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

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Landfill Methane Outreach Program

U.S. Environmental Protection Agency

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

- Industry Partners: **766**
- Community Partners: **145**
- Energy Partners: **111**
- Endorser Partners: **39**
- State Partners: **39**

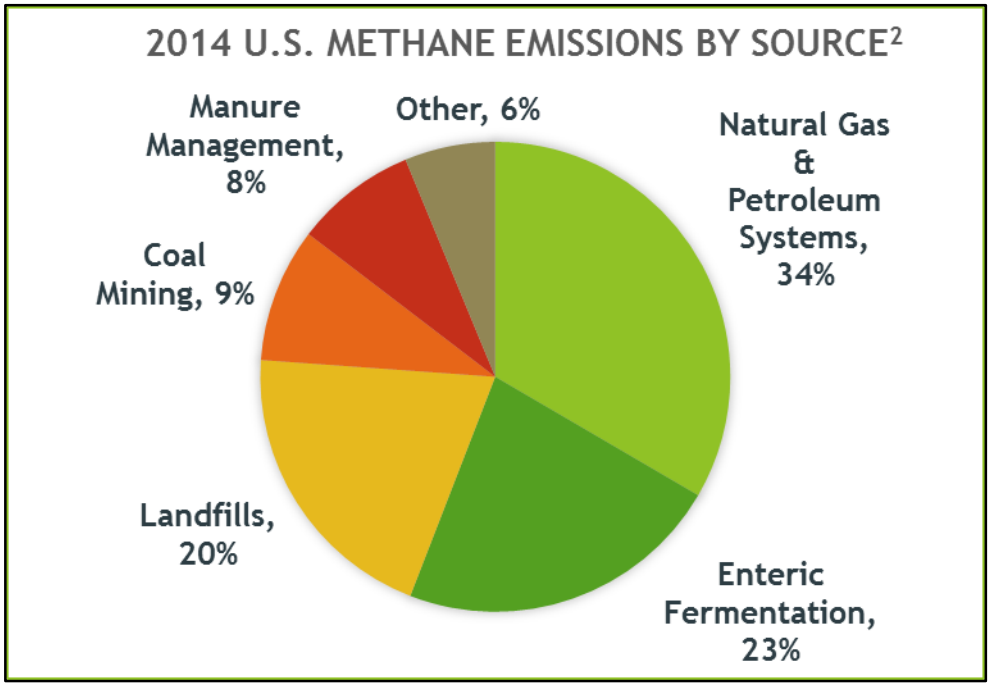
- Benefits of LMOP Partnership
  - Recognition of your commitment to renewable energy
  - Identification on LMOP website
  - Access to Partner network
  - Technical support
- Interested?
  - Fill out and submit an MOU (available on our website)
  - Sign up for LMOP listserv messages

LANDFILL METHANE OUTREACH PROGRAM

Why LFG Energy (LFGE) Projects?

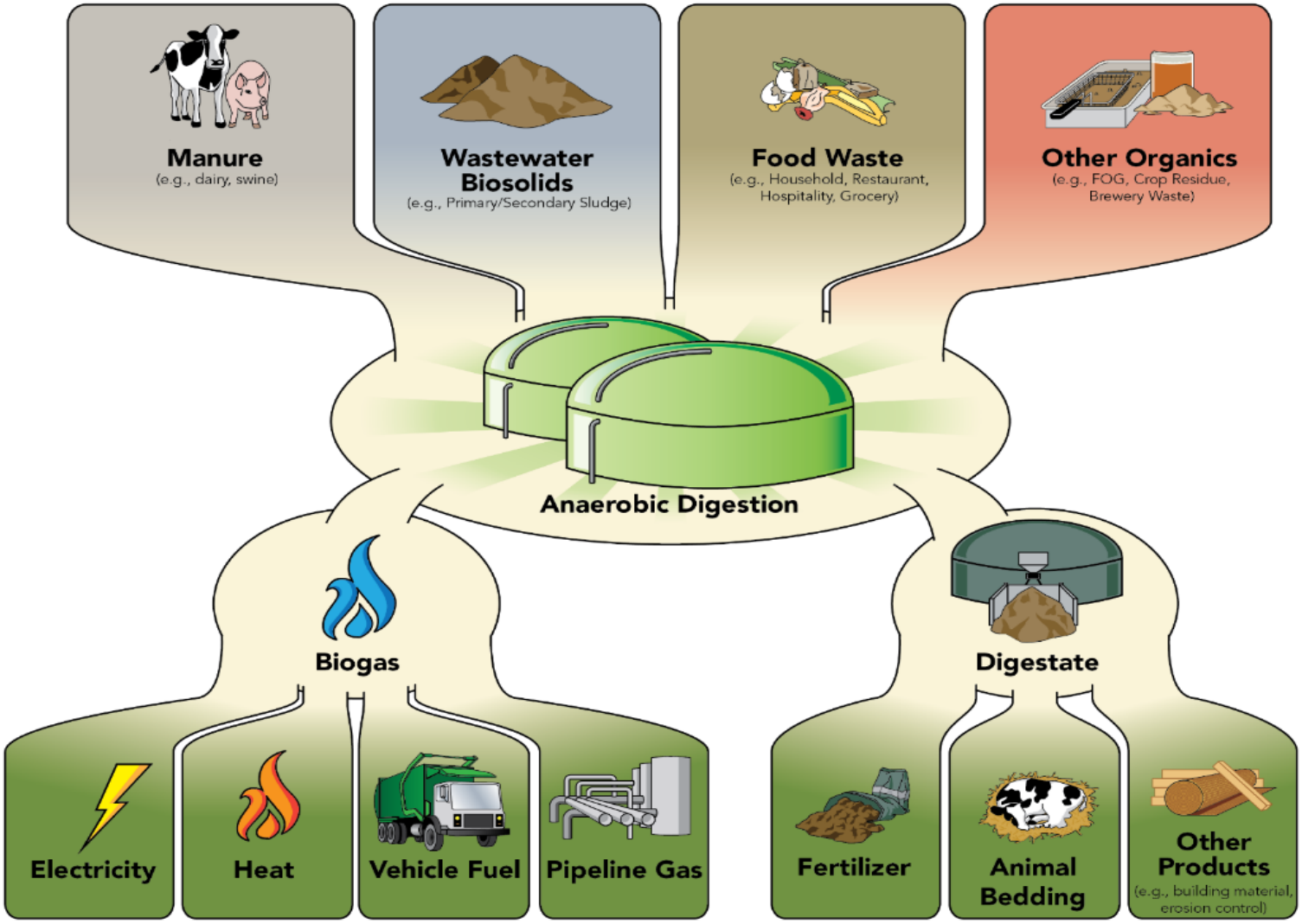
Why the EPA is Concerned about Landfill Gas

- LFG is a by-product of the anaerobic decomposition of municipal solid waste (MSW)
- Landfill gas contains about 50% methane, 50% CO_2, and a small amount of NMOCs
- Methane as a GHG is 28 to 36 times more effective than CO_2 at trapping heat in the atmosphere over a 100-year period[1]
- Landfills are the third largest human-made source of U.S. methane emissions, accounting for 20% of these emissions in 2014[2]



1. IPCC (2014). Fifth Assessment Report.
2. U.S. EPA (April, 2016). Inventory of U.S. Greenhouse Gas Emissions and Sinks.

Sources of Biogas



LFG Energy Benefits

Create local, renewable, and consistent energy

Generate revenue and jobs in the community

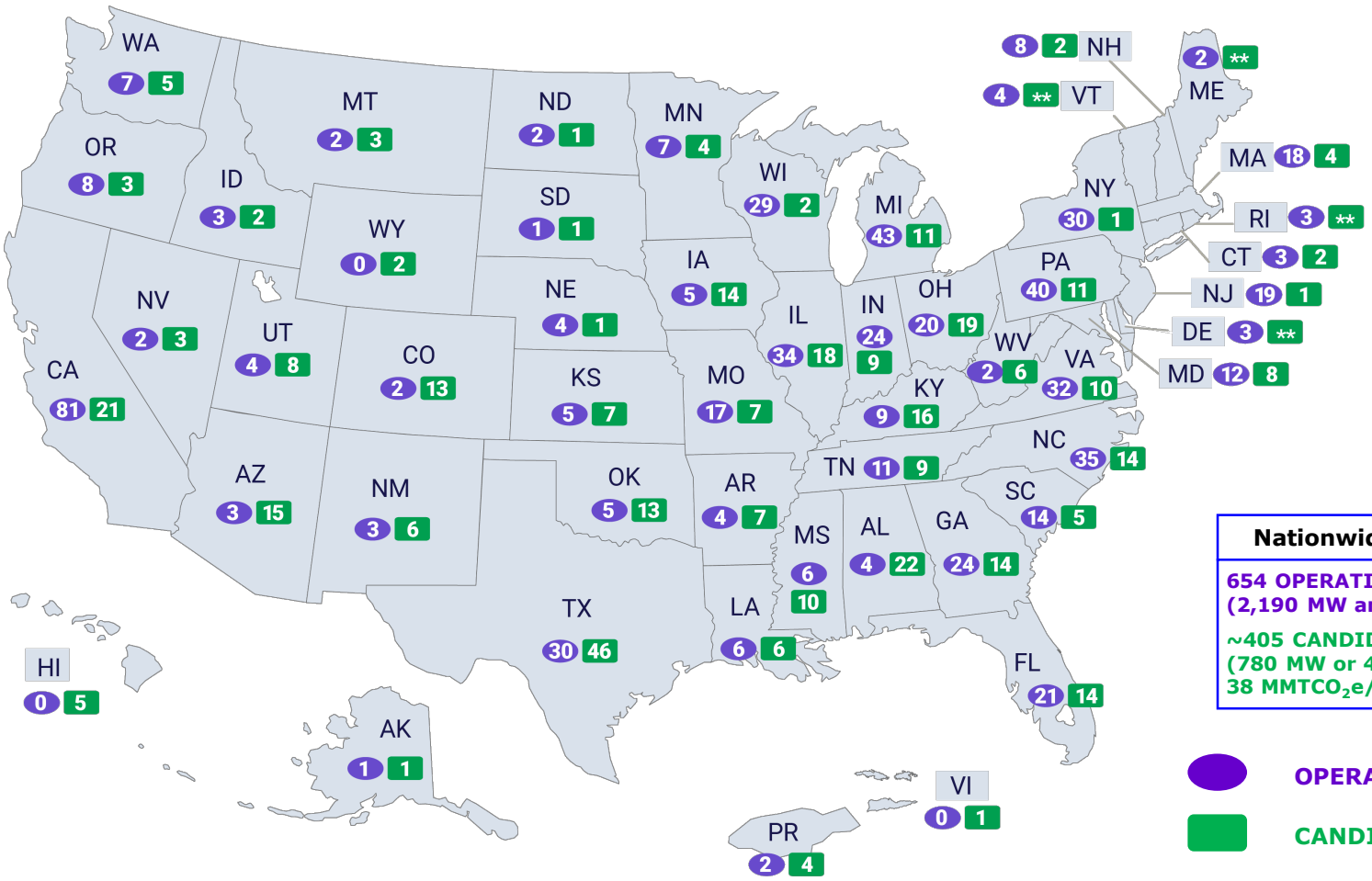
Reduce local air pollution and GHG emissions

$

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 MMTCO$_2$e/yr Potential)

OPERATIONAL PROJECTS

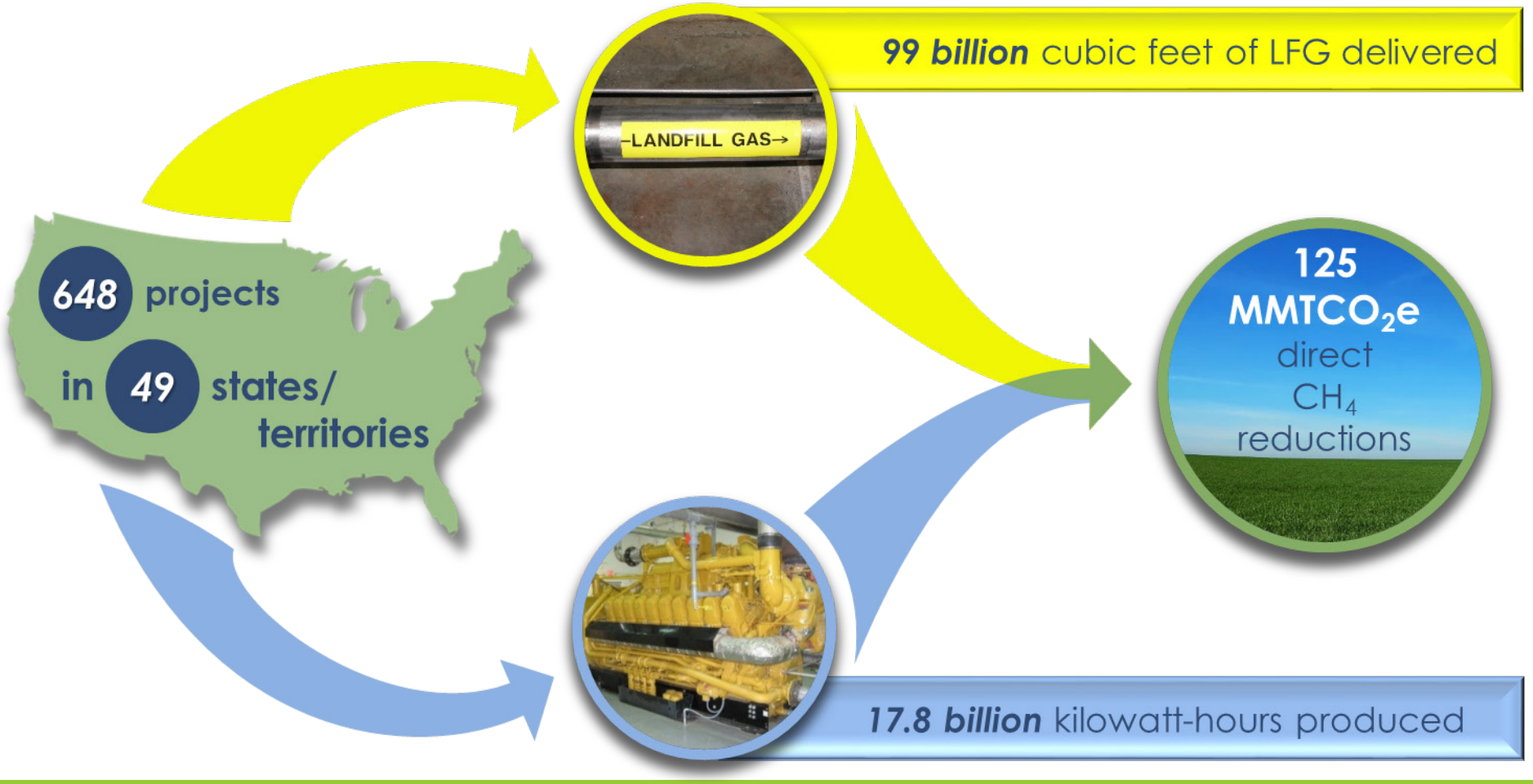
CANDIDATE LANDFILLS*

* 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.

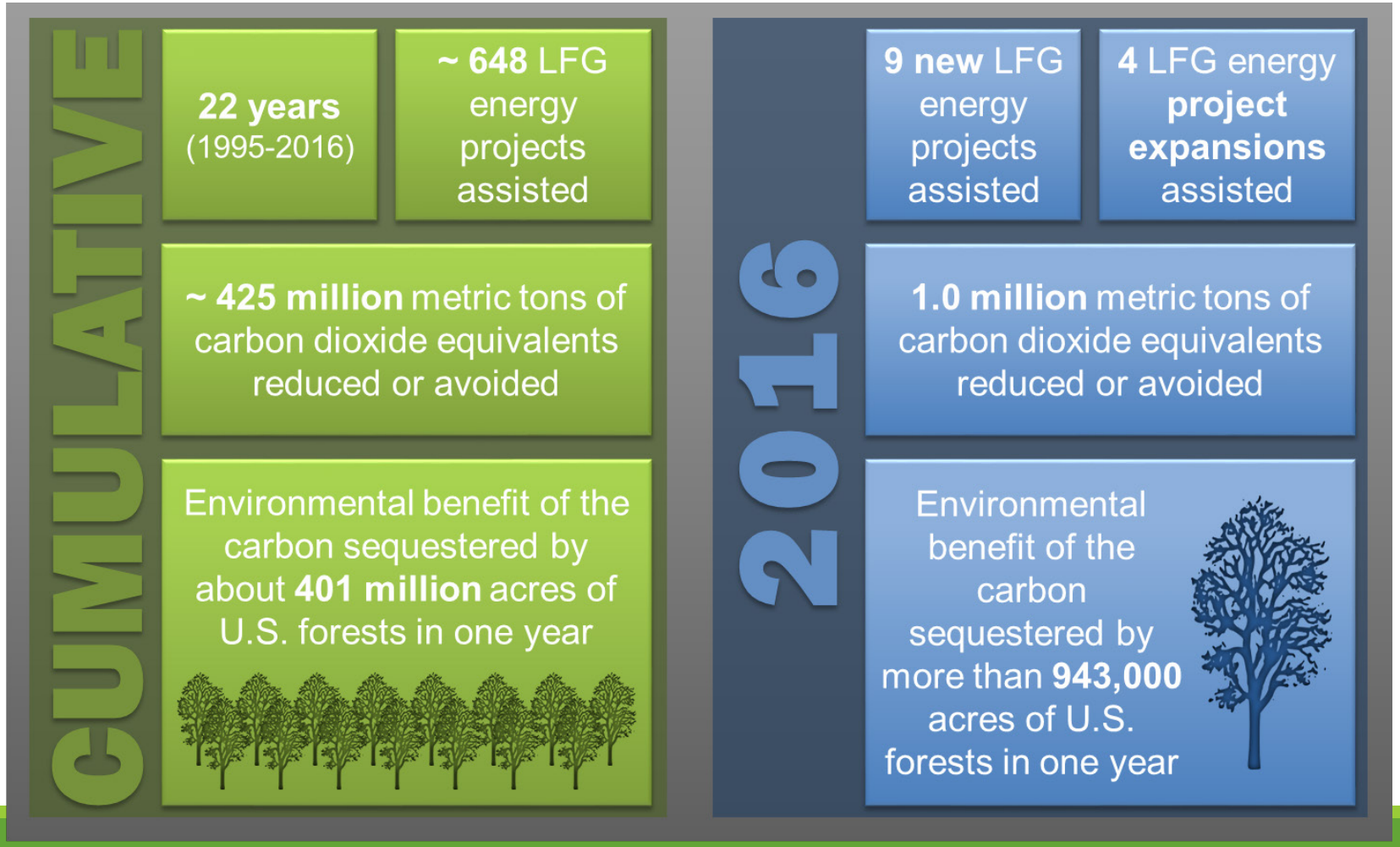
** LMOP does not have any information on candidate landfills in this state.

Data from LMOP Database as of March 2017

Project Snapshot for 2016



LMOP Accomplishments



Barriers to Project Development

Revenue, Funding & Incentives

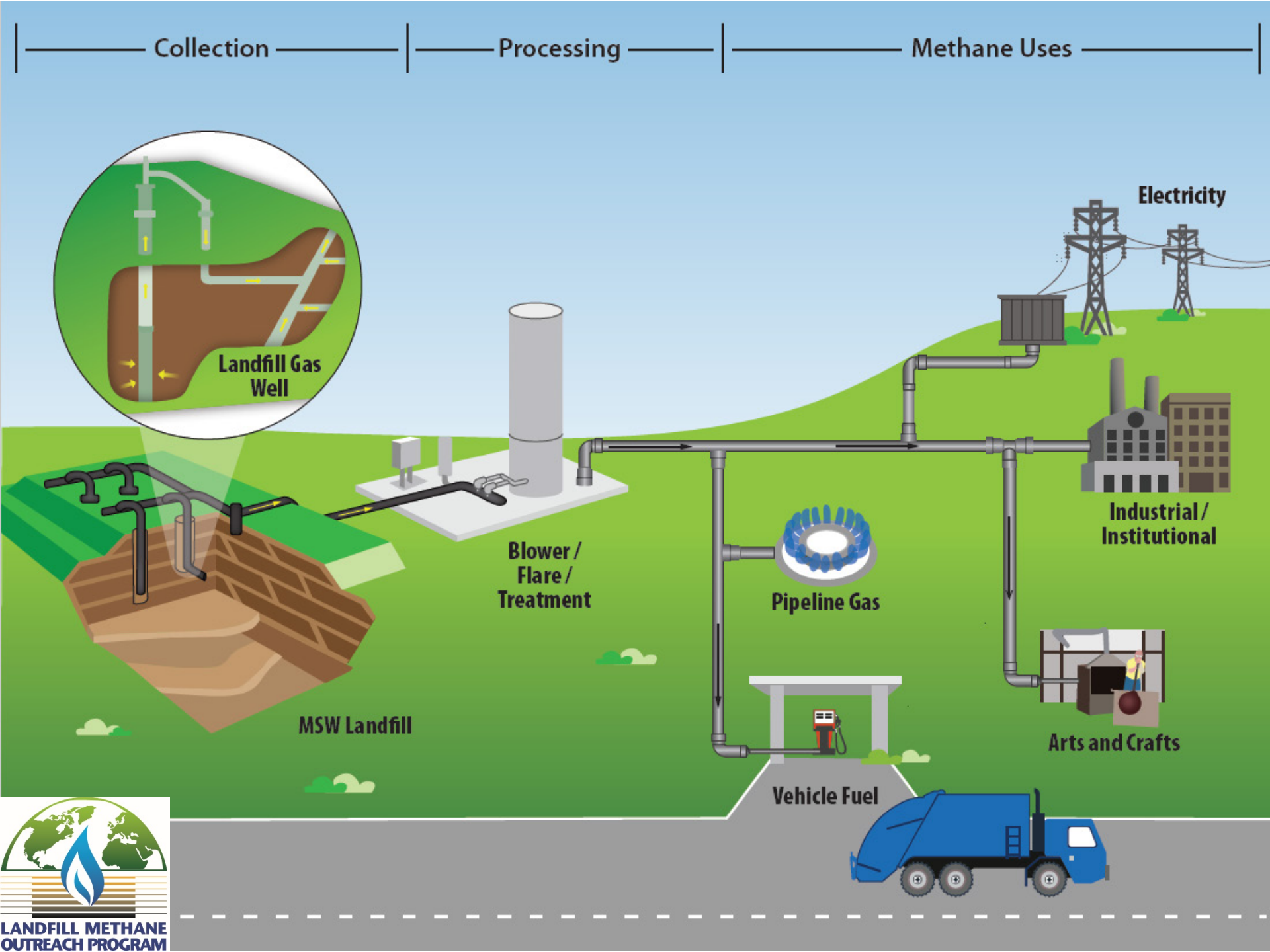
for the development of LFG energy

- 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


Collection
Processing
Methane Uses
Landfill Gas Well
MSW Landfill
Blower / Flare / Treatment
Electricity
Industrial / Institutional
Pipeline Gas
Arts and Crafts
Vehicle Fuel
LANDFILL METHANE OUTREACH PROGRAM

Electricity Project Types

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

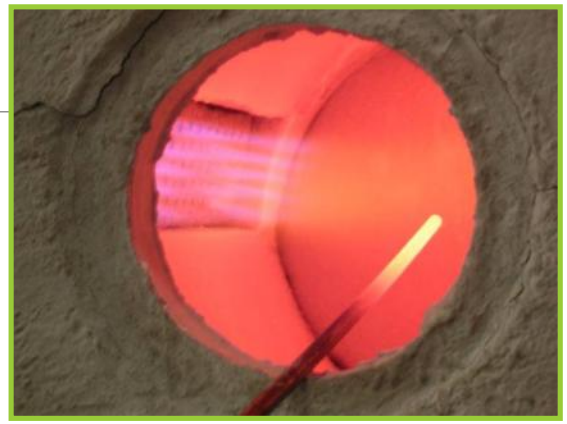
Microturbine (range from 30 kW to 250 kW)

Gas Turbine (range from 800 kW to 10.5 MW)

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

Greenhouse
Jackson County, NC



Glassblowing
Jackson County, NC

Infrared Heater - Lorton, VA

High-BTU End Uses of LFG

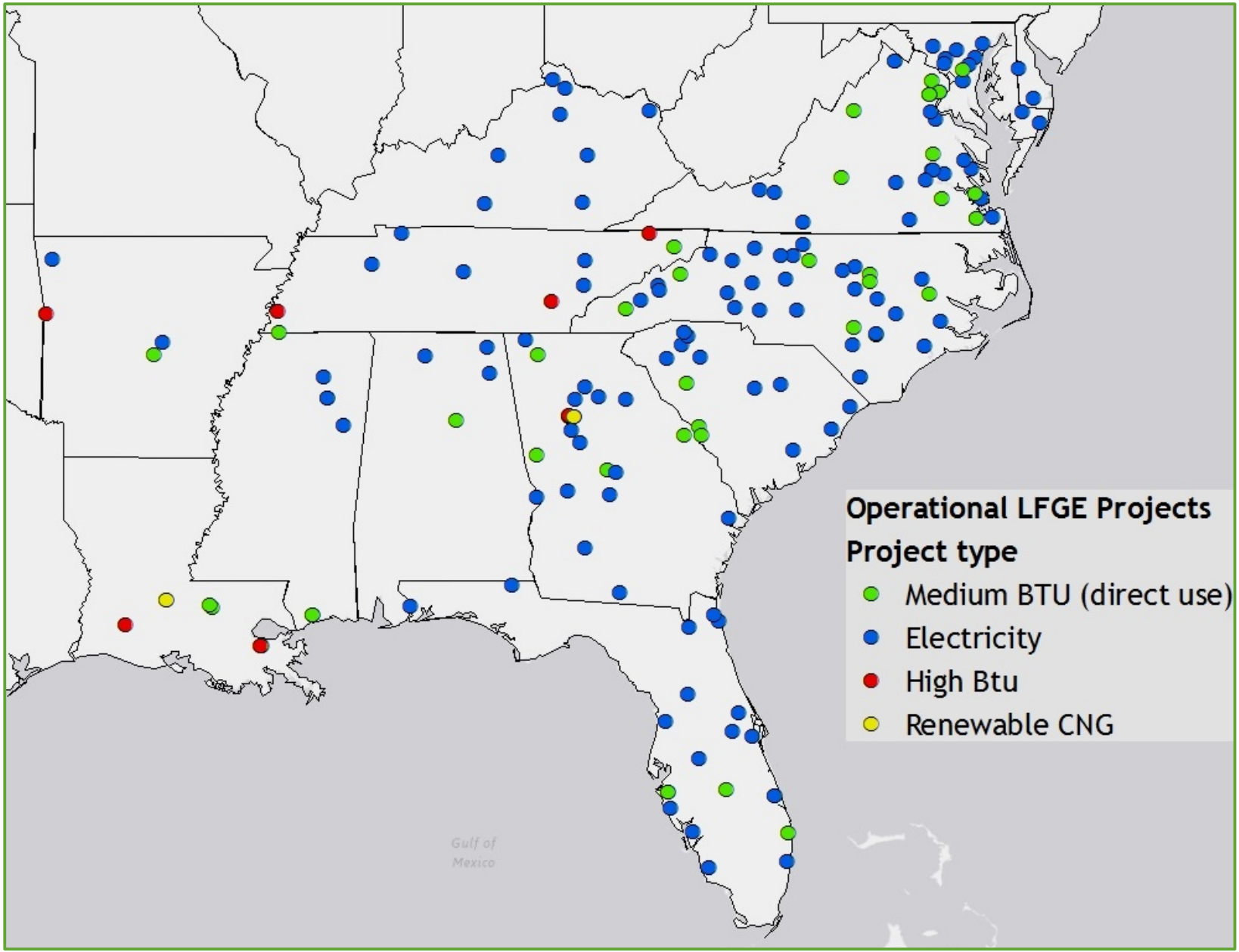
- Natural gas pipeline injection
- Vehicle fuel (CNG, LNG)

Natural Gas Pipeline Injection - Rochester, NH

CNG Fueling Station – St. Landry Parish, LA

BioCNG System – Dane County, WI

LFG Energy Projects in the Southern U.S.



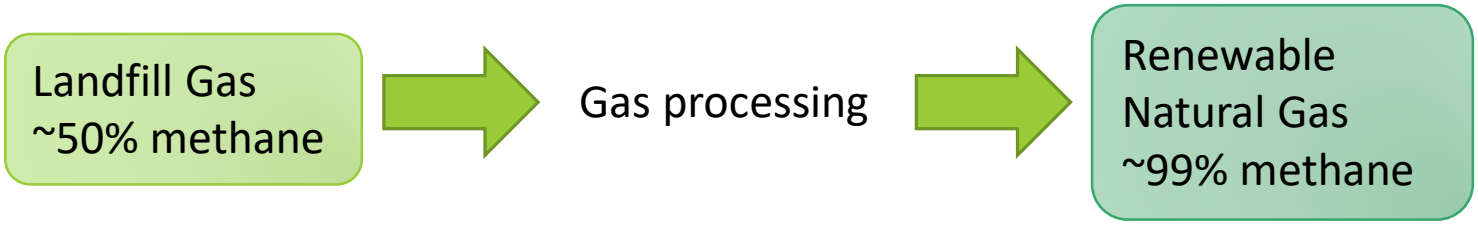
LFG for Vehicle Fuel

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



LFG to Onsite Vehicle Fuel (all projects in the U.S.)

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

Data from LMOP Database as of March 2017

LFG for Pipeline Injection (projects in southern states)

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

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

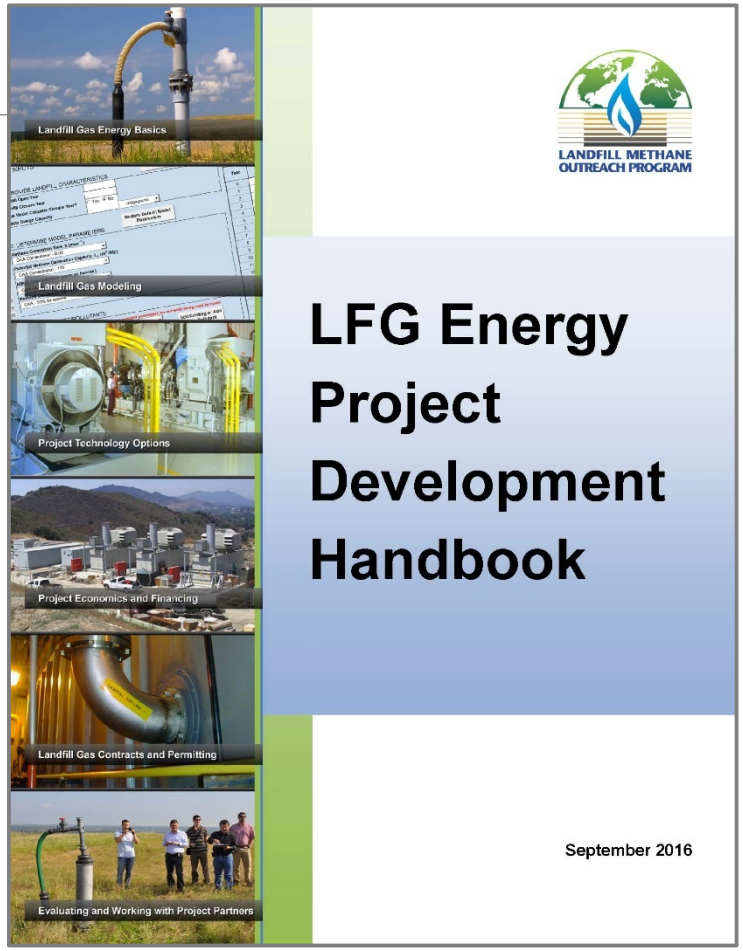
- Technical publications and tools
- Landfill and LFGE Project Database
- Network of 1,100 Partners
- Webinars and other events
- Listserv messages – upcoming events, news, RFPs

Key LMOP Resources

Project Development Handbook (PDH)

Improve understanding to develop successful projects

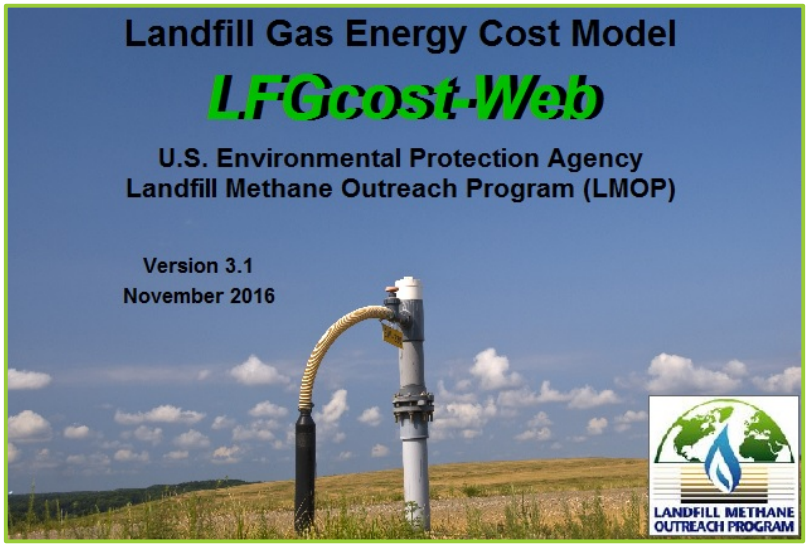
- Provides project-specific considerations
- Helps stakeholders who are new to LFG energy projects
- Highlights useful online resources and successful LFG energy projects



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 CO_2 grid factors based on regional electricity grids
- Added ability to enter user-defined project sizes without entering landfill waste data

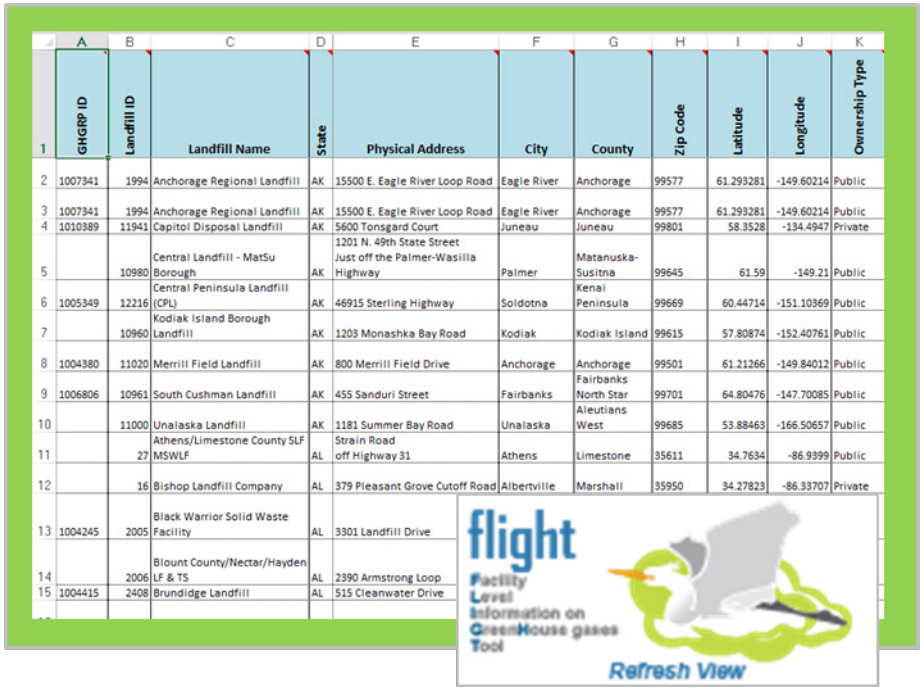
Key LMOP Resources

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)



	A	B	C	D	E	F	G	H	I	J	K
1	GHGRP ID	Landfill ID	Landfill Name	State	Physical Address	City	County	Zip Code	Latitude	Longitude	Ownership Type
2	1007341	1994	Anchorage Regional Landfill	AK	15500 E. Eagle River Loop Road	Eagle River	Anchorage	99577	61.293281	-149.60214	Public
3	1007341	1994	Anchorage Regional Landfill	AK	15500 E. Eagle River Loop Road	Eagle River	Anchorage	99577	61.293281	-149.60214	Public
4	1010389	11941	Capitol Disposal Landfill	AK	5600 Tonsgard Court	Juneau	Juneau	99801	58.3528	-134.4947	Private
5		10980	Central Landfill - MatSu Borough	AK	1201 N. 49th State Street Just off the Palmer-Wasilla Highway	Palmer	Matanuska-Susitna	99645	61.59	-149.21	Public
6	1005349	12216	Central Peninsula Landfill (CPL)	AK	46915 Sterling Highway	Soldotna	Kenai Peninsula	99669	60.44714	-151.10369	Public
7		10960	Kodiak Island Borough Landfill	AK	1203 Monashka Bay Road	Kodiak	Kodiak Island	99615	57.80874	-152.40761	Public
8	1004380	11020	Merrill Field Landfill	AK	800 Merrill Field Drive	Anchorage	Anchorage	99501	61.21266	-149.84012	Public
9	1006806	10961	South Cushman Landfill	AK	455 Sanduri Street	Fairbanks	Fairbanks North Star	99701	64.80476	-147.70085	Public
10		11000	Unalaska Landfill	AK	1181 Summer Bay Road	Unalaska	Aleutians West	99685	53.88463	-166.50657	Public
11		27	Athens/Limestone County SLF MSWLF	AL	Strain Road off Highway 31	Athens	Limestone	35611	34.7634	-86.9399	Public
12		16	Bishop Landfill Company	AL	379 Pleasant Grove Cutoff Road	Albertville	Marshall	35950	34.27823	-86.33707	Private
13	1004245	2005	Black Warrior Solid Waste Facility	AL	3301 Landfill Drive						
14		2006	Blount County/Nectar/Hayden LF & TS	AL	2390 Armstrong Loop						
15	1004415	2408	Brundidge Landfill	AL	515 Cleanwater Drive						

Help us keep this up to date!

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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