

Modern Landfill Gas to Energy

October 2018

Overview

As degradable organic materials such as food and paper decompose in municipal solid waste landfills, landfill gas (LFG) is generated. Anaerobic bacteria, microbes that can exist without oxygen, produce the gas as a byproduct of consuming the organic matter. LFG is approximately half methane (CH₄) and half carbon dioxide (CO₂). There is also a small amount of non-methane organic compounds (NMOC).

Methane is the same compound found in natural gas, used for heating and cooking and producing energy. Therefore, recovered LFG can be used as a source of energy. However, it can be dangerous due to its flammability; and, it is a greenhouse gas (GHG). Because of this, LFG may be regulated for collection and management to protect human health and the environment.

Background

- Landfills are the third largest source of methane emissions in the U.S. after Enteric Fermentation and Natural Gas Systems.
- GHGs emissions are measured using carbon dioxide equivalent or (CO₂e) to establish common standard for comparison.
- A global warming potential (100-year time horizon) of 25 is used for methane. This means that methane emissions are multiplied by 25 to obtain CO₂e.
- Since 1990, landfills have reduced their GHG emissions by 40%, going from 179.6 MMT CO₂e to 107.7 MMT CO₂e.
- Methane emissions are controlled from landfills through collection and flaring or energy recovery.

Regulations Requiring LFG Management

The U.S. EPA regulates emissions from municipal solid waste (MSW) landfills through the New Source Performance Standards or Emission Guidelines. Landfills with a design capacity of 2.5 million metric tons are subject to the rules. The rules require landfills that emit greater than 34 metric tons of non-methane organic compounds annually to install and operate a gas collection and control system.

In addition, along with other industries, landfills are required to report GHG data to the U.S. EPA if emissions exceed 25,000 metric tons CO₂e. The data is compiled into the U.S. Greenhouse Gas Inventory that is released annually.

Landfill gas to energy (LFGTE)

Because LFG is approximately half methane, it can be utilized to generate electricity or be utilized as a fuel. The image below illustrates potential methods for LFG to be converted to energy. (See **fig.1**)

- Many Potential Uses Exist
- Converting to electricity and putting out onto the grid;
- Upgrading the gas to nearly 100% methane and putting it into the natural gas pipeline;
- Compressing the gas and using it for vehicle fuel;
- Using it in direct applications such as in kilns, brick-making or greenhouses; and,
- Industrial applications to power gas turbines or use for on-site needs.

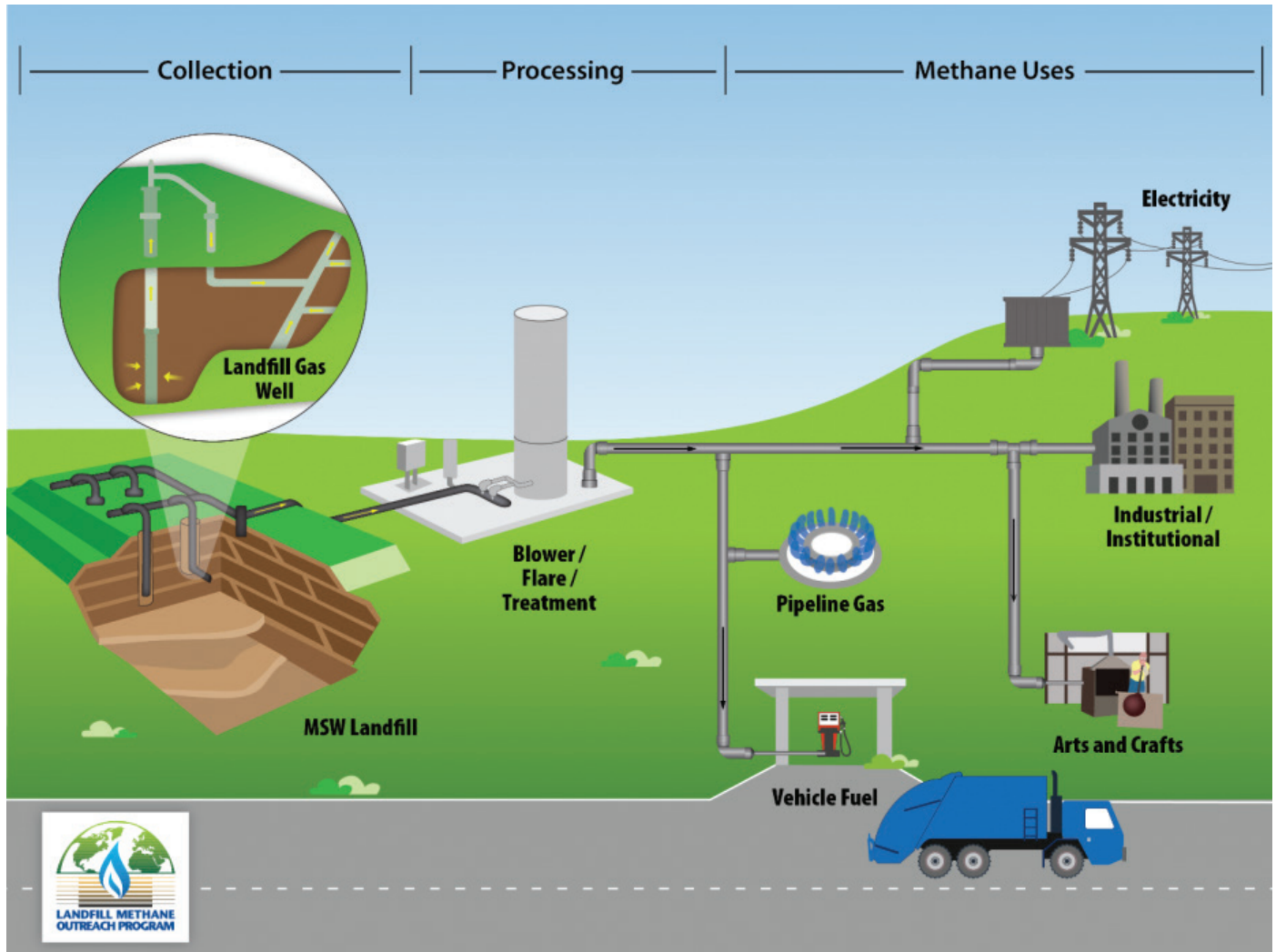


Figure 1: Source - <https://www.epa.gov/lmop/basic-information-about-landfill-gas>

LFGTE Projects

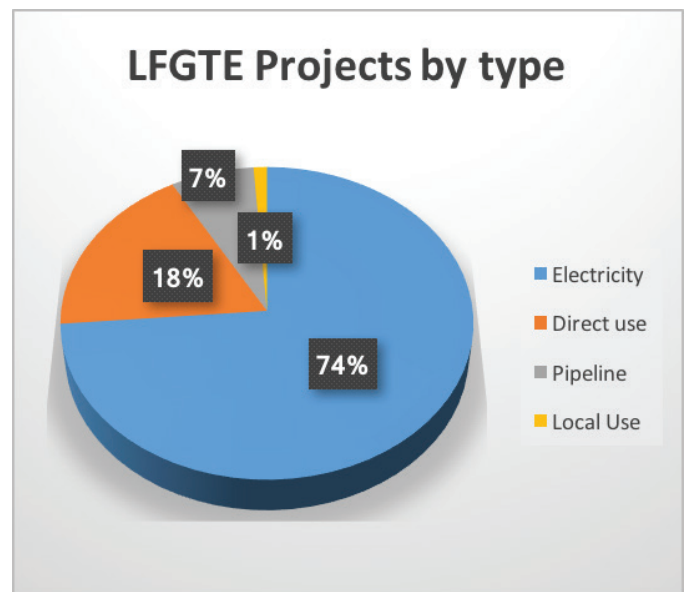
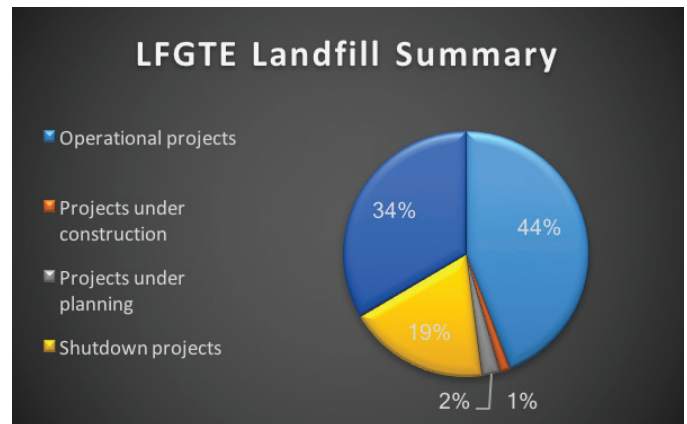
The U.S. EPA's Landfill Methane Outreach Program (LMOP) tracks LFGTE projects. Their most recent data released September 2018 shows the following:

Open Landfills

- Ownership
 - 492 privately owned
 - 725 publicly owned
 - 3 unknown
- Biggest by capacity
 - Apex Regional Landfill, NV – 994 million tons
 - ECDC Environmental Landfill, UT – 482 million tons
 - Columbia Ridge Landfill, OR – 429 million tons
 - Denver Arapahoe Disposal Site (DADS), CO -370 million tons
- Major companies
 - WM – 158 owned, 22 operated
 - Republic – 140 owned, 29 operated
 - Waste Connections – 43 owned, 27 operated
 - Advanced – 29 owned, 2 operated
 - Rumpke – 8 owned
 - Casella Waste Systems – 4 owned, 5 operated
 - Waste Industries – 1 owned, 3 operated

Landfill Gas Projects

- LFGTE project numbers
 - Operational – 623
 - Planned – 34
 - Under construction – 19
- LFGTE project type
 - Electricity – 459
 - Direct use – 113
 - RNG/Pipeline – 44
 - RNG/Local - 7



State	Operational projects	Candidate landfills	Total landfills
Alabama	4	21	43
Alaska	1	3	8
Arizona	3	17	38
Arkansas	4	13	25
California	68	25	298
Colorado	2	14	37
Connecticut	3	2	24
Delaware	4	-	4
Florida	20	17	75
Georgia	23	21	77
Hawaii	0	5	15
Idaho	4	1	31
Illinois	29	19	94
Indiana	24	9	90
Iowa	5	16	30
Kansas	6	8	37
Kentucky	9	14	39
Louisiana	6	16	37
Maine	2	-	12
Maryland	12	8	48
Massachusetts	17	4	47
Michigan	42	14	57
Minnesota	7	5	30
Mississippi	7	11	26
Missouri	17	6	104
Montana	2	3	30
Nebraska	6	6	27
Nevada	2	3	10
New Hampshire	7	1	48
New Jersey	18	1	28
New Mexico	3	9	16
New York	28	2	85
North Carolina	32	12	122
North Dakota	2	3	14
Ohio	19	18	71
Oklahoma	6	15	30
Oregon	7	3	24
Pennsylvania	39	9	73
Rhode Island	3	-	5
South Carolina	13	4	48
South Dakota	2	1	9

Tennessee	10	14	129
Texas	30	49	126
Utah	4	7	54
Vermont	3	-	9
Virginia	31	14	71
Washington	5	7	54
West Virginia	2	9	22
Wisconsin	28	3	54
Wyoming	0	2	4
Total	621	464	2489

Resources:

EPA Landfill Methane Outreach Program (LMOP), Basic information about landfill gas:

<https://www.epa.gov/lmop/basic-information-about-landfill-gas>

ATSDR Landfill Gas Primer, Chapter 2: Landfill Gas Basics:

<https://www.atsdr.cdc.gov/HAC/landfill/html/ch2.html>

EIA Biomass Explains, Landfill Gas and Biogas – Basics:

https://www.eia.gov/energyexplained/print.php?page=biomass_biogas

EPA Landfill Methane Outreach Program (LMOP), Landfill Technical Data:

<https://www.epa.gov/lmop/landfill-technical-data>

EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2016:

https://www.epa.gov/sites/production/files/2018-01/documents/2018_complete_report.pdf

EPA Updates on NSPS and Emission Guidelines for MSW Landfills:

<https://www.epa.gov/sites/production/files/2016-09/documents/landfills-final-nsps-eg-factsheet.pdf>