

Landfill Gas Energy – Good for the Community



U.S. Environmental Protection Agency
Landfill Methane Outreach Program (LMOP)

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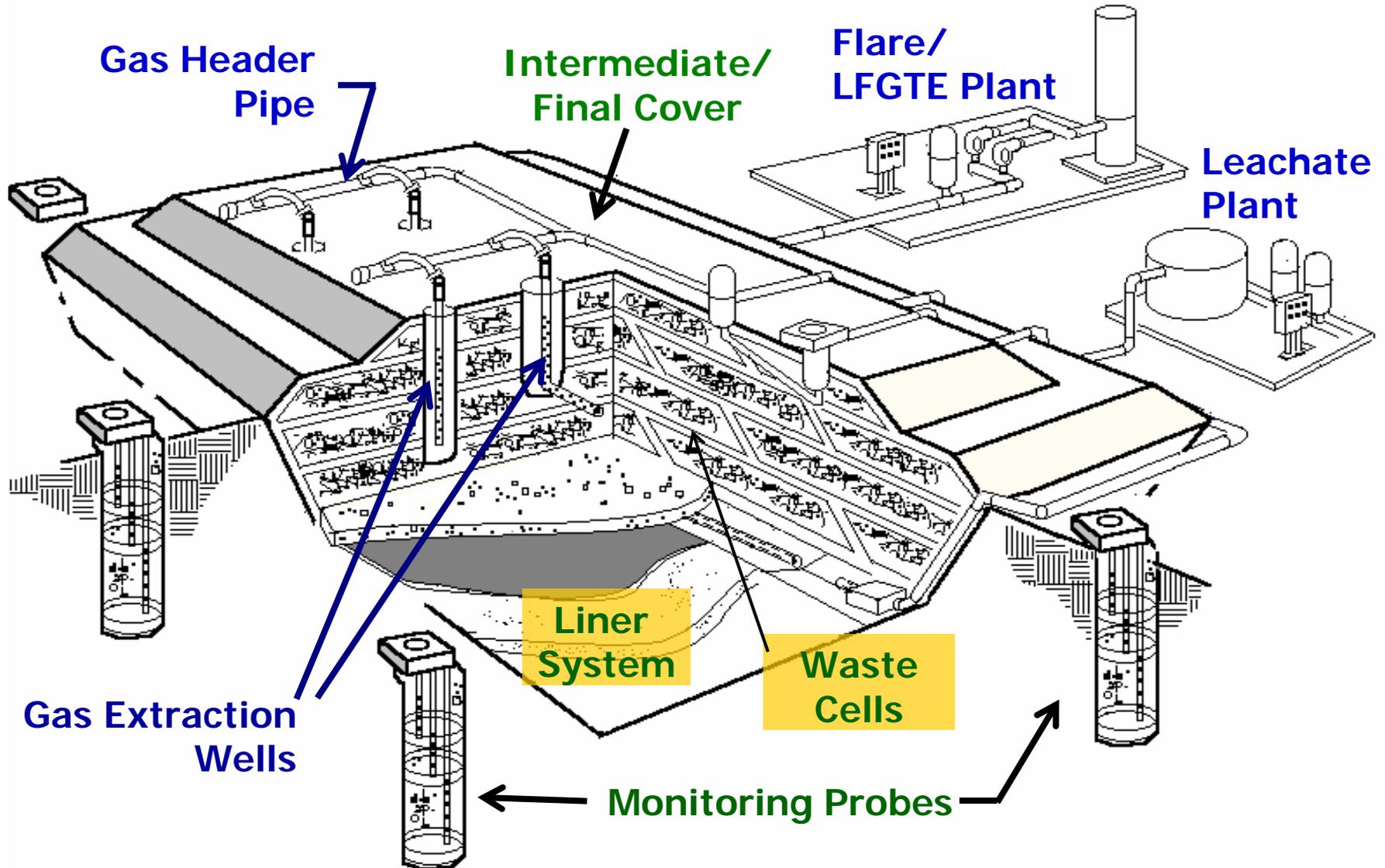
Landfill Gas 101

- Landfill gas (LFG) is a by-product of the decomposition of municipal solid waste (MSW):
 - ~50% methane (CH₄)
 - ~50% carbon dioxide (CO₂)
 - <1% non-methane organic compounds (NMOCs)
- For every 1 million tons of MSW:
 - ~0.8 megawatts (MW) of electricity
 - ~432,000 cubic feet per day of LFG
- If uncontrolled, LFG contributes to smog and global warming, and may cause health and safety concerns

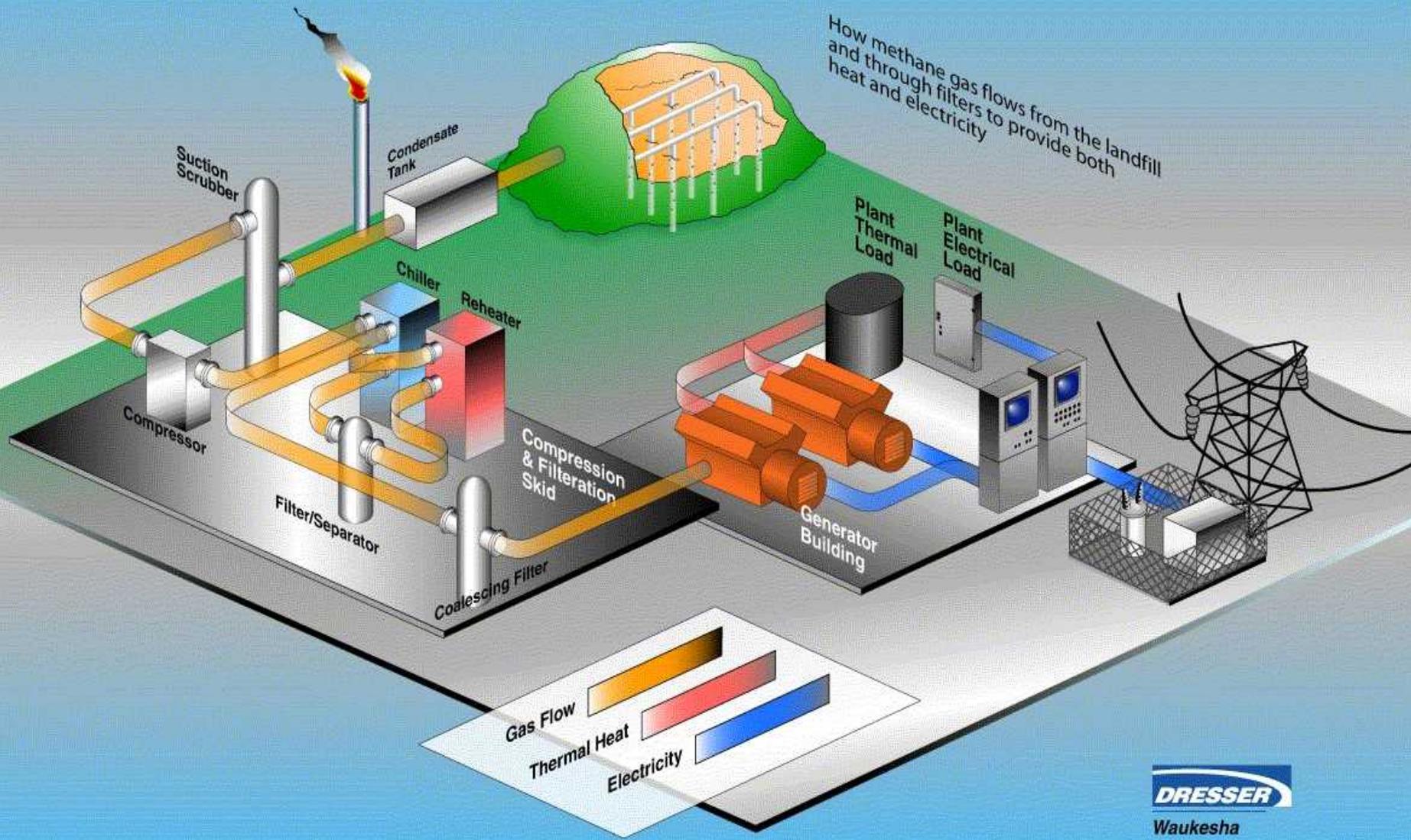
Why Landfill Gas is a Concern

- Methane is a greenhouse gas
 - Methane absorbs terrestrial infrared radiation (heat) that would otherwise escape to space (GHG characteristic)
- Methane as GHG is over 20x more potent by weight than CO₂
- Methane is more abundant in the atmosphere now than anytime in the past 400,000 years and 150% higher than in the year 1750
- Landfills were the second largest human-made source of methane in the United States in 2006, accounting for 22.6% generated

Modern Sanitary Landfill



Landfill Gas to Energy



Benefits of Landfill Gas Energy Projects

- Demonstrate environmental leadership
- Generate additional revenue
- Reduce emissions of GHGs
- Improve air quality
- Reduce environmental compliance costs
- Add economic value – create jobs
- Conserve land



Diversity of Project Types

Electricity Generation



**Reciprocating Internal
Combustion Engine**



Gas Turbine



Microturbine



Diversity of Project Types

Direct Use of LFG

- Direct-use projects are growing!
 - Boiler applications – replace natural gas, coal, fuel oil
 - Combined heat & power (CHP)
 - Direct thermal (dryers, kilns)
 - Natural gas pipeline injection
 - Medium & high Btu
 - Greenhouse
 - Leachate evaporation
 - Vehicle fuel (LNG, CNG)
 - Artist studio
 - Hydroponics
 - Aquaculture (fish farming)



Honeywell

NUCOR

HILL
AIR FORCE BASE, Utah
OGDEN AIR LOGISTICS CENTER



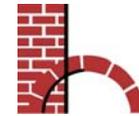
CYTEC



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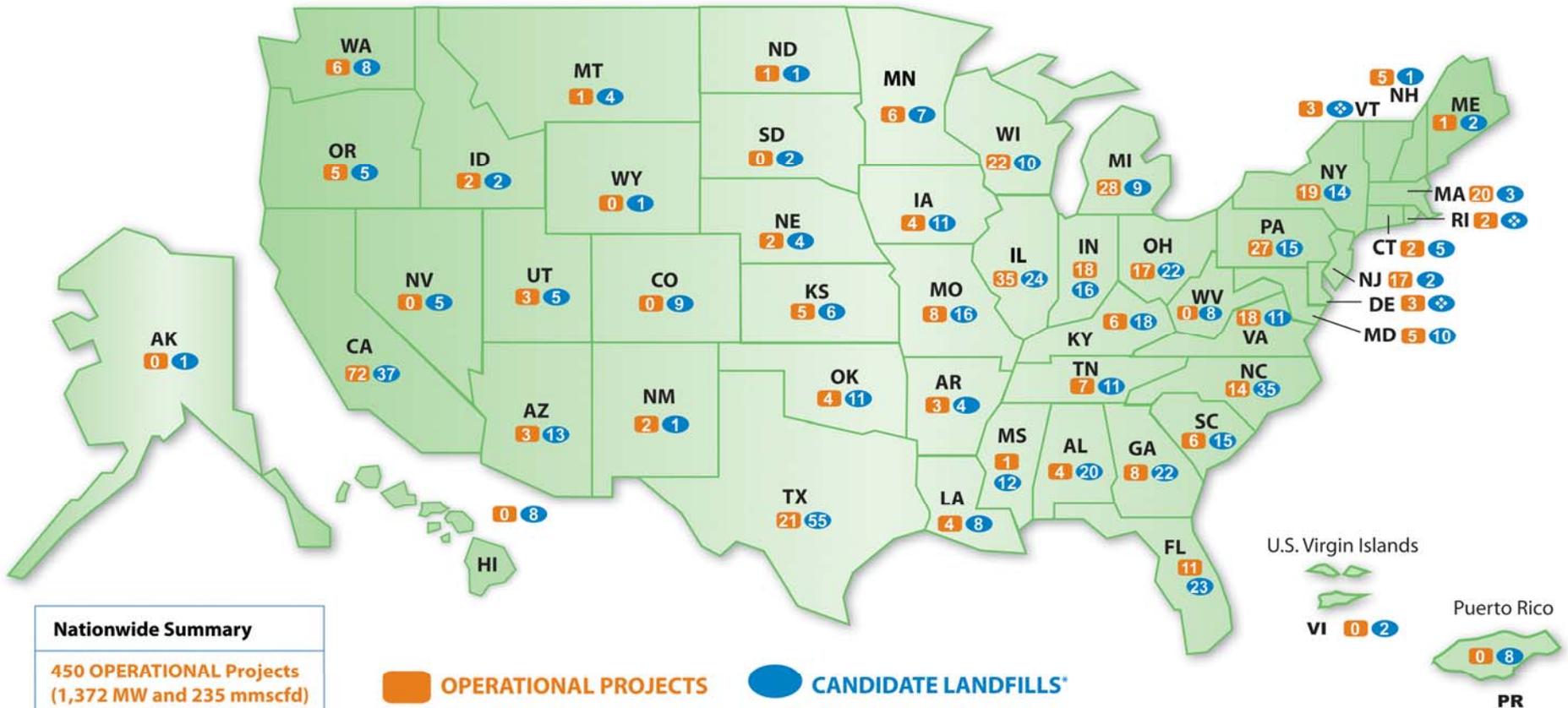
CHRYSLER



State of the National LFG Industry (April 2008)

- At least 450 operational projects in 43 states supplying:
 - 11 billion kilowatt hours of electricity and 77 billion cubic feet of LFG to direct-use applications annually
- Estimated **Annual Environmental Benefits**
 - Carbon sequestered annually by **~17,800,000 acres of pine or fir forests**, or
 - CO₂ emissions from **~182,000,000 barrels of oil consumed**, or
 - Annual greenhouse gas emissions from **~14,300,000 passenger vehicles**
- Estimated **Annual Energy Benefit**
 - Powering more than **870,000 homes** and heating nearly **534,000 homes**

LFG Energy Projects and Candidate Landfills



* Landfill is accepting waste or has been closed for 5 years or less and has at least 1 mmtons of waste and does not have an operational/under construction LFG project; or is designated based on actual interest/planning.

These data are from LMOP's database as of April 11, 2008.
❖LMOP does not have any information on candidate landfills in this state.

Project Structures

- Your landfill gas is an asset
- Options include:
 - Develop the project internally
 - Team with a project developer – sell the gas rights
 - Team with a project developer – share the risk

Typical Electric Project Components & Costs

3 MW, engine, 15-yr project:

- Total capital cost = ~\$3.76 million
 - Gas compression & treatment, engine, & generator = ~\$3.5 million
 - Interconnect equipment = ~\$260,000*
- Annual operation & maintenance cost = ~\$570,000/year

*interconnect costs can vary widely

Typical Direct-Use Project Components & Costs

800 scfm, 5-mi pipeline, 15-yr project:

- Total capital cost = ~\$1.63 million
 - Gas compression & treatment = ~\$230,000
 - Pipeline = ~\$280,000/mile
 - (Plus end-of-pipe combustion equipment retrofits, if needed)
- Annual operation & maintenance cost = ~\$140,000/year

Potential LFG Revenue

- Electric projects
 - Sale of electricity (4 - 6 cents/kWh)
 - Sale of Renewable Energy Credits (RECs)
 - Premium pricing for renewables through RPS/RPG or voluntary green power markets
 - Tax credits & incentives
 - Clean Renewable Energy Bonds (CREBs)
- Direct-use projects
 - Sale of LFG (~\$4.50 per MMBtu)
- Both
 - Greenhouse gas emissions trading
 - Energy cost savings

Jobs and Revenue Creation

- A typical 3 MW LFG electricity project is estimated to have the following benefits (direct, indirect, and induced) during the construction year:
 - Increase the output of the national economy by ~\$14 million (\$3 million of which is a local benefit and mostly employee earnings)
 - Employ nearly 70 people nationally (expressed in full-time equivalents [FTE] per year)

Jobs and Revenue Creation (cont.)

- A typical 1,040 scfm LFG direct-use project is estimated to have the following benefits (direct, indirect, and induced) during the construction year:

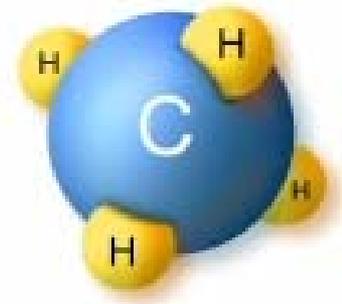
	5-mile pipeline	10-mile pipeline
Increase output of national economy	\$6 million	\$12 million
Portion of national benefit at local level	\$2 million	\$4 million
People employed nationally (FTE)	43	80

LFG and State Renewable Portfolio Standards

- Renewable Portfolio Standard (RPS) – requires utilities to supply a percentage of power from renewable sources
 - 26 states plus District of Columbia have an RPS
- Renewable Portfolio Goal (RPG) – same as RPS except an objective not a requirement
 - 5 states have an RPG (LFG eligibility not certain for 1)
- **LFG is eligible as a renewable source for 30 states and District of Columbia**

Public and Private Entities Moving to Reduce GHG Emissions

- Voluntary Markets
 - Currently where most GHG activity occurs
 - Examples - Chicago Climate Exchange, Blue Source
- Compliance Markets
 - Rapidly evolving, will become the dominant market
 - Led by Massachusetts and California and regional efforts



Emissions Trading of LFG

- Chicago Climate Exchange (CCX) is an example of a voluntary GHG reduction and trading program
 - Offers a credit of 18.25 metric tons CO₂ per metric ton of methane combusted
 - Applicable for LFG collection and combustion systems placed into service after 12/31/98
 - Prices range from \$1 to \$6.50 per metric ton (market factors affect pricing)
 - Only landfills not required by federal law (e.g., NSPS) to combust LFG are eligible
 - Landfill methane emission offsets brochure at www.chicagoclimateexchange.com

Federal Financial Incentives

- Clean Renewable Energy Bonds (CREBs)
 - National allocation of \$1.2 billion
 - Current issuance period of 1/1/07 to 12/31/08
 - In 2006, IRS granted issuance of 36 bonds for LFGE projects
- Renewable Energy Production Incentive (REPI)
 - Local/state government or non-profit electric co-op facilities
 - Online by 10/1/16
 - Payment for first 10 years of operation

EPA's Landfill Methane Outreach Program

- Established in 1994
- Voluntary program that creates alliances among states, energy users/providers, the landfill gas industry, and communities

Mission: To reduce methane emissions by lowering barriers and promoting the development of cost-effective and environmentally beneficial landfill gas energy (LFGE) projects.

LMOP Tools and Services

- Network of 700+ Partners (and growing)
- Newsletter and listserv
- Direct project assistance
- Technical and outreach publications
- Project and candidate landfill database
- Web site (epa.gov/lmop)
- Support for ribbon cuttings/ other PR
- Presentations at conferences
- State training workshops
- ***LMOP Annual Conference, January 2010***



EPA Administrator
Stephen L. Johnson

Keynote Speaker
11th Annual LMOP Conference
Washington, DC
January 9, 2008

How Can We Work Together? Direct Project Assistance

- Analyze landfill resource – gas modeling
- Identify potential matches – *LMOP Locator*
- Assess landfill and end user facilities
- Look at project possibilities
 - Direct-use (boiler, heating, cooling, direct thermal)
 - Combined Heat & Power (engine, turbine, microturbine)
 - Electric (engine, turbine, microturbine)
 - Alternative Fuels (medium or high Btu, LNG, CNG)
- Initial feasibility analyses – *LFGcost*

