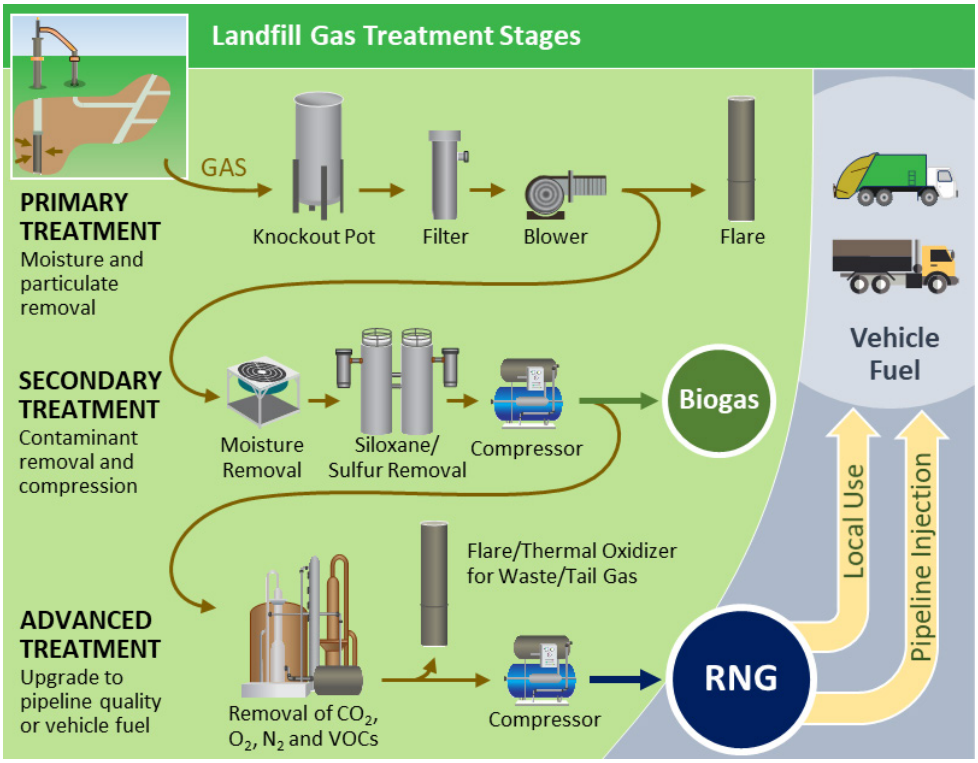
Landfill Gas to Vehicle Fuel

May 2020

Landfill gas (LFG) is produced naturally when organic material decomposes in landfills. LFG consists of roughly 50 percent carbon dioxide and 50 percent methane, with other trace constituents. Methane, a potent greenhouse gas (GHG) that traps heat in the atmosphere, is also the primary component of fossil natural gas. Through treatment, LFG can be upgraded into a fuel substitute for fossil natural gas—called renewable natural gas (RNG)—with a methane content between 96 and 98 percent. Unlike fossil natural gas, **RNG comes from *renewable* sources** (e.g., landfills, livestock farms and organic waste facilities) and does not contain heavy hydrocarbons. RNG has many end uses, including as vehicle fuel, to generate electricity or for heating.

Once compressed (CNG) or liquefied (LNG), RNG can be used in natural gas vehicles, without any modifications to engines or fuel systems. The RNG can be conditioned, stored and dispensed locally or injected into a pipeline for conversion to vehicle fuel at another location. The pipeline networks, fueling station infrastructure and fleet characteristics are the same for RNG and fossil natural gas. In 2019, 56 LFG-to-RNG projects in the United States provided at least a portion of the RNG for vehicle fuel; seven of these projects had local delivery while 49 involved pipeline injection.

Advanced Treatment of LFG for Use as a Vehicle Fuel



Benefits

The U.S. Department of Energy (DOE) estimates that there are more than 160,000 natural gas vehicles (NGVs) operating in the United States.[1] Using vehicle fuel from LFG offers municipalities, states and companies benefits:

- While NGVs typically emit slightly fewer GHGs (on a life cycle basis) than gasoline or diesel vehicles, using RNG can yield GHG reductions of up to 75 percent.[2]
- NGVs emit fewer nitrogen oxides and particulate matter than diesel vehicles.
- NGV fuel systems are sealed from the atmosphere and do not emit hydrocarbons via fuel tank evaporation like gasoline and diesel fuel systems.
- Dedicated natural-gas-fueled trucks emit significantly less noise than comparable diesel-fueled trucks, with a difference of about 10 decibels at idle.[3]
- NGVs can provide critical services during emergencies when gasoline supplies are limited.[4]
- DOE's Alternative Fuels Data Center lists laws and incentives related to NGVs and RNG at afdc.energy.gov/fuels/natural_gas_renewable.html and DOE's Clean Cities Coalition Network (cleancities.energy.gov/) has 90+ coalitions interested in partnering with developers on fleet usage.

EPA's Landfill Methane Outreach Program (LMOP) is a voluntary program that works cooperatively with industry stakeholders and waste officials to reduce or avoid methane emissions from landfills. LMOP encourages the recovery and beneficial use of biogas generated from organic municipal solid waste (MSW) and helps businesses, states and communities protect the environment and build a sustainable energy future. For more information about LMOP, see www.epa.gov/lmop.

Incentives

- RNG derived from LFG is considered a cellulosic biofuel eligible for D3 Renewable Identification Number (RIN) credits under EPA's Renewable Fuel Standard (RFS). When tracked and documented, these credits can be monetized and used to reduce the sales price of the fuel.

  EPA's Office of Transportation and Air Quality manages the RFS program (see epa.gov/renewable-fuel-standard-program) and provides information related to alternative fuel vehicles at epa.gov/greenvehicles.

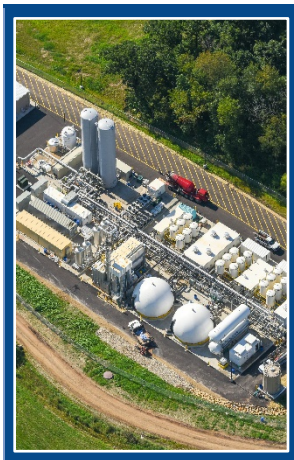
- State-specific vehicle fuel emission reduction programs[5] characterize fuels in terms of "carbon intensity" (CI). A fuel's CI is the measure of GHG emissions associated with producing and consuming the fuel based on a complete life cycle analysis. A fuel with a CI below the annual standard set by the state—like RNG made from LFG—can generate valuable credits.

- Vehicle fuel from RNG is not subject to the market volatility of gasoline and diesel.

More Information

- See EPA LMOP's RNG webpage at epa.gov/lmop/renewable-natural-gas for a map of RNG projects in the United States and other EPA resources.

Project Examples



Dane County's RNG facility[6]

Dane County Public Works
Madison, Wisconsin

- ✓ Since 2013, has produced up to 250 gasoline gallons equivalent of CNG per day from 50 cubic feet per minute (cfm) of LFG for onsite fueling of county vehicles.
- ✓ In April 2019, a new project began to collect and treat LFG for injection into ANR-TransCanada's interstate transmission pipeline for delivery to regional CNG fueling stations.
- ✓ A gas offloading station allows other biogas producers in the area to bring their cleaned-up gas via tube trailers for injection into the pipeline too.
- ✓ This is the first landfill in the nation to receive RNG from multiple offsite locations and connect to local CNG stations.

RNG production facility at the SWACO landfill[7]

Solid Waste Authority of Central Ohio (SWACO)
Grove City, Ohio

- ✓ LFG is refined into RNG and injected into a natural gas pipeline for transport to customers in California, where at least part of the RNG is converted to vehicle fuel.
- ✓ The exact RNG molecules may not be delivered, but an equivalent amount of natural gas is pulled from the pipeline in California to match the RNG injected from this Ohio plant.
- ✓ This project benefits from two fuel credit incentives: California's Low Carbon Fuel Standard and EPA's RFS.
- ✓ SWACO reinvests its revenue from the project into waste diversion programs and other services for the community.

CNG pump at the St. Landry site[8]

St. Landry Parish Solid Waste District
Washington, Louisiana

- ✓ Features a BioCNG™ system capable of producing 630 gasoline gallons equivalent of vehicle fuel per day from 150 cfm of LFG.
- ✓ Original project in 2012 fueled about 15 Parish vehicles on site, including pick-up trucks, sedans and a passenger van.
- ✓ System expansion in 2015 included a new satellite fueling station 15 miles away and a tube trailer to transport CNG there for use by a national waste company and the public.
- ✓ Represents a closed-loop system: the waste collection vehicles that deposit garbage in the St. Landry Parish Landfill are now fueled by the biogas created from that waste.

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1 U.S. Department of Energy, "Natural Gas Vehicles," https://www.afdc.energy.gov/vehicles/natural_gas.html, June 4, 2019.
2 Argonne National Laboratory, Alternative Fuel Life-cycle Environmental and Economic Transportation (AFLEET) tool, https://afleet-web.es.anl.gov/home/, November 2018.
3 Saddle Creek Logistics Services, "Leveraging CNG to Support Corporate Sustainability Goals," https://www.sclogistics.com/wp-content/uploads/2018/08/CNGWhitePaper.pdf, September 17, 2012.
4 Initiative for Resiliency in Energy through Vehicles, *Natural Gas Vehicles and Emergency Response,* https://naseo.org/data/sites/1/documents/publications/iREV%20Natural%20Gas%20Case%20Study.pdf, June 2016.
5 Examples of vehicle fuel emission reduction programs include California's Low Carbon Fuel Standard (https://www.arb.ca.gov/fuels/lcfs/lcfs.htm) and Oregon's Clean Fuels Program (https://www.oregon.gov/deq/aq/programs/Pages/Clean-Fuels.aspx).
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