Encouraging the Recovery and Beneficial Use of Biogas Generated from Municipal Solid Waste

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May 18, 2017 – Environmental Show of the South
Agenda

- Introduction to LMOP
- Why LFGE Projects?
- Where are LFGE Projects?
- Barriers to Project Development
- LFG Processing and Uses
- LFG for Vehicle Fuel
- How Can LMOP Help?
Landfill Methane Outreach Program (LMOP)

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

**Mission:** To work cooperatively with industry stakeholders and waste officials to reduce or avoid methane emissions from landfills by encouraging the recovery and beneficial use of biogas generated from organic municipal solid waste.
1,100 LMOP Partners

- Benefits of LMOP Partnership
  - Recognition of your commitment to renewable energy
  - Identification on LMOP website
  - Access to Partner network
  - Technical support

- Interested?
  - Fill out and submit an MOU (available on our website)
  - Sign up for LMOP listserv messages

- Industry Partners: 766
- Community Partners: 145
- Energy Partners: 111
- Endorser Partners: 39
- State Partners: 39
Why LFG Energy (LFGE) Projects?
Why the EPA is Concerned about Landfill Gas

- LFG is a by-product of the anaerobic decomposition of municipal solid waste (MSW)
- Landfill gas contains about 50% methane, 50% CO₂, and a small amount of NMOCs
- Methane as a GHG is 28 to 36 times more effective than CO₂ at trapping heat in the atmosphere over a 100-year period
- Landfills are the third largest human-made source of U.S. methane emissions, accounting for 20% of these emissions in 2014

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Sources of Biogas

- **Manure** (e.g., dairy, swine)
- **Wastewater Biosolids** (e.g., Primary/Secondary Sludge)
- **Food Waste** (e.g., Household, Restaurant, Hospitality, Grocery)
- **Other Organics** (e.g., FOG, Crop Residue, Brewery Waste)

Anaerobic Digestion

Biogas
- Electricity
- Heat
- Vehicle Fuel
- Pipeline Gas

Digestate
- Fertilizer
- Animal Bedding
- Other Products (e.g., building material, erosion control)
LFG Energy Benefits

Create local, renewable, and consistent energy

Generate revenue and jobs in the community

Reduce local air pollution and GHG emissions

Lead to health benefits
Where are LFGE Projects?
LFG Energy Project Development in the U.S.

Nationwide Summary

654 OPERATIONAL Projects
(2,190 MW and 302 mmscfd)

~405 CANDIDATE Landfills
(780 MW or 435 mmscfd,
38 MMTCO₂e/yr Potential)

OPERATIONAL PROJECTS
CANDIDATE LANDFILLS*

* Landfill is accepting waste or has been closed 5 years or less, has at least 1 mm tons of waste, and does not have an operational, under-construction, or planned project; can also be designated based on actual interest by the site.

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

Data from LMOP Database as of March 2017
Project Snapshot for 2016

- 99 billion cubic feet of LFG delivered
- 125 MMTCO$_2$e direct CH$_4$ reductions
- 17.8 billion kilowatt-hours produced
- 648 projects in 49 states/territories
LMOP Accomplishments

**Cumulative**
- **22 years** (1995-2016)
- **~ 648 LFG energy projects assisted**
- **~ 425 million** metric tons of carbon dioxide equivalents reduced or avoided
- Environmental benefit of the carbon sequestered by about **401 million** acres of U.S. forests in one year

**2016**
- **9 new LFG energy projects assisted**
- **4 LFG energy project expansions assisted**
- **1.0 million** metric tons of carbon dioxide equivalents reduced or avoided
- Environmental benefit of the carbon sequestered by more than **943,000** acres of U.S. forests in one year
Barriers to Project Development
Revenue, Funding & Incentives
for the development of LFG energy

- Direct sale of LFG
- Sale of power generated from LFG
- Renewable Energy Certificates (RECs)
- RINs under Renewable Fuel Standard (RFS)
- California Low Carbon Fuel Standard credits
- Greenhouse gas reduction credits
- Renewable Electricity Production Tax Credit (PTC)
- Federal or state grants
- Low-cost bond programs
  - Clean Renewable Energy Bonds (CREBs)
  - Qualified Energy Conservation Bonds (QECBs)
- Loans
  - U.S. DOE Loan Guarantee program
Trends in the U.S. Solid Waste Industry

▪ States and municipalities are increasingly moving towards diversion of organic waste from landfills
  ▪ ~26 states have laws that address landfilling organic waste

▪ Federal and local initiatives emerging to address/minimize food waste

▪ Growing and sustained interest in LFG to vehicle fuel

▪ LFG energy project development growth has slowed in recent years
  ▪ 9 new projects and 4 expansions in 2016
  ▪ Economic factors continue to challenge project financial feasibility
LFG Processing and Uses
Electricity Project Types

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)
Medium-BTU End Uses of LFG

- Boiler applications – replace natural gas, coal, fuel oil
- Direct thermal (dryers, kilns)
- Greenhouse
- Infrared heaters
- Leachate evaporation
- Glassblowing, pottery, blacksmithing, hydroponics, aquaculture
High-BTU
End Uses of LFG

- Natural gas pipeline injection
- Vehicle fuel (CNG, LNG)

CNG Fueling Station – St. Landry Parish, LA

Natural Gas Pipeline Injection - Rochester, NH

BioCNG System – Dane County, WI
LFG Energy Projects in the Southern U.S.

Operational LFGE Projects
Project type
- Green: Medium BTU (direct use)
- Blue: Electricity
- Red: High Btu
- Yellow: Renewable CNG
LFG for Vehicle Fuel
Using Biogas for Vehicle Fuel

- Two primary project designs:
  - On site fueling of vehicles
  - Injection into natural gas pipeline to fuel vehicles elsewhere

- Biogas (from any source: landfills, anaerobic digesters) must be upgraded to high gas quality standards

- Facilities with multiple sources of biogas
  - Who are your neighbors: waste water treatment plants, farmers?

- Who is the end user?
  - Distance to nearest natural gas pipeline
  - Create vehicle fuel for municipal vehicles
Conversion to High-BTU Gas

- Must increase methane concentration by removing:
  - Moisture, nitrogen, oxygen, carbon dioxide, hydrogen sulfide, NMOCs, siloxanes

- Gas processing methods and technologies
  - Water scrubbing
  - Amine (or chemical) scrubbing: physical solvent process
  - Molecular sieve or pressure swing adsorption (PSA)
  - Membrane separation
  - Cryogenic liquefaction

Landfill Gas ~50% methane  Gas processing  Renewable Natural Gas ~99% methane
<table>
<thead>
<tr>
<th>Landfill</th>
<th>City</th>
<th>State</th>
<th>Use details</th>
<th>Project LFG (mmscf/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sonoma County Central Disposal Site</td>
<td>Petaluma</td>
<td>CA</td>
<td>CNG to fuel county buses; pilot scale project</td>
<td>1.24</td>
</tr>
<tr>
<td>Altamont Landfill &amp; Resource Recovery Facility</td>
<td>Livermore</td>
<td>CA</td>
<td>13,000 gal/day LNG for garbage trucks</td>
<td>3.6</td>
</tr>
<tr>
<td>Seminole Road MSW Landfill</td>
<td>Ellenwood</td>
<td>GA</td>
<td>Onsite CNG fueling station for 40 county garbage trucks and public use</td>
<td>0.198</td>
</tr>
<tr>
<td>St. Landry Parish LF</td>
<td>Washington</td>
<td>LA</td>
<td>250 GGE/day bioCNG for 1 passenger van, 5 sedans, and 10 fleet pick-up trucks; With expansion, total production now ~630 GGE/day</td>
<td>0.27</td>
</tr>
<tr>
<td>Riverview Land Preserve</td>
<td>Riverview</td>
<td>MI</td>
<td>450-500 GGE/day CNG for City vehicles</td>
<td>0.14</td>
</tr>
<tr>
<td>Dane County LF #2-Rodefeld</td>
<td>Madison</td>
<td>WI</td>
<td>250 GGE/day for public works vehicles</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Data from LMOP Database as of March 2017
## LFG for Pipeline Injection (projects in southern states)

<table>
<thead>
<tr>
<th>Landfill</th>
<th>City</th>
<th>State</th>
<th>LFG Upgrade Technology Details</th>
<th>Project LFG (mmscfd)</th>
<th>Vehicle Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fort Smith SLF</td>
<td>City of Fort Smith</td>
<td>AR</td>
<td>Physical solvent process</td>
<td>0.64</td>
<td>Yes</td>
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<tr>
<td>Seminole Road MSW Landfill</td>
<td>Ellenwood</td>
<td>GA</td>
<td>Unknown</td>
<td>0.594</td>
<td>Yes</td>
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<tr>
<td>Live Oak LF</td>
<td>Conley</td>
<td>GA</td>
<td>Air Liquide process; uses membrane technology</td>
<td>6.48</td>
<td>Unk</td>
</tr>
<tr>
<td>River Birch Landfill</td>
<td>Westwego</td>
<td>LA</td>
<td>Air-Liquide membrane separation; biological sulfur removal system (Thiopak)</td>
<td>6.336</td>
<td>Yes</td>
</tr>
<tr>
<td>Jefferson Davis Parish Landfill</td>
<td>Welsh</td>
<td>LA</td>
<td>Physical solvent process</td>
<td>2.14</td>
<td>Yes</td>
</tr>
<tr>
<td>North Shelby Landfill</td>
<td>Millington</td>
<td>TN</td>
<td>Unknown</td>
<td>Unk</td>
<td>Yes</td>
</tr>
<tr>
<td>Meadow Branch Landfill</td>
<td>Athens</td>
<td>TN</td>
<td>Refrigeration, PSA, carbon filtration, membrane separation, Air Liquide-Medal Biogaz System</td>
<td>2.5</td>
<td>Yes</td>
</tr>
<tr>
<td>Carter Valley Landfill</td>
<td>Church Hill</td>
<td>TN</td>
<td>Membrane technology</td>
<td>1.44</td>
<td>Unk</td>
</tr>
</tbody>
</table>

Data from LMOP Database as of March 2017
Programs for Biogas Credits

- Renewable Fuel Standard (RFS) Program – administered by EPA
  - Obligated parties (gasoline or diesel importers or refiners) must meet a Renewable Volume Obligation
  - May meet these obligations by purchasing credits of Renewable Identification Numbers (RINs)
  - Producers of biogas (landfills, WWT plants, manure digesters) generate advanced biofuel (D5) RINs
    - Biogas is the feedstock, CNG or LNG is the fuel
  - Fuels from landfill biogas also qualify for cellulosic biofuel (D3) RINs

- Low Carbon Fuel Standard – administered by CA Air Resources Board
  - Market based mechanism to encourage low-carbon fuels in CA vehicles
  - Certified fuel from a lower carbon intensity fuel pathway can generate and sell credits
  - Landfill and digester biogas
How Can LMOP Help?
LMOP Resources

- Technical publications and tools
- Landfill and LFGE Project Database
- Network of 1,100 Partners
- Webinars and other events
- Listserv messages – upcoming events, news, RFPs
Key LMOP Resources

Project Development Handbook (PDH)
*Improve understanding to develop successful projects*

- Provides project-specific considerations
- Helps stakeholders who are new to LFG energy projects
- Highlights useful online resources and successful LFG energy projects

Available at epa.gov/lmop
Key LMOP Resources

LFGcost-Web

Evaluate the initial economic feasibility of an LFG energy project

Version 3.1 released November 2016

Updated based on a 2015 peer review as well as other revisions

- Updated approach for calculating electricity revenue and avoided \( \text{CO}_2 \) grid factors based on regional electricity grids
- Added ability to enter user-defined project sizes without entering landfill waste data

Available at epa.gov/lmop
Key LMOP Resources

LMOP Landfill and LFG Energy Project Database

Download details about projects and landfills

Includes data for over 2,400 landfills in the U.S.

- Excel files cut the LMOP data in various ways to help you find what you are looking for
- Cross-references EPA’s greenhouse gas reporting program (GHGRP)

Help us keep this up to date!

Available at epa.gov/lmop
LMOP Activities for 2017

- Provide new technical materials
- Release new version of *LFGcost-Web*
  - Job creation estimates
- Host webinars on topics of interest to stakeholders
  - May 23 – LFG to vehicle fuel webinar
How Can We Work Together?

- Facilitating information sharing
- Providing technical information
- Analyzing resource availability through LFG modeling
- Performing initial feasibility analysis using LFGcost-Web
LMOP Contact Information

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