RENEWABLE NATURAL GAS:
Is It Really a Game-Changer for Building Decarbonization?

10 MINUTE READ

Written by Griffin Teed; Edited by Molly Dee-Ramasamy

At a Glance

- Advocates argue that renewable natural gas (RNG) offers a sustainable solution for industries, including the building sector, aiming to achieve net-zero goals and utilize existing infrastructure.
- RNG is a pipeline-compatible fuel derived from renewable or biogenic sources. The emissions of RNG vary depending on its production methods, with potential reductions in CO_2e compared to natural gas.
- RNG's drawbacks include its limited availability, scalability challenges, lack of cost competitiveness, and carbon accounting complexities.
- RNG is more suitable for the hardest-to-electrify buildings and campuses, rather than individual commercial and residential buildings.

Introduction

In recent years, you may have come across the term "renewable natural gas," a fuel that carries an eco-friendly connotation. With many industries adopting net-zero goals, renewable natural gas (RNG) and other low-carbon fuels offer a sustainable solution that leverages existing infrastructure while avoiding costly electrification expenses. RNG has gained attention for its ability to replace conventional natural gas and seamlessly integrate into current pipelines and equipment. In this article, we will assess the viability of RNG in the building industry's energy transition.

What Is Renewable Natural Gas?

Renewable natural gas, as defined by the American Gas Association, is a **pipeline-compatible** gaseous fuel sourced from **renewable** or **biogenic** origins, with lower **life-cycle carbon dioxide equivalent (CO_2e) emissions** compared to traditional natural gas.

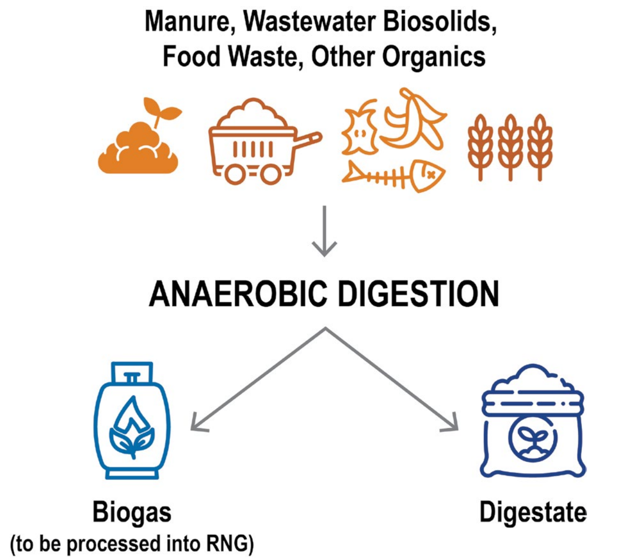
"Pipeline-compatible" means it can seamlessly integrate into the existing natural gas supply chain without impacting consumer end-use equipment such as gas mains, stoves, and furnaces. "Biogenic" indicates that it is derived from living organisms, while "life-cycle CO_2e" refers to the emissions associated with the entire life span of the product, including production, transportation, storage, and combustion.

How Is RNG Produced?

RNG is generated through two distinct processes: **anaerobic digesters** and **thermal gasification systems**. It is essential to differentiate between these systems and understand their respective definitions.

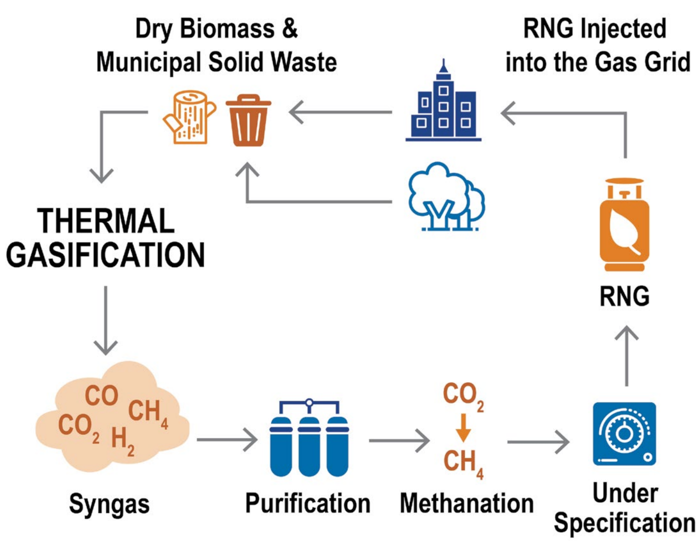
Anaerobic digesters employ oxygen-free conditions and bacteria to decompose organic matter, including animal manure, food waste, landfill gas, and sewage wastewater. A notable example of anaerobic digestion can be found at the Newtown Creek Wastewater Treatment Plant in NYC, where digester eggs facilitate the process. During anaerobic digestion, biogas is generated, which is further purified into RNG for onsite boilers used in wastewater treatment.

Anaerobic Digestion to RNG Process



Thermal gasification involves subjecting agricultural and forestry byproducts, energy crops, and municipal solid waste to high temperatures (~1,300°F) with limited oxygen. This process produces synthetic gas (syngas), which is then filtered, purified, converted to methane through hydrogenation, and dried to obtain pipeline-quality RNG. Historically, thermal gasification presented challenges due to tar formation, but recent advancements have enhanced syngas production while reducing tar content.

Thermal Gasification to RNG Process



Once RNG is generated through either process, it is injected into the local pipeline network, where it can be utilized for various purposes such as power generation, transportation and, in theory, heating and cooking in buildings.

Does Using RNG Actually Mean Fewer Emissions?

The life-cycle emissions of RNG (Scopes 1, 2, and 3) can vary significantly depending on the source, processing, and transportation methods involved in its integration into the pipeline. A 2019 ICF report for the American Gas Foundation provides the following emissions ranges[1]:

Fuel Type	Emissions (kg CO_2e/MMBtu)
Natural Gas[2, 3]	65
RNG – Anaerobic Digestion	Net Negative – 33
RNG – Thermal Gasification	16 – 58

The classification of RNG emissions also remains a subject of debate. Supporters of RNG align with the IPCC's 2006 report[4], emphasizing its environmental benefits, such as preventing methane emissions by utilizing food waste as a source. They argue against considering combusted RNG as a Scope 1 emission[5]. However, critics contend that RNG combustion produces local particulate emissions near to natural gas and should be included in Scope 1 emissions accounting. Moreover, RNG may encounter methane leakage issues like conventional natural gas distribution. In building emissions performance laws like NYC's Local Law 97 and Boston's BERDO 2.0, an RNG calculation methodology hasn't been defined yet for reporting, further complicating this accounting issue. The LL97 Advisory Board reports to RNG as "Captured Methane," and recommends that it should only be assumed as zero emissions if the original methane would have otherwise been vented or flared within NYC, further limiting the ability to count any emissions reductions.

1 https://gasfoundation.org/wp-content/uploads/2019/12/AGF-2019-RNG-Study-Full-Report-FINAL-12-18-19.pdf
2 https://www.epa.gov/sites/default/files/2015-07/documents/emission-factors_2014.pdf
3 https://pubs.acs.org/doi/10.1021/acs.est.2c01205
4 IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. https://www.ipccnggip.iges.or.jp/public/2006gl/
5 https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Greenhouse-Gas-Emissions New York State Energy Research and Development Authority (NYSERDA). 2021. "Potential of Renewable Natural Gas in New York State," NYSERDA Report Number 21-34. Prepared by ICF Resources, L.L.C., Fairfax, VA 22031. nyserda.ny.gov/publications

Demystifying Emissions Accounting Scopes

Scope 1 emissions originate from sources directly owned or controlled by an entity, like the cooking gas used in a house or the gasoline used in a car.

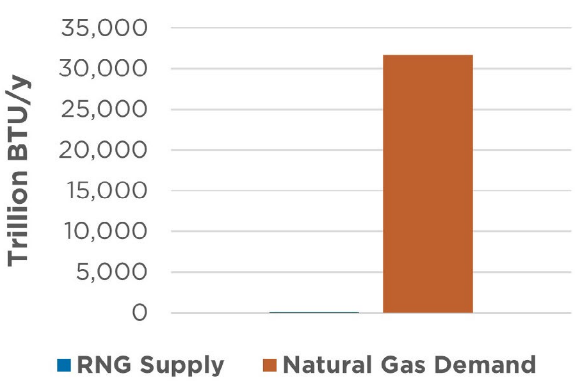
Scope 2 emissions are indirect and stem from the energy sources purchased and utilized by an entity, such as grid electricity in a house.

Scope 3 emissions are even more indirect and result from emissions upstream of the user, such as the products purchased, or travel taken.

Will RNG Be Available for Heating in Buildings?

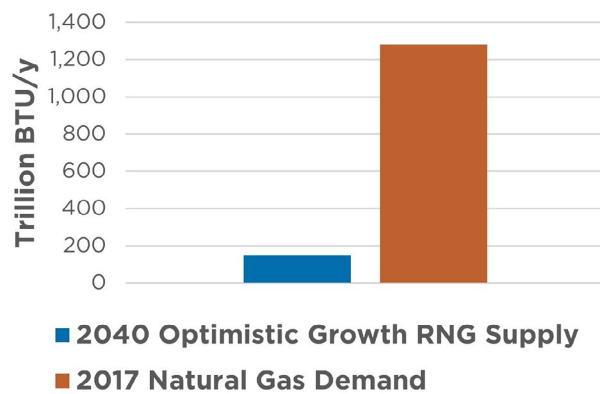
Currently, RNG is available in limited quantities and is primarily utilized for power generation or as a fuel for municipal vehicle fleets[6]. Although the United States produces around 50 trillion BTUs per year of RNG, which may seem substantial at an individual building level, **it accounts for a mere 0.16% of the country's significant gas demand of 31.7 quadrillion BTUs in 2021**.

U.S. Natural Gas Demand vs. RNG Supply



According to a report by NYSERDA, in an optimistic growth scenario, New York State is projected to produce approximately 147 trillion BTUs of RNG annually by 2040 . **This amount represents around 11.5% of the state's total natural gas demand in 2017 (1,280 tBTUs)**. In the case of New York City, the optimistic growth scenario forecasts local annual production of 25 tBTUs of RNG by 2040[7]. For context, the natural gas demand for the building sector in NYC was more than 168 tBTUs[8] in 2021. It is evident that there are clear limitations for future RNG supply that do not align with the existing natural gas demand.

New York State 2017 Natural Gas Demand vs. Optimistic Future RNG Supply



Case Study: National Grid Newtown Creek Wastewater Treatment Plant Pilot Project

In NYC, a recent example highlights the challenges associated with realizing an optimistic growth scenario for RNG. In 2013[9], NYC and National Grid announced a pilot project aimed at utilizing excess RNG from the Newtown Creek Wastewater Treatment Facility to offset building heating emissions in Brooklyn neighborhoods near the plant. Regrettably, the project encountered significant delays, exceeded its original budget by more than three times, and was finally completed in June 2023. According to previous reports by National Grid, the project was expected to generate enough energy to provide 0.78 tBTUs/y of RNG. However, this amount is only a fraction (0.5%) of the overall natural gas demand in the entire city.

6 https://afdc.energy.gov/fuels/natural_gas_renewable.html
7 The report is on NYSERDA's website here: https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Greenhouse-Gas-Emissions
8 Based on the LL84 data set in the link below (uncleaned for duplicates/anomalies), which includes buildings >25K SF that reported annual energy data: https://www.nyc.gov/site/buildings/codes/benchmarking.page
9 https://www.thecity.nyc/2022/4/15/23026137/newtown-creek-plant-burns-methane-waste-recycle-lags

Will RNG Be Cost-Competitive?

The same NYSERDA report estimates that by 2040 the cost of RNG will range from $11.29/MMBTU to $34.56/MMBTU, depending on the production methods and sources employed4. In the short term, the average cost of RNG is expected to increase due to the higher expenses associated with certain large feedstocks used for its production. The report highlights that once the state surpasses 70 tBTUs/y of RNG production, prices escalate significantly, exceeding $30/MMBTU, as wastewater recovery facilities and farms with lower economic viability require substantial infrastructure investments to handle the increased volume of RNG.

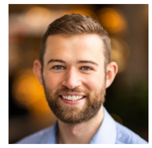
In contrast, the all-in price of natural gas in New York State has consistently ranged from $5.48/MMBTU to $9.63/MMBTU since 2017, excluding recent price spikes caused by geopolitical events[10].

Although market factors can influence costs, the report acknowledges that **RNG could cost 2 to 4 times more than natural gas**, even considering potential cost reductions through increased demand and policies encouraging RNG infrastructure and production.

So, Does RNG Have a Role in the Building Sector's Clean Energy Transition?

In conclusion, RNG is likely to play a role in decarbonizing the built environment, but it will likely be reserved for the hardest-to-electrify buildings and campuses. For instance, RNG can contribute to emission reduction at industrial-scale district steam cogeneration plants, major university campuses, and hospitals with central utility plants. However, due to its limited availability, scalability challenges, non-cost competitiveness, and accounting complexities, RNG is not a practical solution for individual commercial and residential buildings seeking to avoid the costs and disruptions associated with electrifying their heating, domestic hot water, or cooking end uses.

For more information, please contact:



Griffin S. Teed, PE, CEM
Senior Project Engineer
teedg@jbb.com

Molly H. Dee Ramasamy, PE, CEA
Director, Deep Carbon Reduction Group
deem@jbb.com

www.DeepCarbonReduction.com

10 https://www.nyserda.ny.gov/Energy-Prices/Natural-Gas/Monthly-Average-Price-of-Natural-Gas-Commercial