

An Introduction to Renewable Natural Gas

Renewable natural gas (RNG) is a renewable energy source that, when used, can reduce methane emissions, and provide other environmental benefits. Derived from organic waste matter, **RNG** can be used as a substitute for natural gas and has many end uses. This factsheet provides general background information on **RNG** and links to other EPA **RNG**-related resources.

What is RNG?

- EPA's methane partnership programs define RNG as anaerobically generated biogas that has been refined for use in place of fossil natural gas.
- The biogas used to produce RNG can be sourced from municipal solid waste (MSW) landfills, wastewater treatment plants, stand-alone organic waste management operations, and livestock manure management systems.

How is RNG made?

- Raw biogas has between 45 and 65 percent methane and a small amount of carbon dioxide, among other compounds; RNG has a methane content of 90 percent or greater.
- To produce RNG, raw biogas must go through a series of steps to remove carbon dioxide, water, and other trace chemicals.
- The level of refinement depends on use – RNG for pipelines and vehicles needs more refinement than RNG for thermal and electricity uses.

Options for RNG Delivery

- The two main methods for delivering RNG to end users are injection into a pipeline or using the gas on site or locally.

Pipeline Injection¹ (~40% of projects in the United States)

- RNG projects inject the product into a fossil natural gas pipeline, either a transmission or distribution pipeline.
- There are two components to a pipeline interconnection facility:
 - 1. Point of receipt:**
 - » Monitors gas quality to ensure it meets specifications
 - » Prevents non-compliant gas from entering the pipeline network
 - » Meters and odorizes the volume of RNG put into the pipeline network
 - 2. Pipeline extension:**
 - » Transfers the RNG from the point of receipt to the nearest available natural gas pipeline
- If pipeline connections do not exist, the RNG project will need to construct a pipeline extension.

On-site or Local Applications (~60% of projects in the United States)

- **Vehicle fuel**
 - » Use of compressed natural gas (CNG) for on-site fleet vehicles requires less upgrading (no need to meet RNG pipeline specifications) and avoids interconnection and transport costs.

Thermal applications

- » Use of RNG can offset fossil fuel-based thermal energy (e.g., natural gas or distillate oil), resulting in anywhere from 40 to 100 percent decrease in greenhouse gas emissions, reducing flaring or on-site combustion which reduces criteria pollutant emissions and improves air quality.²

Virtual pipeline

- » In a virtual pipeline, RNG is compressed at the point of generation then transported by truck to the point of injection or the site where it will be used.
- » At the destination, the RNG is decompressed to the pressure required by the receiving facility.
- » A virtual pipeline can be convenient for projects where an RNG plant is not close to end users, such as remote landfills, farms, and other biogas sources

Options for RNG Use



VEHICLE FUEL.

RNG can be used as compressed natural gas (CNG) or liquefied natural gas (LNG), in different vehicle types.



ELECTRICITY PRODUCTION.

RNG can be used to generate electricity.



THERMAL APPLICATIONS.

RNG can be used in direct thermal applications such as boilers, greenhouses, and kilns.

Benefits of a Well-Run RNG Project³

Greater Fuel Diversity and Availability

- » Biogas feedstocks are generated continuously from a variety of sources.
- » RNG diversifies domestic energy production from more sources in case of national emergencies or energy shortages.

Local Economic Impacts

- » RNG leads to more sales of CNG- or LNG-powered vehicles in the area.
- » Studies have found that California RNG production facilities could generate 8.5 to 11.2 jobs per million diesel gallon equivalent compared to petroleum refineries that generate 1.6 jobs per million diesel gallon equivalent.⁴

Local Air Quality Improvements

- » Local air quality can be improved when replacing older, heavy-duty diesel vehicles with CNG vehicles that emit less nitrogen oxide and particulate matter.

Reduced Greenhouse Gas Emissions

- » RNG-based vehicles yield greenhouse gas reductions of up to 75 percent compared to gasoline and diesel vehicles.
- » Landfill Gas (LFG)-to-CNG projects are relatively less carbon-intensive than fossil fuel-derived diesel projects.

RNG Operation Best Practices

- Minimize methane leaks from the RNG upgrading process using leak detection technology utilizing automated leak detection systems that notify the operator automatically when a leak occurs.
- Properly operate and maintain upgrading equipment.
- Use renewable electricity to power upgrading equipment wherever possible.
- Minimize the distance between the point of generation and the point of injection or end use wherever practicable.
- Use best practices for leak detection and minimizing leaks along the delivery route.

Considerations for Project Feasibility and Potential for Growth

- Landfills are potential sources of biogas that can be recovered and used for energy, but LFG contains a high percentage of nitrogen that is expensive to remove.
- Under conditions of low natural gas prices, the cost of biogas collection and gas cleanup is relatively expensive, making RNG project economics more challenging.
- RNG pipelines across the United States have different quality specifications and are not standardized, leading to less clarity and certainty for RNG providers.

RNG Projects in the United States⁵

- As of 2022, more than 173 RNG projects are operating across 31 states and approximately 40 more are under construction.
- In the United States, more than 45 percent of operating RNG projects use landfill gas. About 55 percent of U.S. RNG projects are from anaerobic digester systems (manure management systems and food waste).

Policies and Incentives

- Depending on the source of the RNG and how it is documented, it could be eligible for EPA's [Renewable Fuels Program](#), which mandates the incorporation of renewable fuels into the nation's fuel supply and provides financial incentives.
- Some states have renewable portfolio standards with renewable energy certificates that provide financial incentives for RNG derived from biogas.⁶
- California and Oregon have low carbon fuel standards that set carbon intensity targets each state must meet each year; these targets can be met by producing or using RNG.⁷
- California has a policy requiring the state to implement at least five dairy-based RNG projects and has made \$40 million available to offset pipeline interconnection costs.
- A Washington state law established a voluntary program with tax incentives and tools and began the process of developing state standards for RNG injection and policy recommendations for RNG promotion.⁸

EPA RNG Resources

- [AgSTAR](#) provides information and tools about the use of biogas recovery systems to reduce methane emissions from livestock waste.
- The [Landfill Methane Outreach Program \(LMOP\)](#) works with industry stakeholders and waste officials to reduce or avoid methane emissions from landfills.
- The [Natural Gas STAR](#) and [Methane Challenge](#) programs allow partner companies with U.S. oil and gas operations to document their voluntary activities to reduce methane emissions from their operations, including RNG operations.
- The EPA website has an interactive [RNG project map](#) that shows biogas projects across the United States.

¹ U.S. Environmental Protection Agency. January 2021. *An Overview of Renewable Natural Gas from Biogas*. Accessed June 23, 2022. https://www.epa.gov/sites/default/files/2021-02/documents/lmop_rng_document.pdf.

² Ibid.

³ Ibid.

⁴ ICF. May 2017. *Economic Impacts of Deploying Low NOX Trucks Fueled by Renewable Natural Gas*. Accessed June 23, 2022. <https://www.masstransitmag.com/home/document/12330911/economic-impacts-of-deploying-low-nox-trucks-fueled-by-renewable-natural-gas>.

⁵ U.S. EPA. 2022. "RNG Project Map" Accessed April 15, 2022. Accessed June 23, 2022. <https://www.epa.gov/lmop/renewable-natural-gas#rngmap>.

⁶ National Conference of State Legislatures. April 2020. *State Renewable Portfolio Standards and Goals*. Accessed June 23, 2023. <https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx>.

⁷ California Low Carbon Fuel Standard, California Code of Regulations, Title 17, Sections 95480–95489; 95491–95497. Accessed June 23, 2022. <https://www.arb.ca.gov/regact/2015/lcfs2015/lcfsfinalregorder.pdf>.

⁸ Washington State Legislature. Bill Information: HB 2580 - 2017-18. Accessed June 23, 2022. <https://app.leg.wa.gov/billsummary?BillNumber=2580&Year=2017>.