereby generating methane for collection and use. For more information from the Agriculture Subcommittee: www.globalmethane.org/agriculture	 Floating Dome Anaerobic Digester (India)

*estimated 2010 emissions

Initiative's technical subcommittees or task forces, as well as examples of mitigation technologies from Partner countries.[2]

Emission Reduction Potential by Sector

Methane emissions can be relatively inexpensive to reduce compared with CO_2, and various government agencies and organizations are incorporating non-CO_2 mitigation into analysis and policy discussions. The *Global Mitigation of Non-CO_2 Greenhouse Gas* report conducted an analysis applying currently available mitigation options and technologies to global methane emission baselines in four of the GMI target sectors to provide insight into methane emission reduction potential and costs.[3]

The following sectors were identified because of their tremendous potential for anthropogenic methane emission reductions, particularly for those resulting from cost-effective or low-cost actions:

- **Agriculture:** This sector has an increased reduction potential of nearly 20 percent associated with raising activity costs from \$0 to \$30/$MTCO_2E$. In this sector, activities costing more (\$45 to \$60/$MTCO_2E$) do not generate significant additional reduction benefits (i.e., less than 2 to 4 percent per cost increment).
- **Coal Mines:** More than 65 percent of potential reductions in this sector could be achieved by increasing costs from \$0 to \$15/$MTCO_2E$, above which the potential for reductions remains steady regardless of increased activity cost.
- **Landfills:** This sector has significant emission reduction potential of nearly 30 percent change with a minimal \$15/$MTCO_2E$ investment, but then the potential reduction drops to less than 10 percent per cost increment from \$15 to \$45/$MTCO_2E$. In this sector, however, another 30 percent increase in reduction potential exists for activities costing \$60/$MTCO_2E$, which results in a total overall reduction potential for actions from \$0 to \$60/$MTCO_2E$ reaching 76 percent more than the baseline, representing the greatest total reduction potential of all sectors.
- **Oil and Gas:** Emission reduction potential follows a similar trend as landfills, with its largest reduction potential of approximately 15 percent resulting from both the lower (from \$0 to \$15/$MTCO_2E$) and higher (from \$45 to \$60/$MTCO_2E$) cost ranges, and less than a 10 percent change per cost increment from \$15 to \$30/$MTCO_2E$ and \$30 to \$45/$MTCO_2E$.

Table 1: Global Percentage Reduction from Projected Baseline, 2020

Cost per $MTCO_2E$	\$0	\$15	\$30	\$45	\$60	Baseline ($MMTCO_2E$)
Agriculture	13%	21%	30%	34%	36%	269.3
Coal Mines	15%	80%	80%	80%	80%	449.5
Landfills	12%	41%	50%	57%	88%	816.9
Oil and Gas	10%	25%	33%	38%	54%	1,695.8

Source: *Global Mitigation of Non-CO_2 Greenhouse Gases: 1990 – 2020* (EPA Report 430-R-06-005)

Overall, the potential for methane mitigation at or below \$0/$MTCO_2E$ is approximately 500 $MMTCO_2E$, and the mitigation potential more than triples to 1,800 $MMTCO_2E$ as the price of the action rises from \$0 to \$30/$MTCO_2E$. The analyses also found that the largest methane emitters (e.g., China, India, United States) show significant mitigation potential in the lower range (e.g., \$10/$MTCO_2E$).

Conclusion

There are many cost-effective and economically viable opportunities worldwide to reduce methane emissions. The GMI serves as an innovative mechanism to bring together interested parties from government and the private sector to overcome barriers and facilitate methane project development and implementation around the world. By conducting technology transfer, improving local capacity, and marketing project opportunities across borders and sectors, the Initiative is developing local, clean energy resources while reducing GHG emissions.

For additional information, please visit the GMI website at
www.globalmethane.org
or contact the Administrative Support Group.

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

[3] Complete details on the inputs and methodologies used in this analysis are fully described in the report *Global Mitigation of Non-CO_2 Greenhouse Gases* at www.epa.gov/climatechange/economics/international.html. No formal analysis is presented for wastewater because data are insufficient on wastewater systems' infrastructure and abatement technology costs.