

U.S. Department of Energy - Energy Efficiency and Renewable Energy
Alternative Fuels Data Center

Renewable Natural Gas (Biomethane)

Renewable natural gas (RNG), also called biomethane, is becoming more common as a vehicle fuel in the United States. RNG is produced from biogas – also known as swamp gas, landfill gas, or digester gas—which is the gaseous product of [anaerobic digestion](#) of organic matter. With minor cleanup, biogas can be used to generate electricity and heat. When processed to a higher purity standard, biogas is called RNG and can be used as an alternative fuel for [natural gas vehicles](#).

Biogas is usually 50% to 80% methane and 20% to 50% carbon dioxide, with traces of gases such as hydrogen, carbon monoxide, and nitrogen. In contrast, natural gas is usually more than 70% methane, with most of the rest being other hydrocarbons (such as propane and butane) and traces of carbon dioxide and other contaminants.

According to NGVA Europe, About 60% of the gas used in Sweden's 38,500 natural gas vehicles is RNG. In Germany, 25% of the public compressed natural gas stations dispense 100% RNG. In the United States, biomethane vehicle activities are on a smaller scale.

Production

Biogas is a product of decomposing organic matter, such as sewage, animal byproducts, and agricultural, industrial, and municipal solid waste.

To fuel vehicles, biogas must be upgraded to a purity standard and either compressed for onsite dispensing or injected into the gas grid for distribution to dispersed fueling locations.

Biogas from Landfills

Landfills are designated locations for disposal of waste collected from residential, industrial, and commercial entities. Landfills are the third-largest source of human-related methane emissions in the United States, according to [EPA](#). Biogas collection is practical for landfills at least 40 feet deep with at least 1 million tons of waste. Biogas from landfills is also called landfill gas (LFG), as the digestion process takes place in the ground rather than in an anaerobic digester. As of July 2013, there were about 621 operational LFG projects in the United States, according to [EPA](#). However, most of these projects use biogas to produce electricity rather than power natural gas vehicles.

Find [examples of landfills using biogas](#) for vehicle fuel from the [Sanitation Districts of Los Angeles County](#).

Biogas from Livestock Operations

Biogas recovery systems at livestock operations can produce renewable fuel. Animal manure can be collected and delivered to an [anaerobic digester](#) to stabilize and optimize methane production. The resulting biogas can be upgraded and used to fuel natural gas vehicles. [EPA estimates](#) that 8,200 U.S. dairy and swine operations could support biogas recovery systems, with the potential to generate more than 13 million megawatt-hours and displace about 1,670 megawatts of fossil fuel-fired generation collectively per year. Biogas recovery systems are also feasible at some poultry operations and confined animal operations.

There are several biogas-to-CNG projects at animal farms in the United States, including Hilarides Dairy in California and Fair Oaks Dairy in Indiana. More information can be found at EPA's [Operating Anaerobic Digester Projects](#).

Biogas from Wastewater Treatment

Biogas could be produced during the digestion of solids removed in the wastewater treatment process. [EPA](#) estimates this biogas potential to be about 1 cubic foot of digester gas per 100 gallons of wastewater. Energy generated at U.S. wastewater treatment plants (WWTPs) could potentially meet 12% of the national electricity demand, according



This tractor trailer sanitation vehicle runs on renewable natural gas made from converted landfill gas.

to the [National Association of Clean Water Agencies](#) ; there are over 16,000 WWTPs in the United States, and about 1,500 employ anaerobic digestion to produce biogas, which is used on site.

Other Sources of Biogas

Other sources of biogas include organic waste from industrial, institutional, and commercial entities, such as food manufacturing and wholesalers, supermarkets, restaurants, hospitals, educational facilities, etc. Learn more about [Clean World's Sacramento BioDigester](#) project, the largest anaerobic digestion system of its kind in North America.

Biogas could also be produced from lignocellulosic material, such as crop residues and dedicated energy crops, via thermochemical conversions, co-digestion, and dry fermentation. These technologies are well underway in [Europe](#) , with limited applications in the United States.

Distribution

After biogas is produced, it must be refined to meet pipeline specifications. Refining biogas means increasing the proportion of methane and decreasing the proportion of carbon dioxide, carbon monoxide, nitrogen and other contaminants through absorption, adsorption, membrane separation, or cryogenic separation. RNG can be distributed via existing [natural gas distribution](#) routes.

Benefits

RNG can be an alternative to conventional transportation fuels. The benefits of RNG are similar to the [benefits of natural gas](#). Additional benefits include:

- **Increased Energy Security**—Biogas offsets non-renewable resources, such as coal, oil, and fossil fuel-derived natural gas. Producing biogas creates U.S. jobs and benefits local economies.
- **Lower Emissions**—Capturing biogas reduces emissions by preventing methane release into the atmosphere. Methane is 25 times stronger than carbon dioxide as a greenhouse gas.
- **Better Economics**—Biogas reduces the cost of complying with EPA combustion requirements for landfill gas.
- **Cleaner Environment**—Producing biogas through anaerobic digestion reduces landfill waste and odors and produces nutrient-rich liquid fertilizer.

Research and Development

Research and development efforts are reducing the costs of biogas production and purification, working toward advanced and efficient conversion technologies, producing higher-quality RNG, and evaluating the performance of RNG-fueled vehicles. Some federal and state programs assist in these efforts, including EPA's [Landfill Methane Outreach Program](#) and [AgSTAR Program](#), a collaborative effort of EPA, the [U.S. Department of Agriculture](#), and the U.S. Department of Energy.

More Information

Learn more about RNG and biogas from the links below. The AFDC and U.S. Department of Energy do not necessarily recommend or endorse these companies (see [disclaimer](#)).

- [Biogas Potential in the United States Fact Sheet \(PDF\)](#) (NREL)
- [American Biogas Council](#)
- [Task 37: Energy from Biogas](#) (International Energy Agency)
- [Renewable Natural Gas for Transportation: An Overview of the Feedstock Capacity, Economics, and GHG Emission Reduction Benefits of RNG as a Low-Carbon Fuel \(PDF\)](#) (The National Petroleum Council)
- [A Biogas Road Map for Europe \(PDF\)](#) (European Biomass Association)
- [Canadian Biogas Study: Benefits to the Economy, Environment and Energy \(PDF\)](#) (Biogas Association)
- [Natural Gas Vehicle Technology Forum](#)
- [Waste to Wheels: Building for Success Workshop](#) (Clean Cities)
- [Renewable Natural Gas: Current Status, Challenges, and Issues](#) (Clean Cities)
- [Operational Biogas Systems in the United States](#) (American Biogas Council)
- [EPA's Landfill Methane Outreach Database](#) (EPA)
- [Operating Anaerobic Digester Projects](#) (EPA)