

# ***An Overview of Landfill Gas Energy in the United States***

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



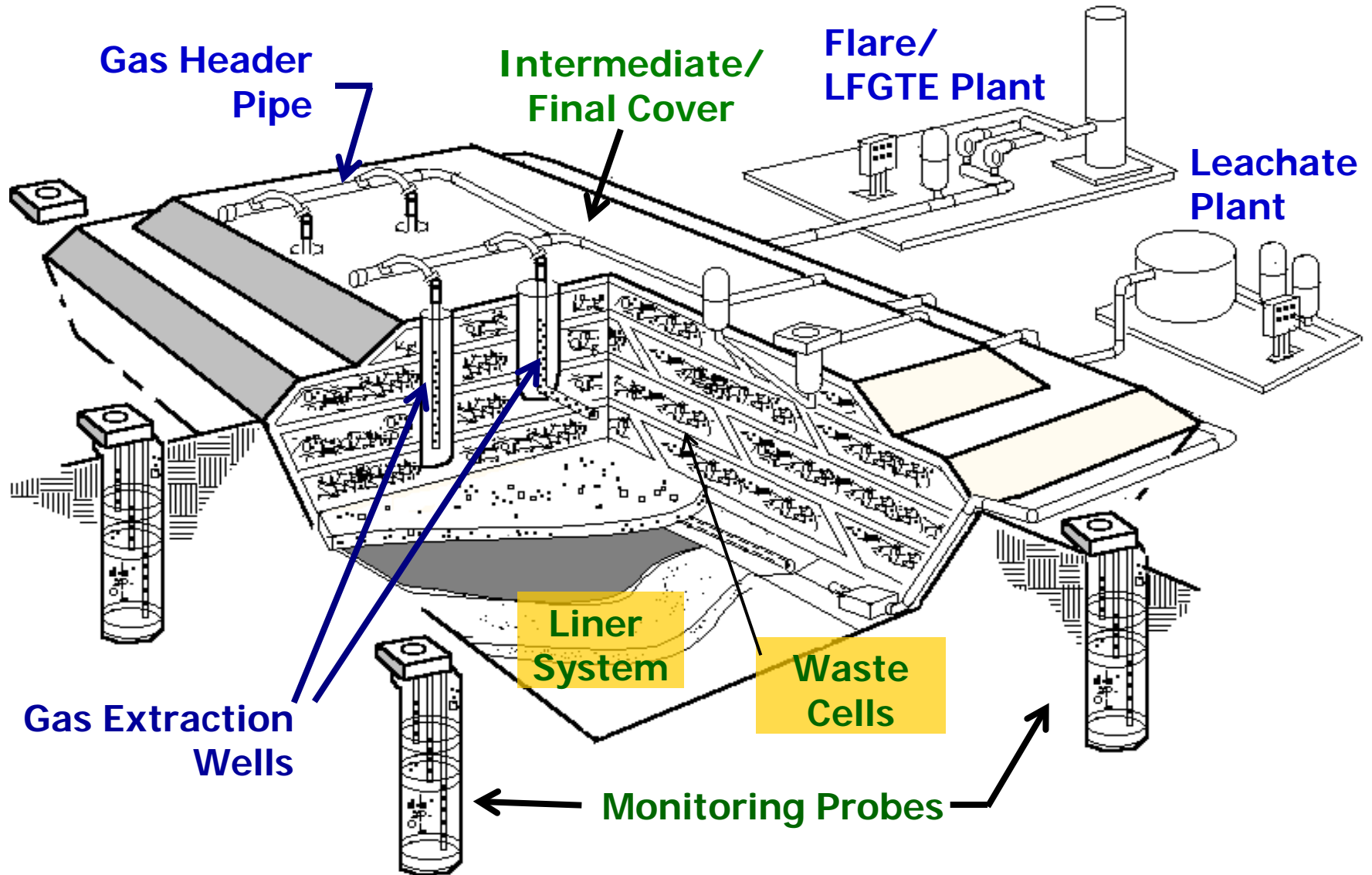


# ***EPA's Landfill Methane Outreach Program***

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

*Mission: To reduce methane emissions by lowering barriers and promoting the development of cost-effective and environmentally beneficial LFG energy projects.*

# *Modern Sanitary Landfill*





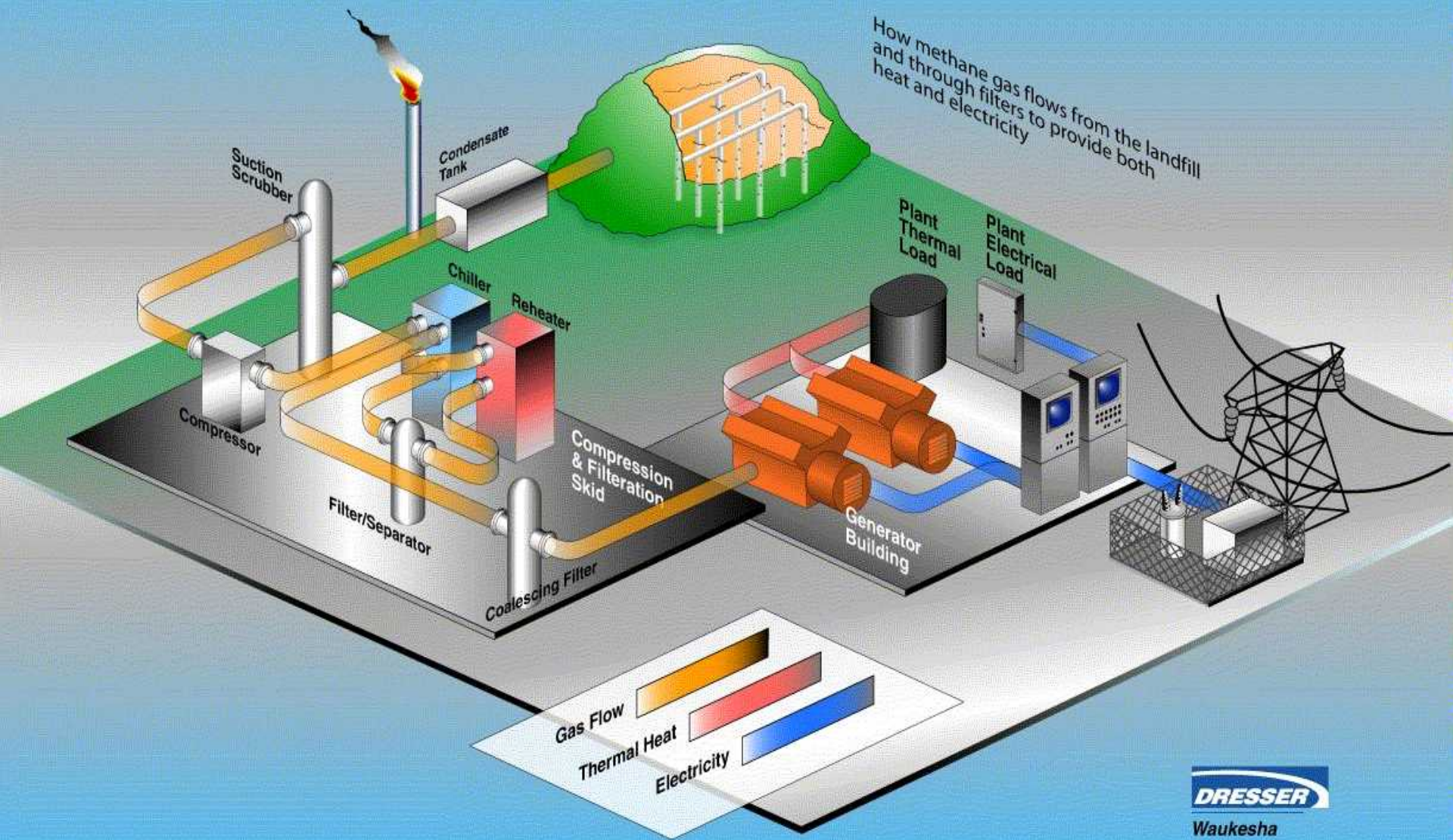


# ***Landfill Gas 101***

- LFG is a by-product of the decomposition of municipal solid waste (MSW):
  - ~50% methane ( $\text{CH}_4$ )
  - ~50% carbon dioxide ( $\text{CO}_2$ )
  - <1% non-methane organic compounds (NMOCs)
- Landfills were the third largest human-made source of methane in the United States in 2010, accounting for 16.2% generated
- [ghgdata.epa.gov/ghgp](http://ghgdata.epa.gov/ghgp)
- For every 1 million tons of MSW:
  - ~0.78 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



# Landfill Gas to Energy







**~445 CANDIDATE Landfills  
(845 MW or 475 mmscfd,  
10 MMTCE Potential)**

## OPERATIONAL PROJECTS

## CANDIDATE LANDFILLS\*

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

\*\* LMOP does not have any information on candidate landfills in this state.

**These data are from LMOP's database as of October 2012.**



# ***State of the National LFG Industry (Oct 2012)***

- At least 600 operational projects in 48 states annually supplying:
  - **15 billion kilowatt-hours** of electricity and **100 billion cubic feet** of LFG to direct-use applications
- Estimated '12 **Annual Environmental Benefits**
  - Carbon sequestered annually by **~22,100,000 acres of pine or fir forests**, or
  - CO<sub>2</sub> emissions from **~240,000,000 barrels of oil consumed**, or
- Estimated **Annual Energy Benefits**
  - Powering **1,100,000 homes** and heating **725,000 homes**





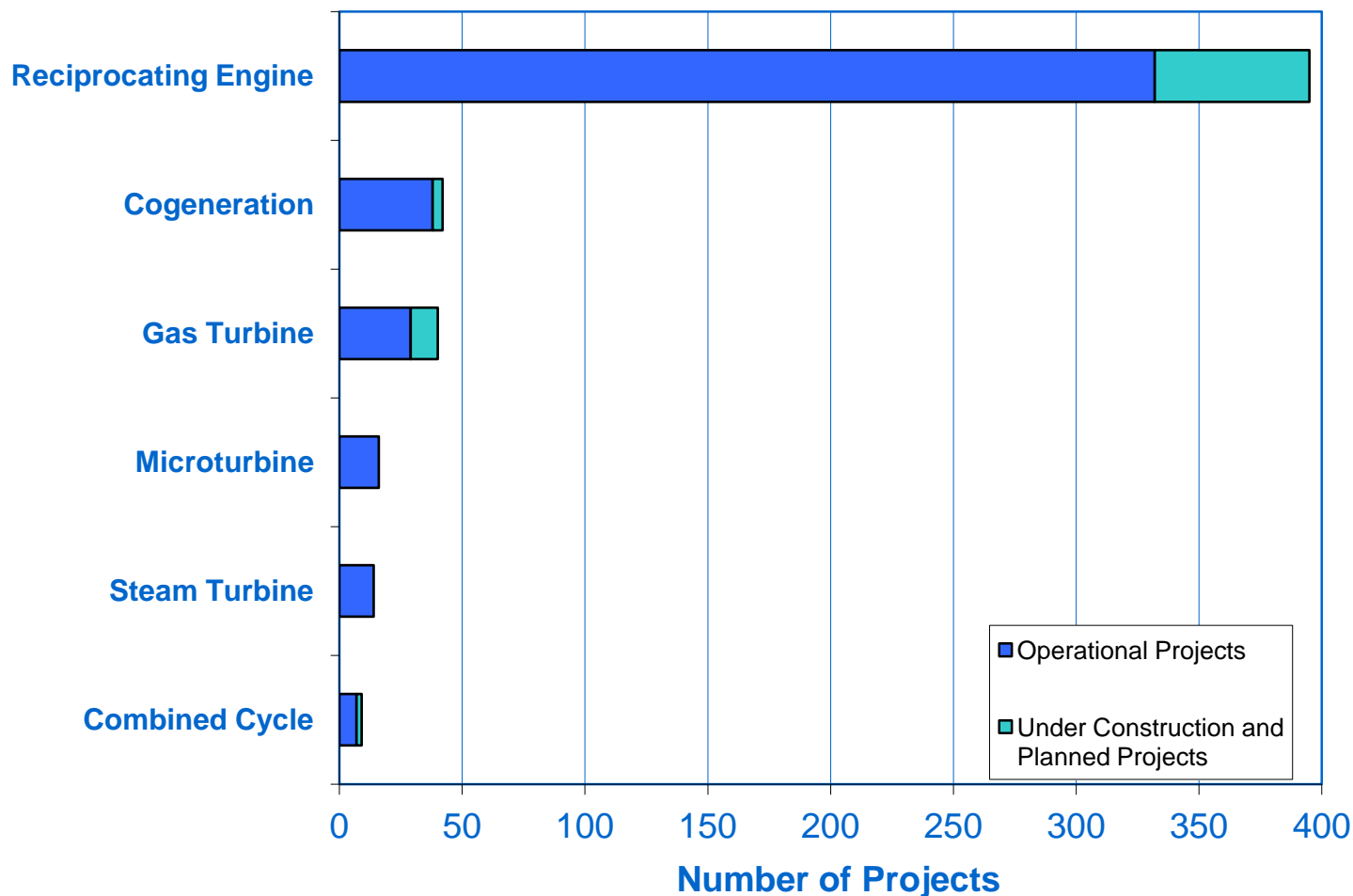
# ***Many Untapped LFG Resources***

- Currently ~445 candidate landfills with a total gas generation potential of 173 billion cubic feet per year (~10,000 MMBtu/hr) OR total electric potential of 845 MW (~7 million MWh/yr)
- If projects were developed at all these landfills, the estimated
  - **Annual Environmental Benefit =**  
Carbon sequestered annually by ~**8 million acres** of pine or fir forests
  - **Annual Energy Benefit =**  
Powering nearly **500,000 homes** OR heating more than **1.1 million** homes per year





# ***Technology Trends Electricity Projects***





# ***Diversity of Project Types Electricity Generation***

**Internal  
Combustion Engine  
(range from 100 kW  
to 3 MW)**



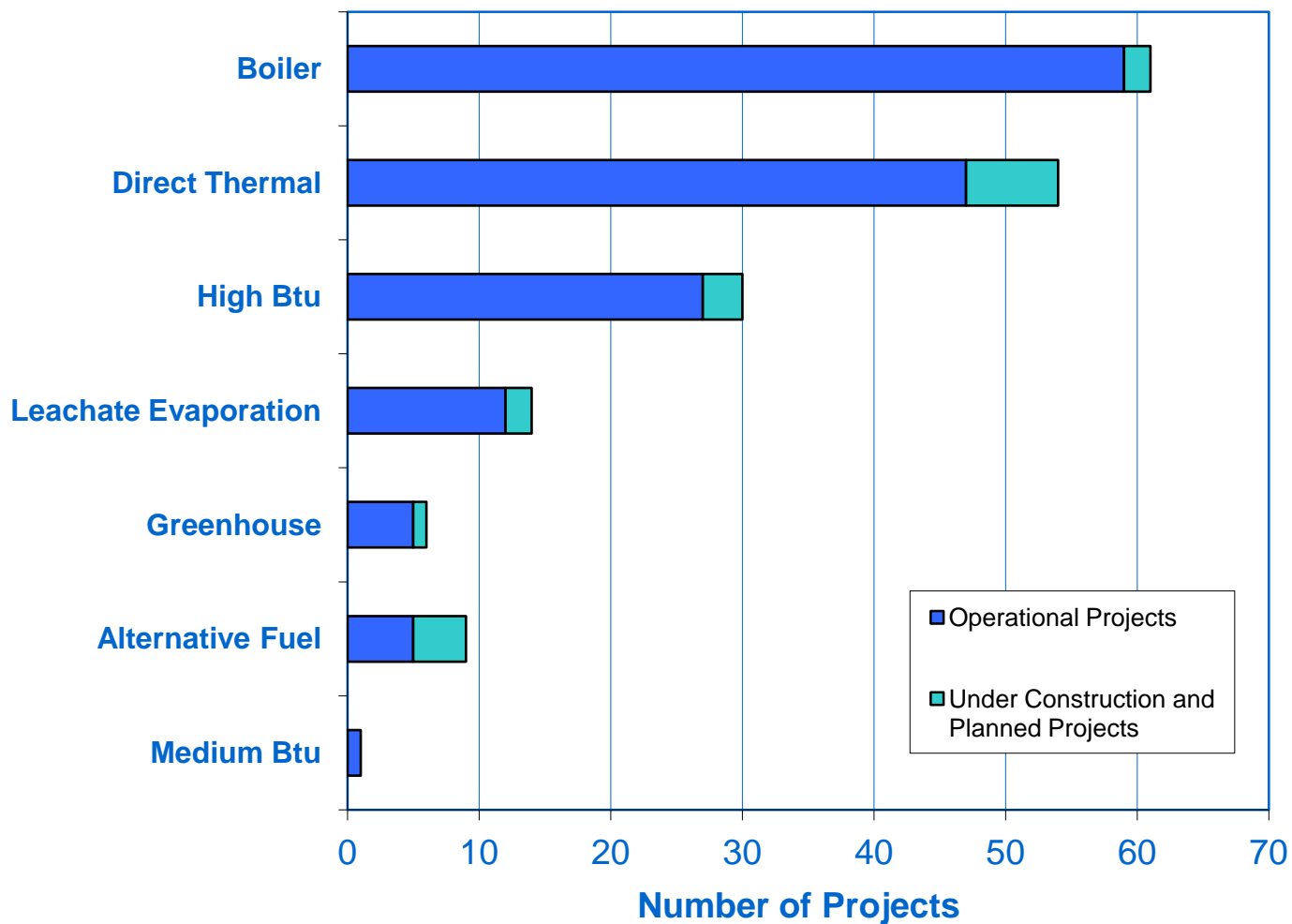
**Gas Turbine  
(range from 800 kW  
to 10.5 MW)**



**Microturbine  
(range from 30 kW  
to 250 kW)**



# ***Technology Trends Direct-Use Projects***





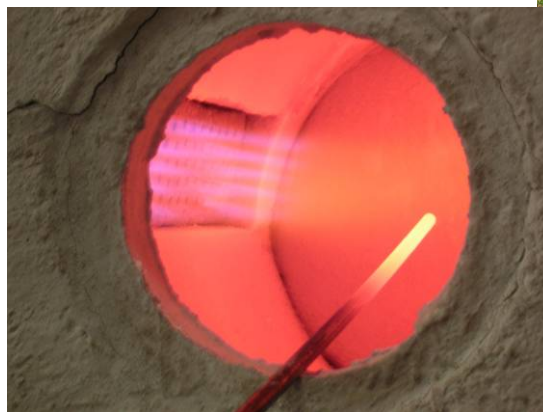


# ***Diversity of Project Types***

## ***Direct Use of LFG***

- Boiler applications – replace natural gas, coal, fuel oil
- Direct thermal (dryers, kilns)
- Natural gas pipeline injection (medium- & high-Btu)
- Ethanol production
- Greenhouse
- Infrared heaters
- Leachate evaporation
- Vehicle fuel (LNG, CNG)
- Glassblowing & pottery
- Blacksmithing
- Hydroponics
- Aquaculture (fish farming)

Greenhouse  
Jackson County, NC



Glassblowing  
Jackson County, NC



Infrared heater - Lorton, VA



# ***Growing Technology: LFG for Vehicle Fuel***

- POET plant in Sioux Falls, SD uses LFG from local landfill to create ethanol (Feb. 2009)
- Waste Management & Linde produce 13,000 gal LNG per day for garbage trucks (Altamont LF, Sept. 2009)
- Central LF, CA LFG-to-CNG project fuels Sonoma County school buses (Sept. 2009)
- Dane County, WI's pilot project produces 100 GGE/day bioCNG from 20 cfm LFG to fuel on-site vehicles (Mar. 2011)
- Rumpke SLF, OH converting excess LFG into CNG for 10 trucks to start (July 2011)





# ***LMOP Tools and Services***

- Website: [www.epa.gov/lmop](http://www.epa.gov/lmop)
- Direct project assistance
- Technical and outreach publications
- Project and candidate landfill database
- Network of 1,000+ Partners
- Listserv
- Support for ribbon cuttings/other PR
- Presentations at conferences
- Annual Conference, Project Expo & Partner Awards in Baltimore, MD







# ***How Can We Work Together? Direct Project Assistance***

- Analyze landfill resource – gas modeling
- Identify potential matches – *LMOP Locator* (tool available on website)
- 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*
  - New boiler retrofit cost analysis





# State Support

- State Partner Program
  - Encourage coordination among permitting and regulatory offices to lower barriers and increase opportunities for LFG recovery
  - Currently over 35 Partners
- Training workshops
- Facilitate meetings with regional and local organizations
- State Resources - <http://epa.gov/lmop/publications-tools/state-resources.html>
  - Lists key state organizations for air permitting, energy policy, and public utility regulation
  - Links to LMOP State Partner contact info
- Share detailed information about landfills and LFG energy projects from LMOP's database





# North Carolina: State Partner Success Story

- Co-hosted Seminar for LFG Energy Project ARRA Funding Awardees with LMOP State Partner NC Dept. of Environment & Natural Resources and NC State Energy Office
  - 10 counties learned about grant requirements, permitting, project budgeting, emerging small technologies, power and REC sales, and public utilities and electric cooperatives
  - LMOP presented *Developing an RFP and Managing Your LFG Energy Project*, which covered planning for an RFP, essential elements of an RFP, and evaluating proposals
  - Three of the attending landfills brought an energy project online in 2012; Six others are in project construction or planning stage
- Coordinated panel of expert speakers on financing LFG energy projects at Quad State SWANA conference in NC
- Provided key resources to state stakeholders with concerns about air permitting for LFG energy projects and facilitated communications between EPA Region 4 and NC DENR
  - Resulted in multiple projects coming online in time to receive grant funds

