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U.S. Perspective on Landfill Gas Utilization Projects

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Presentation Overview

- Introduction
- Landfill Gas Energy in the United States
- Overview of Financing Structures in the United States
- Case Studies
- Available Resources



Introduction

U.S. EPA's Landfill Methane Outreach Program (LMOP):

- Established in 1994
- Voluntary program that creates partnerships among landfill owners and operators, states, municipalities, energy users and providers, and the LFG industry and communities



Mission: To work cooperatively with industry and stakeholders to reduce or avoid methane emissions from landfills by encouraging the recovery and beneficial use of biogas generated from organic municipal solid waste (MSW)

International Collaboration

The United States provides technical support to:

- Global Methane Initiative (GMI)
 - GMI is a voluntary, multilateral partnership that aims to reduce methane emissions and to advance the abatement, recovery, and use of methane as a clean energy source
 - Biogas Subcommittee: Covers methane recovery from agriculture (manure management), waste water, and MSW
 - Held meeting in September 2017 in Baltimore, MD
- Climate and Clean Air Coalition
 - MSW Initiative
 - To enable cities to develop robust waste management systems to achieve real and immediate SLCP reductions and other development benefits



Why Are We Concerned about Landfill Gas?

- More than half of U.S. MSW generated is landfilled – 52.6% in 2014¹
- LFG (~50% methane) is formed by anaerobic decomposition of MSW
- MSW landfills are an important source of U.S. methane emissions, hazardous air pollutants, and VOCs

1,000,000 tons of MSW generates enough LFG to produce³ 

**~0.78 megawatts
(MW) of electricity**

-or-

**~432,000 cubic
feet per day of LFG**

-or-

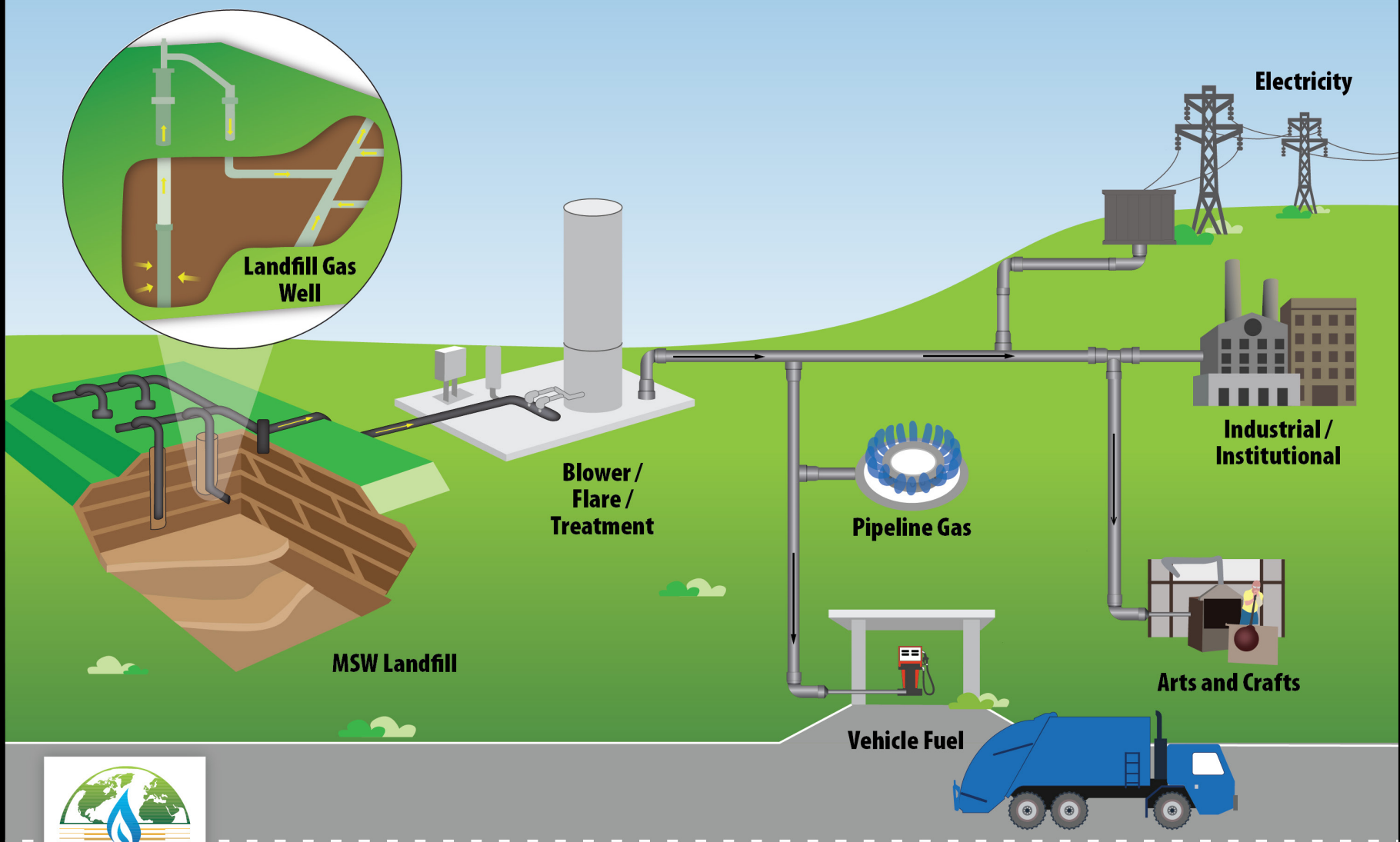
**433,700 gallons of gasoline
equivalent (GGE) per year of
CNG**

1. Advancing Sustainable Materials Management: 2014 Fact Sheet. November 2016. U.S. EPA. epa.gov/smm/advancing-sustainable-materials-management-facts-and-figures-report.
2. Inventory of U.S. Greenhouse Gas Emissions and Sinks. April 2017. U.S. EPA. epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.
3. *LMOP Interactive Conversion Tool*, U.S. EPA LMOP. epa.gov/lmop/list-publications-tools-and-resources and *LFGcost-Web*, Version 3.2. U.S. EPA LMOP. epa.gov/lmop/lfgcost-web-landfill-gas-energy-cost-model.

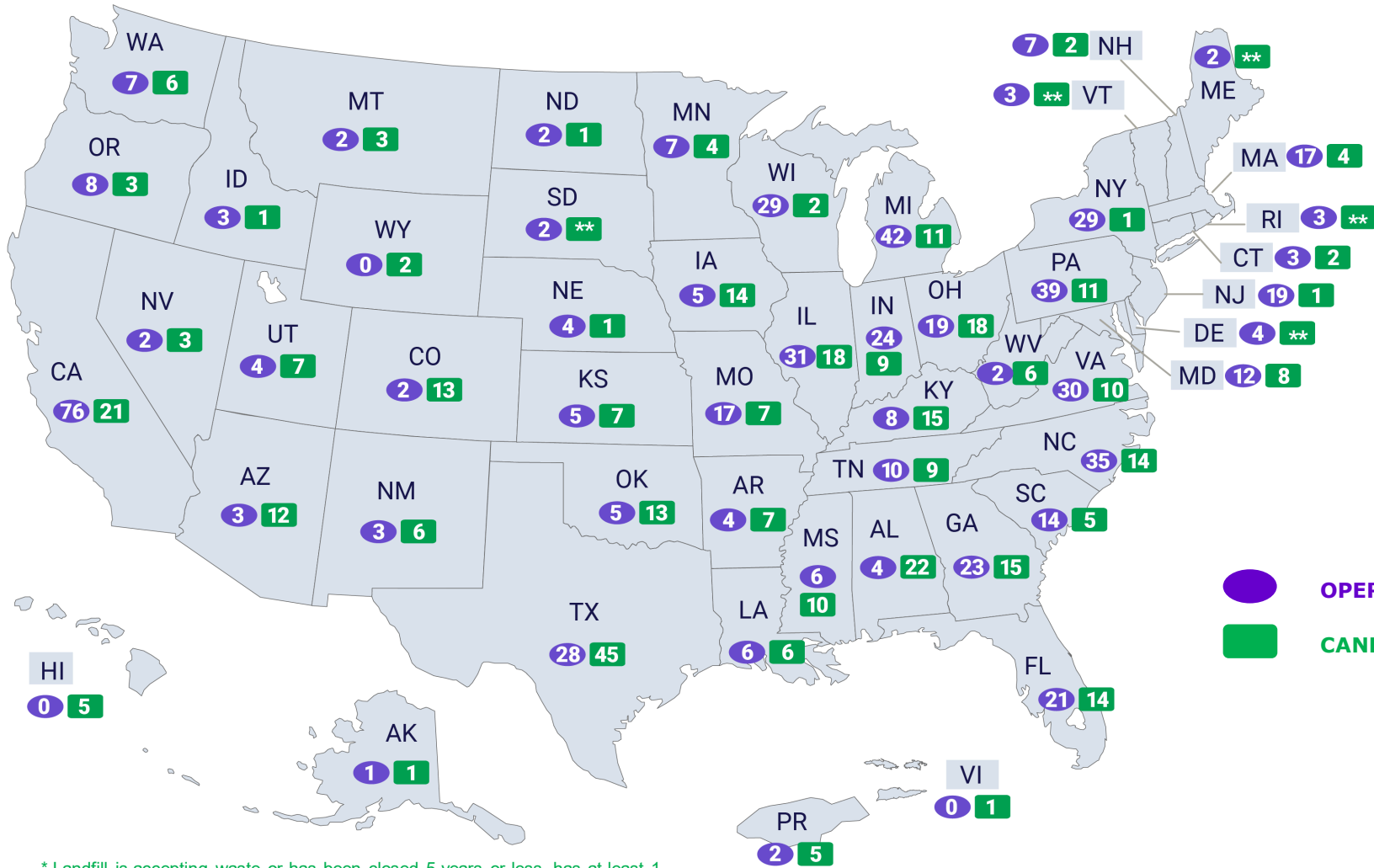
Collection

Processing

Methane Uses



LFG Energy Project Development in the United States



Nationwide Summary

634 OPERATIONAL Projects
(2,143 MW & 291 mmscfd)

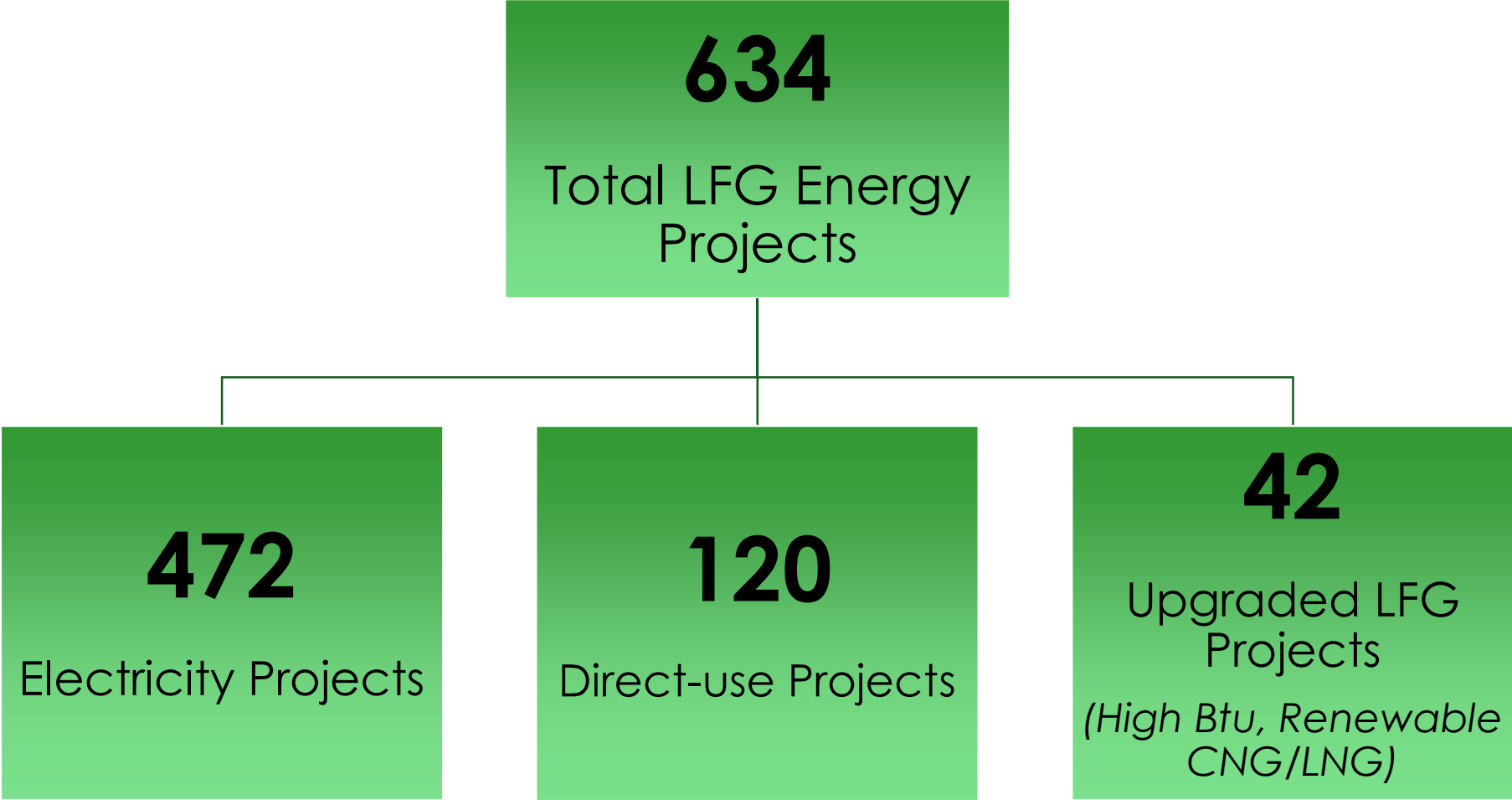
~400 CANDIDATE Landfills
(780 MW or 434 mmscfd,
38 MMTCO₂e/yr Potential)

* 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.

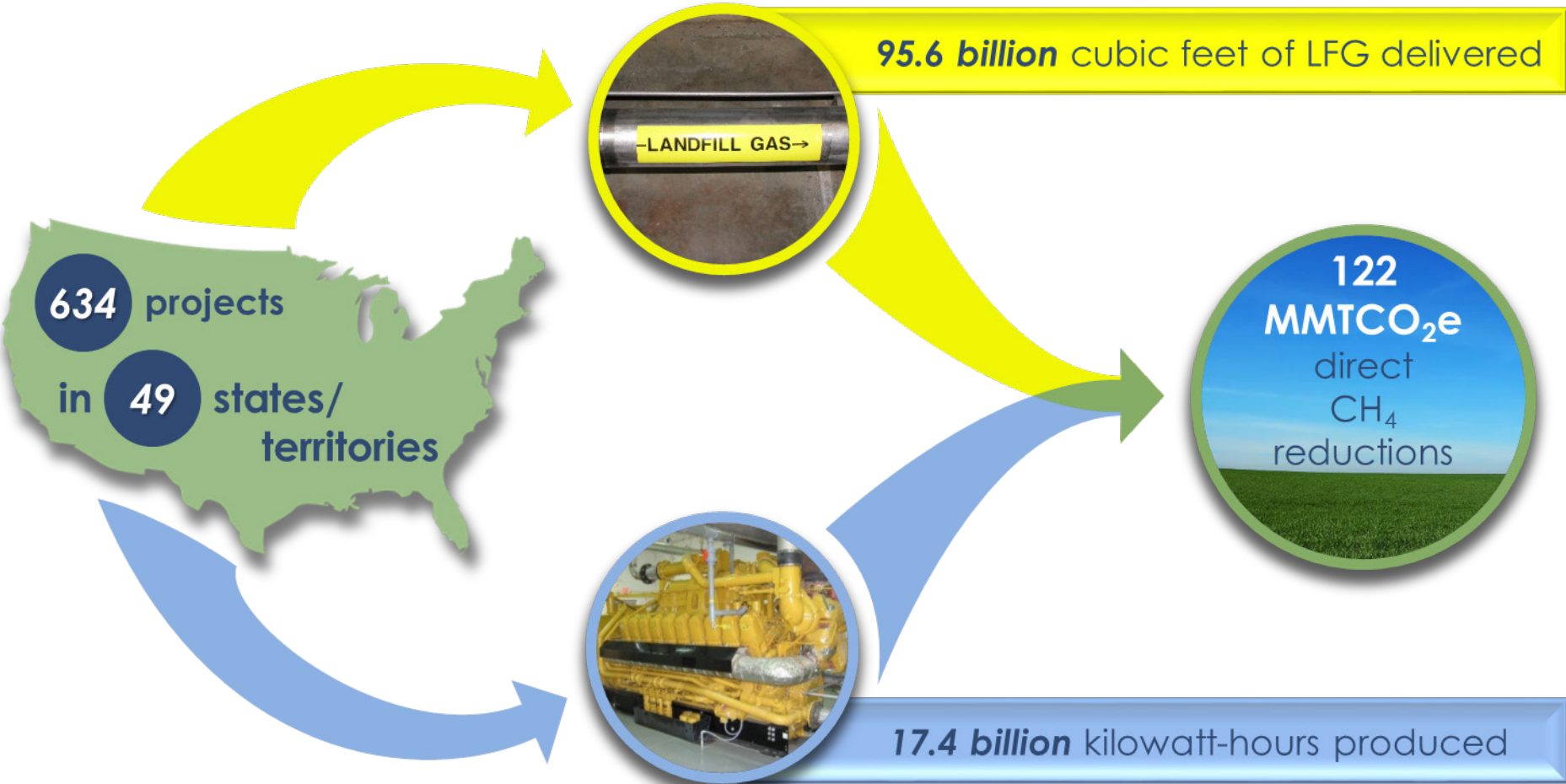
*These data are from LMOP'S Landfill and Landfill Gas Energy Database as of June 2017.

U.S. LFG Energy Project Types



*LFG energy project counts from LMOP's Landfill and Landfill Gas Energy Database as of June 2017.

U.S. LFG Energy Project Snapshot for 2017



*Estimated values are based on LFG energy projects operating in June 2017.

Benefits of LFG Energy Projects

Create local, renewable and consistent energy

Reduce local air pollution

Lead to health benefits

Generate revenue and jobs in the community and beyond

Typical Cost Elements for LFG Energy Projects

Capital Cost Elements

-  Design and engineering
-  Permits and fees
-  Site preparation and installation of utilities
-  Equipment, equipment housing and installation
-  Startup costs and working capital
-  Administration

Operations & Maintenance Elements

-  Parts and Materials
-  Labor
-  Utilities
-  Financing costs
-  Taxes
-  Administration

Three Main Structures for LFG Energy Project Development

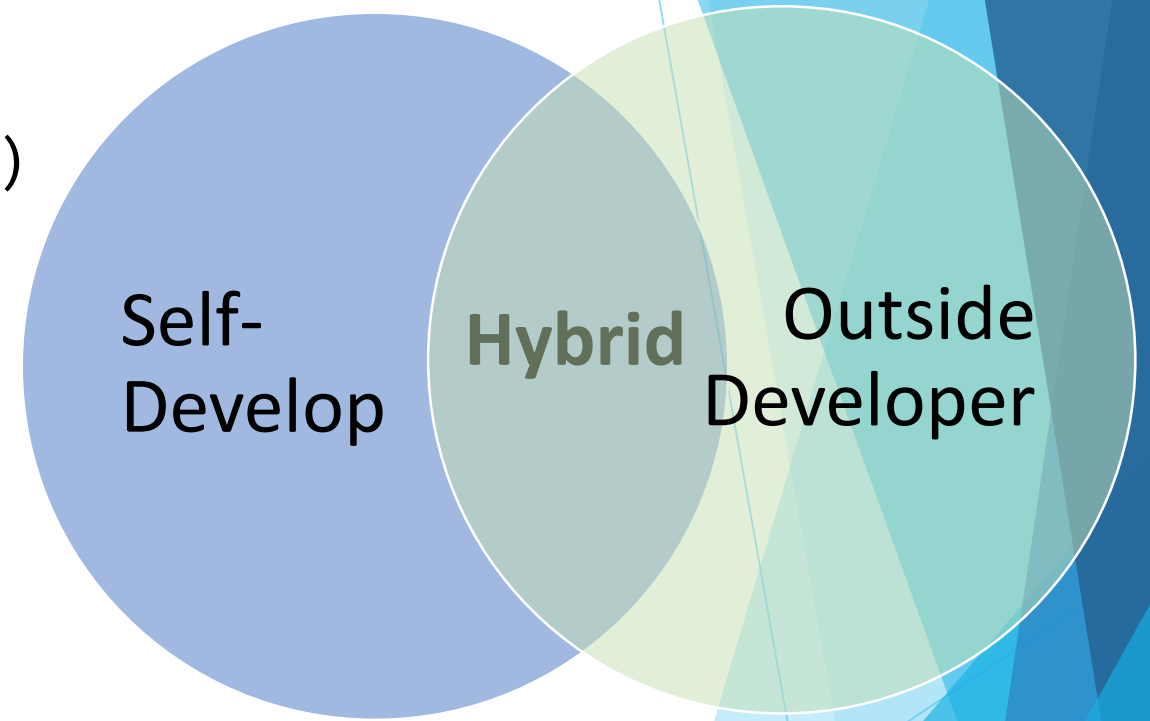
(1) Outside project developer

- E.g., Design Build Own Operate (DBOO)

(2) Self-develop

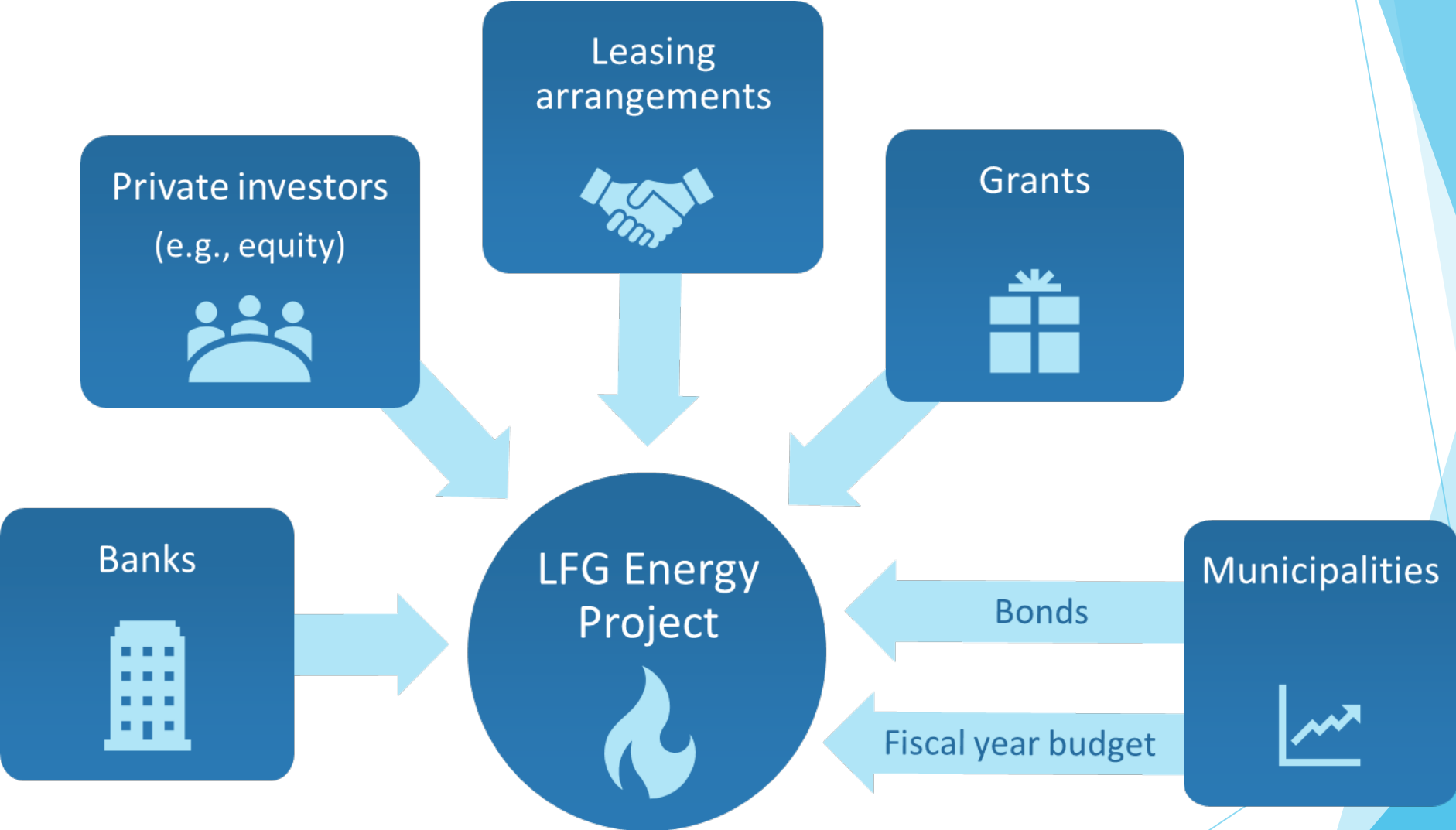
(3) Hybrid

- E.g., Design Build Operate (DBO)
- Engineer-Procure-Construct (EPC)
- Turnkey



Decision factors include: Economics; Expertise; Risk level

Financing Structures for LFG Energy Projects



Sources of Revenue or Savings for LFG Energy Projects

- Primary revenue sources are commodity sales and environmental markets
 - Direct sale of LFG / transportation fuel / electricity from LFG
 - Renewable Energy Certificates (RECs)
 - GHG Reduction Credits
 - Vehicle Fuel Credits
 - Renewable Fuel Standard (RFS) RINs
 - California Low Carbon Fuel Standard / Oregon Clean Fuels Program
 - Offsetting Energy or Fuel Costs

U.S. Policies that Encourage LFG Energy Projects

- LFG collection/destruction requirements
 - Federal Clean Air Act rules
 - State examples: California Landfill Methane Rule; Wisconsin air toxics rule
- Renewable Portfolio Standards/Goals (state, local or utility)
- Compliance (state/regional) or voluntary greenhouse gas markets
- Requirements for cleaner vehicle fuels (federal and/or state)
 - Renewable Fuel Standard (Federal)
 - California Low Carbon Fuel Standard (State)

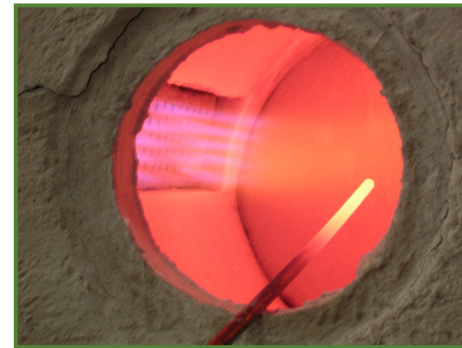
Challenges Facing LFG Energy Project Development

- Low natural gas prices / low electricity rates
- Expiration of incentives
- Interconnection logistics and costs
- Uncertainty about future LFG generation rates due to increased interest in (or requirements for) organic waste diversion away from landfills

Example 1: Self-developed Direct-use Project with Grants

Jackson County Green Energy Park, North Carolina – 1st phase online in 2006

- Small, closed landfill – saw opportunity to use this resource to help local artisans
- LFG used in greenhouses, blacksmith forges, metal art foundry, glassblowing
- Funded through grants from: NC State Energy Office, U.S. Department of Agriculture Rural Enterprise, NC Rural Center, Appalachian Regional Commission, Golden LEAF Foundation, Handmade in America, The Conservation Fund's Resourceful Communities
- Grants totaled at least \$452,000



Example 2: Utility-financed, Customer Green Power Program, and REPI

East Kentucky Power Cooperative (EKPC)

- Started its first 3 LFG electricity projects in 2003 and added 3 more between 2006 and 2015, for a total of 6 plants with 16 MW capacity
- Developing its own projects allows EKPC to minimize costs and maintain control over its power supply for its customers
- 15 of the 16 member systems within EKPC offer a voluntary green power purchasing program – customers can purchase 100-kWh blocks of green energy for a surcharge
- Several of EKPC's projects received federal REPI payments in 2005 through 2007



Example 3: Self-developed CNG with Carbon Credits, Grant, RINs

St. Landry Parish, Louisiana – onsite CNG project

- Initial capacity in 2012: 250 GGE/day from 50 cfm LFG for Parish vehicles; Total capacity in 2015: 630 GGE/day from 190 cfm LFG with transport of CNG to a satellite station to sell to a waste management company's fleet
- Value of carbon credits for 2009-2012 totaled \$616,000
- Received \$551,000 grant from EmPOWER Louisiana – Transportation Efficiency & Alternative Fuels Program for fleet conversion / purchase
- Earning \$0.74/GGE for RINs (in 2014)



2018 Global Methane Forum

- Hosted jointly by GMI, CCAC, and Canada
- Audience: Partner Country delegates, private sector, NGOs, academia

Registration will open soon!



For more information, please contact Monica Shimamura: shimamura.monica@epa.gov

Thank you!

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