Municipal Solid Waste Sector Action Plan – Revised January 2013

United States Municipal Solid Waste Sector Action Plan for the Global Methane Initiative

1. Country Background and overview of Methane Emissions

The U.S. Environmental Protection Agency (EPA) develops a national greenhouse gas inventory each year to track the national trends in emissions and sinks since 1990. The Inventory of U.S. Greenhouse Gas Emissions and Sinks is submitted to the United Nations in accordance with the Framework Convention on Climate Change. According to the latest inventory, methane emissions from waste activities in the United States are estimated to be 132.5 Tg CO_2E (132.5 $MMTCO_2E$), or just under 2 percent of total U.S. greenhouse gas emissions. Landfills accounted for approximately 107.8 Tg CO_2E (107.8 $MMTCO_2E$) or 16 percent of total U.S. anthropogenic methane emissions, the third largest contribution of any CH_4 source in the United States. Additionally, composting of organic waste accounted for approximately 1.6 Tg CO_2E (1.6 $MMTCO_2e$) and waste incineration accounted for 0.05 Tg CO_2E (0.05 $MMTCO_2e$), respectively, of total U.S. anthropogenic methane emissions in 2010. Chart 1 reflects that 93.5 Tg CO_2e (93.5 $MMTCO_2e$) was emitted from MSW landfills in 2010, as well as the emitted amounts from composting and waste incineration. Chart 2 represents that of the landfill gas recovered from MSW landfills in 2010, 79.8 Tg CO_2e (79.8 $MMTCO_2e$) was used as an energy resource while 80.3 Tg CO_2e (80.3 $MMTCO_2e$) was flared.

Through EPA's Greenhouse Gas Reporting Program, facilities that emit 25,000 metric tons or more per year of GHGs are required to annually report their GHG emissions to EPA. The facilities are known as direct emitters. The data reported by direct emitters provides a "bottom-up" accounting of the major sources of GHG emissions associated with stationary fuel combustion and industrial processes. Well over half of total U.S. greenhouse gas emissions are accounted for in this facility level data set, including nearly complete coverage of major emitting sectors such as power plants and refineries. Municipal solid waste landfills are one of 41 industrial categories to report under the greenhouse gas reporting program representing 85-90 percent of 85-90 percent of the total U.S. GHG emissions from approximately 13,000 facilities

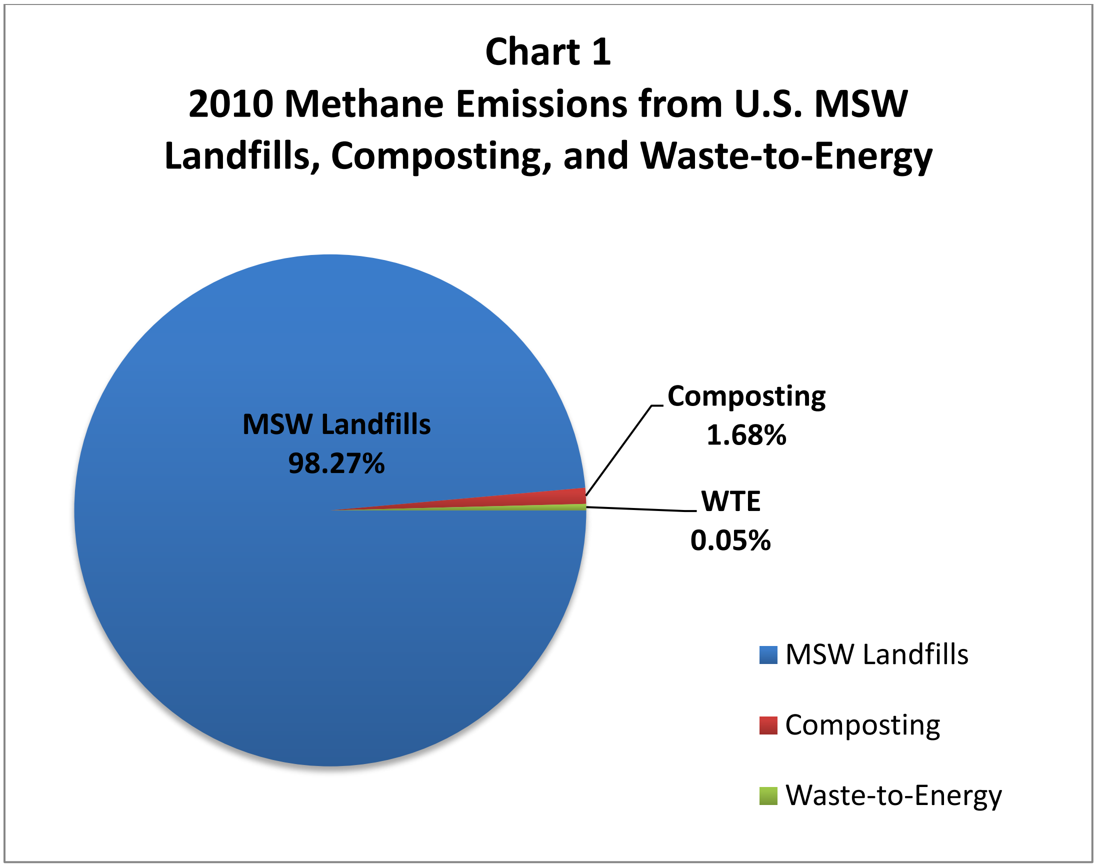


Chart 1
2010 Methane Emissions from U.S. MSW Landfills, Composting, and Waste-to-Energy
MSW Landfills 98.27%
Composting 1.68%
WTE 0.05%
MSW Landfills
Composting
Waste-to-Energy

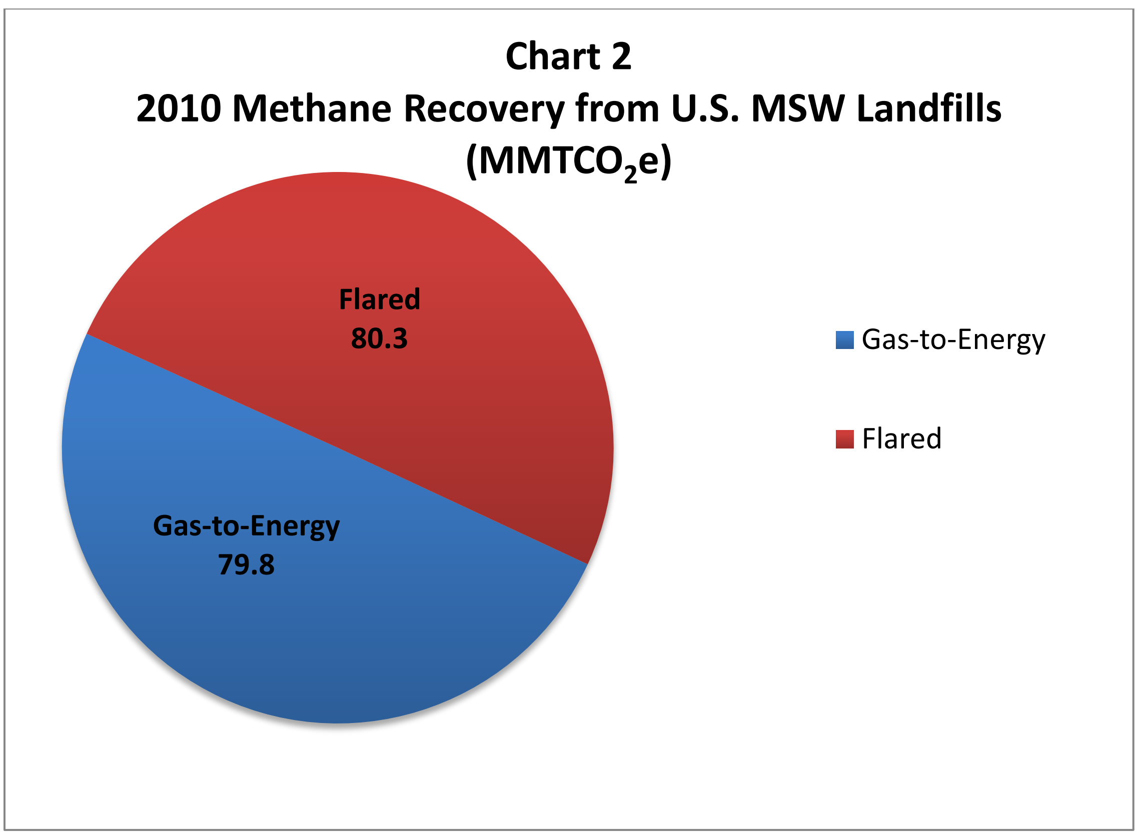


Chart 2
2010 Methane Recovery from U.S. MSW Landfills ($MMTCO_2e$)
Flared 80.3
Gas-to-Energy 79.8
Gas-to-Energy
Flared

Methane from the Solid Waste Sector – Options for Landfill Gas Capture and Utilization, Methane Abatement & Mitigation

Elements of an integrated solid waste management plan include: source reduction, recycling, composting, waste-to-energy (WTE), and landfills. Additionally, energy recovery from waste through combustion (WTE), LFGE, and the use of anaerobic digester biogas are demonstrated strategies for communities to recover value from the solid waste generated in their jurisdiction[1].

According to the U.S. EPA report titled, *Municipal Solid Waste Generation, Recycling and Disposal in the United States: Facts and Figures for 2009* (U.S. EPA 2010b), Americans generated 243 million tons of MSW. Of the waste generated, 132 million tons (54.3 percent) were disposed of in MSW landfills. The remainder of the MSW stream was either recovered for recycling or composting (33.8 percent) or combusted in WTE facilities (11.9 percent).

Managing solid waste in the U.S. is a complex issue and requires a mix of technologies and processes that are highly dependent on a community's local conditions and economics. There is no one process or technology that is capable of managing all the MSW generated in the U.S., rather a variety of methods for managing solid waste are often used in a community in order to successfully manage the waste stream. Not only is this important from a cost perspective, but also because utilizing different methods will help maximize the reduction of GHG emissions. These different strategies for solid waste management are not in competition with each other. Rather, they are complementary because they help a community manage its solid waste while meeting several critical obligations:

- Cost effective management of its waste;
- Minimization of environmental impacts;
- Maximization of material recovery;
- Maximization of energy benefit.

Energy from waste can be gained indirectly through energy conservation from recycling and directly from energy recovery through WTE, LFGE, and anaerobic digestion. Local governments are under extreme scrutiny to minimize costs associated with public service, and whether they operate their own landfill or contract waste disposal to a private company, the cost of disposal is always a significant consideration. For example, according to the National Solid Wastes Management Association's *2005 Tip Fee Survey* (Repa 2005), the average cost per ton of MSW being routed to a landfill in 2004 was $34.29, whereas the average cost per ton of MSW being routed to a WTE facility was $61.64. Such a cost difference would most certainly be an issue from a local government perspective. Similarly, the costs associated with recycling and composting strategies are also considered as a local community determines its method for waste management.

[1] from 34th LFG Symposium Proceedings: Frankiewicz and Dieleman. 2011. "Landfill Gas Energy – An Important Component of Integrated Solid Waste Management". SWANA 34th Annual Landfill Gas Symposium

LFGE is a small but important component of an integrated approach to solid waste management given that the use of landfills continues to remain the predominant method of waste disposal. The U.S. EPA waste hierarchy treats landfills and incineration equally, as environmentally acceptable disposal options for MSW. However, source reduction, recycling, and composting are the more environmentally preferred waste management options. When these preferred methods of waste management are not employed and the use of landfills is the available option, energy recovery improves the GHG profile and makes use of the energy generated when the organic fraction of MSW decomposes. Where landfills exist, the utilization of methane generated by the decomposing waste already in place to generate energy is the best-case option to reduce GHG emissions and provide an alternative to fossil fuel-based power generation.

2. Characterization of Public and Private Sector Involvement

Key stakeholders for both solid waste management as well as innovation in methane abatement capture and utilization include the public and private sector. While Federal agencies may set standards for solid waste handling and treatment as well as some tax incentives and other financial mechanisms, implementation falls largely on municipal and local government. In the U.S., the private sector plays a significant role in waste handling and therefore also in much of the innovation behind methane abatement, capture and utilization. Some of the key stakeholder groups include the following:

Federal Government

The EPA is largely responsible for solid waste and air emissions programs. These offices and programs address promulgation of rules and regulations, research, and enforcement and compliance aspects related to the municipal solid waste management sectors. The EPA also has a number of voluntary programs established to work with state and local government, the public and private sectors to encourage methane capture, utilization, mitigation and abatement.

In the waste sector, EPA has developed a number of initiatives to educate the public and businesses and work to create a marketplace for the waste stream, including the Federal Green Challenge, the Food Recovery Challenge, the Electronics Challenges, and WasteWise. More information about these initiatives may be found at: http://www.epa.gov/osw/conserve/index.htm

EPA's Landfill Methane Outreach Program (LMOP) is a voluntary partnership aimed at addressing methane emissions from landfills. Established in 1994, LMOP promotes the use of LFG as a renewable energy source. By preventing emissions of methane - a powerful greenhouse gas - through the development of LFG energy projects, LMOP helps businesses, states, and communities protect the environment and build a sustainable future. LMOP works with landfill owners/operators, industry organizations, energy providers and marketers, state agencies, communities, end-users, and other stakeholders to help them overcome barriers to LFG energy development. Background information as well as a database of operational and candidate sites may be found at: **http://www.epa.gov/lmop/projects-candidates/index.html**.

- From 1994 through December 31, 2011, LMOP has assisted in the development of more than 535 LFG energy projects.
- As of December 31, 2011, LFG energy projects with LMOP involvement have cumulatively prevented more than 197.8 (232.5 when including flaring-only) million metric tons of carbon dioxide equivalent from direct and avoided emission reductions into the atmosphere.
- LMOP has 1,020 Partners that have signed voluntary agreements to work with EPA to develop or otherwise support cost-effective LFG energy projects.

State and Local Governments

State governments are tasked with developing policies and programs to safeguard their constituents and the environment, including reducing greenhouse gas emissions, improving air quality from municipal solid waste management. State and local governments often lead by example by implementing programs within their own buildings and operations that reduce greenhouse gas emissions and save energy and money. States and local governments have specific regulatory authority in numerous areas critical for waste management and mitigating greenhouse gases, including:

- **Utility regulation**
- Building codes development and enforcement
- Appliance efficiency standards
- Land use, zoning, and siting decisions
- Transportation policy

Local governments also play a big role in resource conservation by setting policies, establishing programs, providing education and outreach to the communities, and by leading by example. Examples include:

- **Source reduction initiatives.** For example, in some cities, there are centralized locations for residents to drop off extra paint and household products, which other residents can then pick up for free.
- **Promote programs that provide financial incentives for waste reduction,** such as refund programs for recyclables and volume-based fee programs like EPA's **Pay-As-You-Throw** (PAYT).
- **Support the collection and analysis of data on waste, resource conservation practices, landfills, and landfill methane emissions.** High-quality data tracking allows for identification of which strategies work best, how changes in waste management are affecting GHG emissions, and where improvements can be made. These data can also be used in GHG inventory development and life-cycle accounting (see box).

Rules and regulations, permits, renewable incentive programs, and policies for LFG projects and gas collection systems vary greatly from state to state and jurisdiction to jurisdiction. State regulations must usually be as stringent as applicable Federal regulations.

Non-Governmental Organizations (NGOs)

The primary NGOs representing the solid waste industry are the Solid Waste Association of North America (SWANA) and the National Solid Waste Management Association (NSWMA). Both of these organizations represent public and private sector solid waste professionals and whose goals is to provide their members with educational and training opportunities, research, dissemination of information about solid waste management, and advocacy capability.

The U.S. Composting Council (USCC) is a national organization dedicated to the development, expansion and promotion of the composting industry. The USCC encourages, supports and performs compost related research, promotes best management practices, establishes standards, educates professionals and the public about the benefits of composting and compost utilization, and develops training materials for composters and markets for compost products. USCC members include compost producers, marketers, equipment manufacturers, product suppliers, academic institutions, public agencies, nonprofit groups and consulting/engineering firms.

The Energy Recovery Council (ERC) is a national trade organization representing the waste-to-energy industry and communities that own waste-to-energy facilities. ERC members include 3 major waste-to-energy companies, 28 municipalities that are served by waste-to-energy plants, and other associate members that work in the municipal waste management and energy fields. Current ERC members own and operate 69 of the 86 modern waste-to-energy facilities that operate in the United States.

The mission of the Waste-to-Energy Research and Technology Council (WTERT) is to identify and advance the best available waste-to-energy (WTE) technologies for the recovery of energy or fuels from municipal solid wastes and other industrial, agricultural, and forestry residues. WTERT brings together engineers, scientists and managers from universities and industry to conduct academic research and disseminate data on the economic and environmental performance of WTE technologies in the U.S. and worldwide.

The American Biogas Council promotes anaerobic digestion and the biogas industry by educating policymakers, industry leaders, the media, and the general public about the economic and environmental benefits of biogas.

Public and Private Landfill Owners

Proper waste disposal is largely a municipal responsibility, though the waste handling facilities are a combination of publicly and privately owned or operated. Landfills in the U.S. are owned by a combination of public (e.g., municipalities, counties, state environmental authorities), and private entities. Given municipal responsibilities, they have taken a lead role in advancing waste diversion and composting programs. For example, the city of XX

As of March 2012, 50% of landfills with operational LFG energy project(s) are publicly owned and the remaining landfills with LFG energy projects are privately owned. LFG projects are typically developed in two ways: 1. Landfill owners self-develop and operate the LFG project with landfill personnel or contractors or both (i.e., landfill owner directly hires individual consultants and contractors to fulfill each role that the landfill personnel cannot perform themselves); or 2. An outside project developer finances, constructs, owns, and operates the LFG project.

Utilities and Electric Cooperatives

Power providers may be able to use LFG to generate electricity and meet the requirements or goals of their renewable energy portfolios. As of March 19, 2012, 37 out of the 50 U.S. states plus the District of Columbia and Puerto Rico have enacted an RPS or a renewable portfolio goal (RPG). See Section 6 of this document for more information on green power in the United States.

Private Sector Landfill Gas Industry

The private sectors role in MSW management and LFG recovery is focused primarily on providing technical and financial assistance, consulting services, and equipment to help government or companies to manage MSW or develop LFG as an energy source. These companies typically include project developers, engineering consulting firms, equipment suppliers, lawyers, project facilitators, and project financiers. These companies are usually contracted by local government or private waste companies to handle various aspects of the project (e.g., design, engineering or construction services, legal and financial advisory services, technologies that collect, manage and treat MSW such as windrow turners and tub grinders for composting or piping, wellheads, flares and engines for LFG recovery.

3. Policy, Market and Legal Drivers to Advance Methane Project Development

The policy, market, and legal drivers of methane projects – whether mitigation such as flaring and energy generation or abatement such as composting and other forms of organic diversion are related to three key market elements: Energy Supply and Demand, Government Policies and the Regulatory Environment, and Financing Mechanisms. This section will focus on the drivers of landfill gas energy projects, specifically, as they are related to the sale of an energy commodity. While these may generally apply to generation of electricity from anaerobic digestion, for example, the market for the sale of compost as a commodity has its own economics, incentives, and requirements.

- **Energy Supply and Demand**, a landfill gas energy project can be viable in light of both competing sources of energy, such as other renewable energy sources and fossil fuels, as well as the level of demand for energy produced by the project from possible customers.
- **Government Policies and the Regulatory Environment**, the legal framework from both the energy and environmental perspectives within which the project must operate. In most cases, a government policy or regulation for energy or the environment will represent either a barrier or an incentive for the LFGE project.
- **Financing Mechanisms**, because financing may man be obtained from both the public and private sectors, LFGE financial resources take many forms.

The ability of a LFGE project to generate revenue is a direct result of the LFGE's project economics relative to the economics associated with the production of competing energy sources. In general, barriers to utilizing landfill gas for energy are common. These include, for example, uncertainty about energy and environmental policies, high initial capital costs of project construction, prohibitive electrical grid interconnection policy, and lack of understanding by landfill operators of the opportunities available.

Regulatory Drivers

Regulation of solid waste treatment and handling as well as the emissions from landfills are driven by several major national laws with implementation, compliance, and enforcement authority delegated to states and localities. Additionally, national, state, and local voluntary programs have worked to encourage advancement of markets for areas that are not driven by regulations such as utilization of landfill gas for energy purposes, waste diversion, and composting.

States and localities also enact laws and regulations to manage solid waste including local ordinances (e.g., odor nuisance). State statues must be at equivalent to federal laws and can exceed federal standards. Below are the two primary federal regulations for the management landfill gas emissions - either directly from landfills or by the combustion of landfill gas for energy generation.

Resource Conservation and Recovery Act (RCRA)
Subtitle D RCRA addresses the management and disposal of solid waste. Part 258 of RCRA, Criteria for Municipal Solid Waste Landfills (40 CFR Part 258), specifically describes proper siting, design, operation, management, closure, and post-closure care requirements for sanitary municipal solid waste landfills (MSWLFs). In general, the design criteria require MSWLFs to have liners (e.g., flexible membranes/geomembranes, compacted clay soil) covering the bottom and sides of the landfill) to protect groundwater from leachate migration and a final cover at landfill closure to prevent water infiltration. This design creates an anaerobic environment where the degradation of waste over time generates landfill gas. To prevent explosions from methane build up, MSWLFs are required to have methane detection, monitoring or recovery systems. The criteria also allow MSWLFs with composite liners to recirculate collected leachate and gas condensate back into the landfill to accelerate waste degradation and subsequent increase in landfill gas generation.

Clean Air Act (CAA)CAA New Source Performance Standards (NSPS) and Emission Guidelines (EG) for MSW Landfills (final rule published 3/12/96) requires landfills that are greater than or equal to 2.5 million Mg and 2.5 million cubic meters in design capacity and have estimated emissions of non-methane organic compounds (NMOCs) of at least 50 Mg per year must reduce their emissions of LFG. For landfills that commenced construction, reconstruction, or modification on or after May 30, 1991, the NSPS apply. For older landfills that received waste after November 8, 1987, the EG apply. For the final rule and other information: **http://www.epa.gov/ttn/atw/landfill/landflpg.html**

Funding Incentives

While LFG recovery offers significant environmental, energy, and economic benefits to the public and private sector, there are still barriers to project development. To help overcome these barriers, Federal and state governments have a number of programs and strategies to create financial incentives for landfill gas energy projects including loans, grants, renewable portfolio standards, renewable energy trust funds, and property, sales, and use tax exemptions.

- **Grants.** Grants provide direct financial support and are usually awarded by government and nonprofit agencies.
- **Loans.** Loans are arrangements in which a lender (e.g., a government agency or a nonprofit organization) provides money to a borrower (e.g., an LFG energy project developer), and the borrower agrees to repay the money, along with interest, at some future date.
- **Tax credits and exemptions**, which reduce the tax liability of eligible parties.
- **Production incentives**, which are financial payments, usually on a cents-per-kilowatt-hour (kWh) basis, for electricity generated by qualifying LFG energy facilities.

Funding incentives specifically for landfill gas energy are tracked by the Landfill Methane Outreach Program. For more information about LFG incentives, visit **http://www.epa.gov/lmop/publications-tools/funding-guide/index.html**

Examples of state and Federal incentives for the promotion of landfill gas and municipal solid waste energy conversion include:

Sample State Incentives

Currently, 26 states, the District of Columbia, and two U.S territories (Puerto Rico, Northern Mariana Islands) define waste-to-energy as a “renewable” source of energy. In states with mandates that power suppliers purchase a certain percentage of their energy from renewable sources, defining waste-to-energy as renewable significantly increases the value of the electricity generated by these facilities.

California’s Renewable Portfolio Standard (RPS), established in 2002 and expanded in 2011, requires investor-owned utilities, electric service providers, and community choice aggregators to increase procurement from eligible renewable energy resources to 33 percent of total procurement by 2020, creating markets for certain eligible waste conversion technologies.
http://www.cpuc.ca.gov/PUC/energy/Renewables/index.htm

The Oregon Department of Energy provides grants for feasibility studies for renewable energy, heat, and fuel projects under the Community Renewable Energy Feasibility Fund (CREFF). Smaller scale heat and fuel generation projects are eligible, and generally electric generation projects sized 25 kilowatts (kW) to 10 megawatts (MW) will be considered. Landfill gas and anaerobic digestion projects are eligible for these grants. The maximum incentive is $50,000.
http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=OR140F&re=1&ee=1

The Pennsylvania Department of Community and Economic Development (DCED) Alternative and Clean Energy Program provides support for a variety of renewable energy and energy efficiency technologies through loans, grants, and loan guarantees (i.e., grants to be used in the event of a financing default) for alternative energy and clean energy production projects including landfill gas, municipal solid waste, waste-to-energy, and anaerobic digestion.
http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=PA45F&re=1&ee=0

The Massachusetts Clean Energy Center (MassCEC) offers a Commonwealth Organics-to-Energy grant program. Organics-to-Energy grants support the use of anaerobic digestion and other technologies that convert source-separated organic wastes into electricity and thermal energy. Grants up to $60,000 may be requested. A 5% cost share is required and grants are administered on a cost-reimbursement basis. http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=MA124F&re=1&ee=0

Sample Federal Incentives

Clean Renewable Energy Bonds (CREBS) may be used by certain entities—primarily in the public sector—to finance renewable energy projects, which include landfill gas and municipal solid waste. The Energy Improvement and Extension Act of 2008 (Div. A, Sec. 107) allocated $800 million for new Clean Renewable Energy Bonds (CREBs). In February 2009, the American Recovery and Reinvestment Act of 2009 (Div. B, Sec. 1111) allocated an additional $1.6 billion for New CREBs, for a total New CREB allocation of $2.4 billion. CREBs may be issued by electric cooperatives, government entities (states, cities, counties, territories, Indian tribal governments or any political subdivision thereof), and by certain lenders. CREBs are issued with a 0% interest rate. The borrower pays back only the principal of the bond, and the bondholder receives federal tax credits in lieu of the traditional bond interest. http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US45F&RE=1&EE=1

U.S. Department of Treasury - Renewable Energy Grants, created by the American Recovery and Reinvestment Act of 2009 (H.R. 1), allows facilities that qualify for the renewable electricity production tax credit (PTC) to receive a grant from the U.S. Treasury Department instead of taking the PTC for new installations. Both landfill gas and municipal solid waste operations are eligible for this grant. http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US53F&re=1&ee=0

4. Challenges to Mitigation or Abatement of Methane Emissions

The most significant barriers to implementation of methane capture and utilization (landfill gas energy), abatement and mitigation are technical, informational, and economical. The incentives and activities discussed in the next section are largely aimed at overcoming these barriers. The first decision of solid waste treatment, however, is largely driven by financial considerations. Below is a cost comparison for different treatment options including landfill gas capture, utilization, abatement and mitigation through waste diversion, waste to energy and composting.

Table 1: Example Break-Even Prices for MSW Landfill Technology Options (continued)

Option by Landfill Type	Reduced Emissions (tCO_2e)	One-Time Capital Costs ($\$/tCO_2e$)	Present Value of Annual Cost ($\$/tCO_2e$)	Present Value of After-Tax Benefits ($\$/tCO_2e$)	Present Value of Tax Benefit of Depreciation ($\$/tCO_2e$)	Break-Even Price ($\$/tCO_2e$)
Engineered Landfill						
Direct use	40,424	$36	$41	$127	$5	–$12

Combined heat and power	41,772	$105	$62	$97	$15	$12
Engine	41,772	$73	$59	$70	$11	$11
Microturbine	41,772	$67	$39	$51	$10	$10
Turbine	41,772	$82	$45	$58	$12	$12
Flare	41,772	$16	$28	$0	$4	$9

Note: Based on USA CH_4 generation parameters: L0 = 3,204 and k = 0.04. Assuming model landfill standardized size assumptions from Table 3-5. Present values calculated using a discount rate of 10% and a tax rate of 40%.

Table 2: Break-Even Prices of Waste Diversion Options

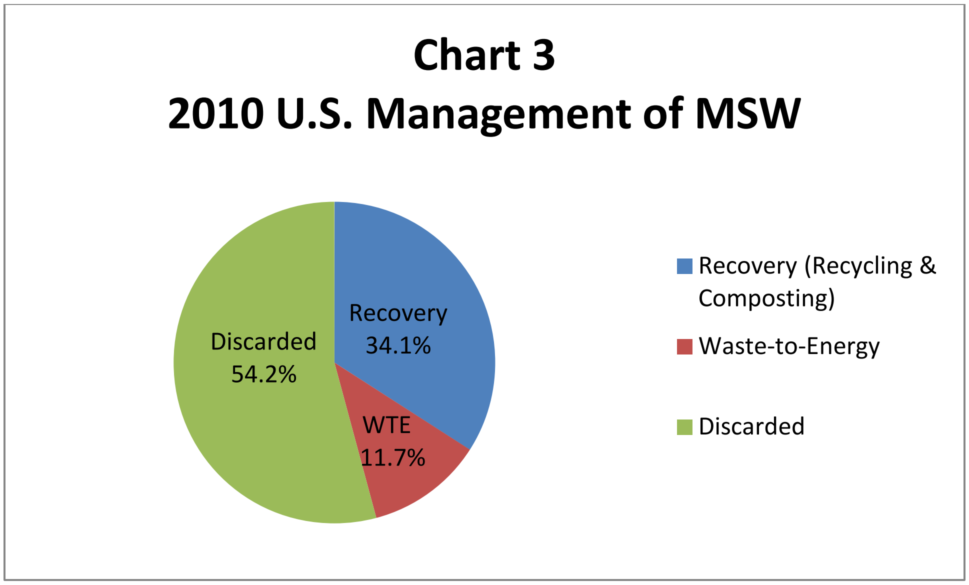
Waste Diversion Options	Reduced Emissions (tCO_2e)	One-Time Capital Costs ($/$tCO_2e$)	Present Value of Annual Cost ($/$tCO_2e$)	Present Value of After-Tax Benefits ($/$tCO_2e$)	Present Value of Tax Benefit of Depreciation ($/$tCO_2e$)	Break-Even Price ($/$tCO_2e$)
Composting	35,787	$50	$148	$124	$10	$14
Anaerobic digestion	24,850	$679	$587	$299	$116	$167
Mechanical biological treatment	51,033	$303	$307	$444	$52	$23
Paper recycling	63,513	$549	$1,196	$562	$94	$213
Waste to energy	153,099	$1,083	$445	$373	$184	$190
Enhanced oxidation systems	10,483	$515	$7	$0	$41	$212

Note: Assuming model sizes as described in Section 3.3. Present values calculated using a discount rate of 10% and a tax rate of 40%.

Summary of the Solid Waste Management Sector

In 2010, U.S. residents, businesses, and institutions produced more than 250 million tons of municipal solid waste (MSW), which is approximately 4.43 pounds of waste per person per day. Currently, in the U.S., 34.1 percent of municipal solid waste is recovered and recycled or composted, 11.7 percent is burned at combustion facilities, and the remaining 54.2 percent is disposed of in landfills.

Although source reduction, reuse, recycling, and composting can divert large portions of MSW from disposal, some waste still must be placed in landfills. Modern landfills are well-engineered facilities that are located, designed, operated, monitored, closed, cared for after closure, cleaned up when necessary, and financed to insure compliance with federal regulations. The federal regulations were established to protect human health and the environment. In addition, these new landfills can collect potentially harmful landfill gas emissions and convert the gas into energy.



Source: **http://www.epa.gov/osw/nonhaz/municipal/**

Waste to Energy (WTE)
In 2010, 86 WTE plants operate in 24 states and combusted approximately 30 million tons of MSW for energy recovery (about 12 percent of the total 250 million tons of trash generated), equivalent to 0.52 pounds per person per day.
(**www.epa.gov/osw/nonhaz/municipal/pubs/msw_2010_rev_factsheet.pdf**)
These 86 plants have a total estimated waste combustion capacity to process more than 97,000 tons of MSW per day. (**www.energyrecoverycouncil.org/userfiles/file/ERC_2010_Directory.pdf**)

The following are a list of federal statutes and policies defining waste-to-energy as renewable energy, as of October 1, 2010:

- Energy Policy Act of 2005
- Federal Power Act
- Public Utility Regulatory Policy Act (PURPA) of 1978
- Biomass Research and Development Act of 2000
- Pacific Northwest Power Planning and Conservation Act
- Internal Revenue Code (Section 45)
- Executive Orders 13123 and 13423
- Federal Energy Regulatory Commissions Regulations (18 CFR.Ch. I, 4/96 Edition, Sec. 292.204)

In addition, 25 states, the District of Columbia, and Puerto Rico also have defined waste-to energy as renewable energy in various state statutes and regulations, including renewable portfolio standards.
http://www.energyrecoverycouncil.org/userfiles/file/ERC_2010_Directory.pdf

Composting

Yard trimmings and food residuals together constitute 27 percent of the US municipal solid waste stream. In 2010, composting recovered approximately 20.2 million tons of waste in the United States—equivalent to 0.36 pounds per person per day. Of this amount, 19 million tons were yard trimmings. An estimated 57.5 percent of yard trimmings were recovered for composting or grasscycled in 2010, a dramatic increase from the 12 percent recovery rate in 1990. Accompanying this surge in yard waste recovery is a composting industry that has grown from less than 1,000 facilities in 1988 to over 2280 in 2010 (October 2010 Biocycle State of Garbage report). Once dominated by public sector operations, the composting industry is increasingly entrepreneurial and private-sector driven, led by firms that add value to compost products through processing and marketing. Bulk retail yard waste compost sells for between $15.00 and $32.00 per cubic yard in the United States (August 2011 Compost News). (**http://www.epa.gov/osw/conserve/rrr/composting/index.htm**, **www.epa.gov/osw/nonhaz/municipal/pubs/msw_2010_rev_factsheet.pdf**).

Gasification

Currently there are no commercially-operating MSW gasification plants in the United States. There are as many as twenty gasification facilities that process pre-dried food waste and other select materials recovered from the MSW stream, but no facilities that manage mixed MSW. Seven recent waste conversion technology (WTC) procurements (since 2006), however, have approved gasification technologies for implementation or further consideration (City of Los Angeles, California; New York City, New York; Los Angeles County, California; Collier County, Florida; Salinas Valley Solid Waste Authority, California; Santa Barbara County, California; and St. Lucie County, Florida).

In addition, another eight commercial and demonstration gasification facilities are planned and in the contract negotiation to construction phases. These include:

- Ada, Idaho (commercial) — contracts signed
- Clark, Idaho (commercial)— contracts signed
- Schneider, Indiana (commercial) — permitting
- Vero Beach, Florida (demonstration) —construction
- Taunton, Massachusetts (commercial) —contract negotiations
- Pontotoc, Mississippi (commercial) —permitting
- Storey, Nevada (commercial) —construction
- Montgomery, New York (demonstration) — construction

Plasma Gasification

At this time there are no commercially operating plasma arc gasification facilities processing MSW in the United States. Since 2006, there have been four WTC procurements in the United States that have approved plasma arc technologies for implementation or further consideration in the management of MSW. These include:

- A 680-TPD plasma gasification facility under construction in St. Lucie County, Florida for which the air permit has been approved.
- A proposed 100,000 TPY facility in Honolulu, Hawaii.

- A Salinas Valley Solid Waste Authority facility in Salinas, California approved for review.
- Santa Barbara County, California where proposals will be further considered.

The S4 Energy Solutions, at Columbia Ridge Landfill in Arlington, Oregon, is on schedule to be the first operational commercial plant in the United States to use plasma gasification to convert municipal household garbage into gas products. Once it's running at full capacity, it will process 25 tons of waste a day. S4 is in the process of building a second plasma gasification plant in McCarran, Nevada. Two other planned plasma arc gasification operations include a Milwaukee, Wisconsin, facility for which a deal has been signed, and a Marion, Iowa facility for which a contractor has been selected and construction expected to begin in the near future. (SWANA Applied Research Foundation. *Waste Conversion Technologies*. December 2011.)

Anaerobic Digestion

While anaerobic digestion (AD) is commonly used to treat homogenous organic waste streams (e.g., biosolids, food processing wastes), there are no commercial operations utilizing AD to manage non-separated municipal solid waste in the United States at this time. There have been several demonstration and pilot projects that studied AD processing of MSW. These studies lead to the conclusion that AD processes are not readily applicable to the MSW stream in the United States due to the necessity of extensive preprocessing to remove inorganic materials. Post-processing removal of contaminants is usually required as well, and further adds to the cost. (**http://www.co.ramsey.mn.us/nr/rdonlyres/c9000bb9-1c1a-43f5-8e1d-80a0a7e6af35/11778/research_study_gasification_plasma_ethanol_anaerob.pdf**)

Currently, there at least two demonstration projects are in the works to further test this technology. The first, in Los Angeles County, California which will treat material recovery facility (MRF) residuals, has a signed MOU in place and is currently pursuing funding. The second, in Columbia, South Carolina which will manage food and grease, produce, and yard wastes is still in the planning stages.

Pyrolysis

Currently, there are no commercially-operating MSW pyrolysis facilities in the United States. During the late 1970s and early 1980s, several full-scale demonstration facilities were constructed in the United States, but none proved commercially viable and all shutdown operations. More recently, a 50 TPD pyrolysis demonstration facility in Romoland, California processed residuals from a MRF from 2004 to 2010, when it was dismantled and moved to another commercial site.

Since 2004, four WCT procurements have approved pyrolysis technologies for implementation or further consideration in the management of MSW. These include the City of Los Angeles, California; New York City, New York; Los Angeles County, California; and Santa Barbara County, California.

Bioreactor Landfills

U.S. EPA is conducting and sponsoring research and demonstration projects on bioreactor landfills. Bioreactor landfills are MSW landfills where addition of other liquids, in addition to recirculated leachate and gas condensate from the landfill, are added to the waste to increase the average moisture content of the waste (to at least 40 percent by weight) to accelerate or enhance the anaerobic biodegradation of the waste. This increases the rate of methane production and longer term waste stabilization.

5. Country Priorities

Through its participation in the Global Methane Initiative, U.S. EPA LMOP staff provides a variety of technical assistance and training. Efforts are focused on overcoming three key barriers:

- **Technical** : basic landfill management and LFG system O&M that must be overcome in most developing countries
- **Institutional:** Lack of (but increasing) awareness of all LFG uses; short-term nature of municipal governments/political motivations; and limited or no renewable energy incentives in many countries.
- **Financial:** Collaboration with financial institutions/banks/investors still a challenge; current financial and carbon market uncertainty – position projects to be ready to receive financing on market turnaround. Lack of tipping fees means less capital for project development.

Assistance is prioritized based on level of methane emissions, potential for reductions and level of engagement by partner countries. The highest level of engagement may include Hands-on Technical Assistance, Institutional Capacity Building, Workshops, customized Training and Outreach. On an ongoing basis, EPA staff has worked with the GMI Landfill Subcommittee to develop tools and resources that may be used by all Partner countries and other solid waste professionals.

6. Activities to Promote Methane Mitigation and Abatement

U.S. EPA regularly provides tailored assistance to Partner countries in coordination with Landfill Subcommittee delegates. Additionally, EPA continues to develop a number of tools and resources that may be used by Partner countries to advance proper landfill gas mitigation, abatement, and utilization. In addition to country specific activities, EPA is planning to develop these sector-wide tools and resources for GMI partners:

- International Best Practices Guide: this guide is a collection of best practices for landfill gas collection and utilization from broad range of countries and intended to provide a tool for Partner countries to develop a comprehensive approach to landfill gas management.
- ISWA Collaboration: building on a recent memorandum of understanding, EPA continues to cooperate with ISWA to provide training and capacity building to participating solid waste professionals
- Regional Models: EPA has developed numerous country-specific landfill gas generation models to estimate landfill emissions and project potential. The next year, EPA will use this platform to begin developing a regional model that incorporates data from partner countries in Eastern and Central Europe that may be used throughout the region.

- Direct Use Resource Packet: based on the success of U.S. companies in utilizing landfill gas directly for thermal needs (industrial boilers, process heating, etc.,.) EPA is developing a resource packet of case studies, technical consideration, and outreach materials that may be used by the private sector in Partner countries.
- International Landfill Database: EPA continues to build and support a database of landfill and landfill gas energy project information from Partner countries. While only partially complete (and an ongoing effort), it is the only central database of operational landfill gas energy project and potential project information.

7. Additional Information - Emission Sources, Mitigation Potential and Successful or Potential Projects

U.S. EPA and Landfill Methane Outreach Program staff has developed numerous resources to support landfill gas energy project development. Additionally, the program tracks projects data, incentives, and resources developed by other state and municipal programs. Below is a collection of program and project data as well as other tools and resources.

State Policies and Incentives

State Resources guide contains state-specific information regarding permits and policies that may affect LFG energy projects: **http://www.epa.gov/lmop/publications-tools/state-resources.html**

DSIRE is a comprehensive source of information on state, local, utility and federal incentives and policies that promote renewable energy and energy efficiency: **http://www.dsireusa.org**

Federal Programs, Incentives and Regulations

U.S. EPA Program

LMOP's LFG Energy Project Development Handbook provides LFG energy project development guidance, with individual chapters about the basics of LFG energy, gas modeling, technology options, economic analysis and financing, contract and permitting considerations, and selection of project partners. The intended audience for this handbook is landfill owners, energy service providers, corporate energy end users, state agencies, local governments, and communities: **http://www.epa.gov/lmop/publications-tools/handbook.html**

LMOP online project profiles of successful LFG energy projects: **http://www.epa.gov/lmop/projects-candidates/profiles.html**

LMOP Quick Reference Sheet: Regulations and Proposals Affecting Landfills and LFG Energy Projects: **http://www.epa.gov/lmop/documents/pdfs/LMOPQuickReference.pdf**

EPA State and Local Climate and Energy Program's Landfill Gas Energy: A Guide to Developing and Implementing Greenhouse Gas Reduction Programs: **http://epa.gov/statelocalclimate/documents/pdf/landfill_methane_utilization.pdf**

Current Inventory of U.S. Greenhouse Gas Emissions and Sinks and archive of previous years' inventories: **http://www.epa.gov/climatechange/emissions/usinventoryreport.html** . The Waste chapter discusses methane and other emissions from landfills and composting, while the Energy chapter includes information about waste incineration.

EPA's Methane website: **http://www.epa.gov/methane/index.html**

Federal regulations

The RCRA Subtitle D regulations, found at 40 CFR Part 258, established the design, operation, and closure requirements for municipal solid waste landfills. These criteria create an ideal situation for the formation and collection of landfill gas (i.e., methane). A 2004 amendment to these requirements allows for permit variances that further promote the accelerated generation and a collection of landfill methane. For more the relevant final rules and other information: **http://www.epa.gov/osw/nonhaz/municipal/landfill.htm**

NESHAP for MSW Landfills (final rule published 1/16/03) – Landfills with design capacities of at least 2.5 million Mg and 2.5 million cubic meters and estimated uncontrolled emissions of NMOCs of at least 50 Mg per year are required to collect and treat or control emissions of LFG. Subject landfills that operate part or all of the landfill as a bioreactor must install collection and control systems for the bioreactor earlier than would be required by the NSPS. The NESHAP also require semi-annual compliance reporting, instead of the annual reporting required by the NSPS. For the final rule and other information: **http://www.epa.gov/ttn/atw/landfill/lndfillpg.html**

In 2004, EPA finalized the Research, Development, and Demonstration Permits for Municipal Solid Waste Landfills rule (69 *FR* 13242; March 22, 2004) that allows states to issue research, development, and demonstration permits to MSWLFs that allow landfills with approved alternative liners (i.e., non-composite liners) to recirculate leachate and gas condensate and redirect surface water runoff into the landfill to promote waste degradation and stabilization, and enhance methane production and collection. For the final rules and other MSWLF-related information: **http://www.epa.gov/osw/nonhaz/municipal/landfill.htm**

GHG Reporting Rule (final rule published 10/30/09) – MSW landfills are required to report if annual CH4 generation ≥ 25,000 metric tons CO2e. Subject landfills report CH4 generation, emissions, and associated data. For the final rule, a landfill information sheet, FAQs, an applicability tool, and data reported by subject landfills: **http://www.epa.gov/climatechange/emissions/ghgrulemaking.html**

PSD and Title V GHG Tailoring Rule (final rule published 6/3/10) – Set thresholds for GHG emissions that define when CAA permits under Title V and NSR permit programs would be required. There are two initial phases: Step 1 (January 2011 – June 2011): no sources were subject due solely to emissions of regulated GHGs, rather something else must have triggered the new requirements. For the rule, proposed deferral, guidance document, and other information: **http://www.epa.gov/nsr/ghgpermitting.html**

Major Source Boiler and Process Heater NESHAP (final rule published 3/21/11; stay to delay effective date of rule 5/18/11; reconsideration proposal 12/23/11) – Per the 12/23/11 proposal, LFG-fired units

that operate no more than 876 hours/year, have a design heat input capacity < 10 MMBtu/hr, or fire a gas stream that either meets a minimum CH_4 content or heating value or does not exceed the maximum Hg concentration will be subject to tune-up work practices. The proposal also exempts a unit used as a control device to comply with another MACT standard if ≥ 50% of its heat input is from the gas stream regulated under that standard. Units not meeting the above criteria would be subject to emission limits for PM, HCl, Hg, and CO. For the reconsideration proposal and other information:
http://www.epa.gov/ttn/atw/boiler/boilerpg.html.

Internal Combustion Engines NESHAP (final rules 8/20/10, 3/9/11) and NSPS (final rule 6/28/11) – The NESHAP established emission standards, monitoring, recordkeeping, and reporting requirements for LFG-fired internal combustion engines at major and area sources of HAP. The final Spark Ignition NSPS contains emission standards, monitoring, recordkeeping, and reporting requirements for new spark ignition engines (including LFG-fired). For the final rules and other information:
http://www.epa.gov/ttn/atw/rice/ricepg.html,
http://www.epa.gov/ttn/atw/nsps/sinsps/sinspspg.html.