

“Renewable” Gas is Even More Expensive than Fossil Gas

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Renewable natural gas (RNG) is often hailed as a panacea for climate worries: an ostensibly climate-friendly fuel that can be used with the same piped distribution network, same meters, same furnaces, same boilers, with no sacrifices. Technically, RNG is any piped gas derived from organic sources like agricultural wastes, garbage in landfills, wastewater, or manure, instead of conventional fossil natural gas. As the reasoning goes, these sources took their carbon from the atmosphere via photosynthesis, so burning the derived gas re-releases this gathered carbon, and hence the direct combustion is carbon neutral on balance. The real story is much more complicated. In truth, RNG is an expensive fuel with limited supply that’s not actually clean and will continue to require significant infrastructure investment. For all but a handful of hard-to-decarbonize uses, electrification is a more cost-effective, cleaner option.

A 2019 report¹ by the American Gas Foundation found that RNG is likely to be available at costs of \$7/MMBtu to \$45/MMBtu. A 2016 report² for the California Air Resources Board found that costs per MMBTU for RNG ranged from \$30 to over \$100 for dairies, \$15 to \$22 for municipal solid waste, \$7 and over \$50 for landfills, and between \$9 and over \$50 for wastewater treatment plants. According to the EIA, the city gate price of fossil gas is about \$3.30/MMBTU.³ In short, the price of RNG varies between 2 and 15 times as expensive as fossil gas.

¹ American Gas Foundation. RENEWABLE SOURCES OF NATURAL GAS: SUPPLY AND EMISSIONS REDUCTION ASSESSMENT. December 2019.

<https://www.gasfoundation.org/wp-content/uploads/2019/12/AGF-2019-RNG-Study-Full-Report-FINAL-12-18-19.pdf>

² Jaffe, Amy Myers. Final Draft Report on The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute. California Air Resources Board. Contract No. 13-307. 2016.

<https://ww2.arb.ca.gov/sites/default/files/classic/research/apr/past/13-307.pdf>

³ US Energy Information Administration. Natural Gas Prices. Retrieved March 1, 2022.

https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_a.htm

Under the most optimistic circumstances at very low production volumes, these data imply that RNG is over twice as expensive as fossil gas. As more RNG is produced, less optimal sources must be used, driving up the price and exacerbating the differential with fossil gas. For example, just 20 percent of the potential RNG resource is accessible at two times the price of fossil gas. In producing just half of the potential RNG resource, the price jumps to four times the price of fossil gas. By the time we are producing nearly the total technical potential, the price is over 15 times as expensive.

Given that heat provided by high performance electric heat pumps is approximately at cost parity with that provided by fossil gas today, a transition to RNG would increase household energy bills by several fold, tipping the scales heavily in favor of electrification.

RNG and Fossil Gas Alternatives are Not Clean

Despite their branding, RNG and other fossil gas alternatives are not clean like other forms of renewable energy. Because these products are still chiefly methane, the unavoidable leaks in transmission and distribution along with their ultimate combustion are significant sources of emissions.

Recent data shows methane leaks are extensive. A 2021 study⁴ found that the majority of U.S. urban natural gas emissions were not accounted for in greenhouse gas inventories, finding an average leak rate between 3.3 and 4.7 percent from well to urban customer. A 2018 study⁵ found that methane emissions were 60 percent higher than previously estimated by the EPA, estimating approximately 2.3 percent of the U.S. gross gas production is lost to leaks. Other studies have found even higher values, for example a 2011 study⁶ estimated the leak rate at 3.6 percent to 7.9 percent. When factored into residential natural gas heating, these leaks account

⁴ Sargent, Maryann, et.al. Majority of US urban natural gas emissions unaccounted for in inventories. October 25, 2021. <https://www.pnas.org/content/118/44/e2105804118>

⁵ Alvarez, Ramon, et.al. Majority of US urban natural gas emissions unaccounted for in inventories. Science. June 21, 2018. <https://www.science.org/doi/10.1126/science.aar7204>

⁶ Howarth, Robert, et.al. Letter: Methane and the greenhouse-gas footprint of natural gas from shale formations. Climatic Change (2011) 106:679–690. https://link.springer.com/content/pdf/10.1007_%2Fs10584-011-0061-5.pdf

for roughly one-half of equivalent emissions,⁷ Thus, in the most optimistic case, RNG still causes approximately 50 percent of the emissions of conventional gas.

However, research indicates that leakage rates among RNG facilities may be even higher than the fossil gas industry at large, leading to higher emissions from RNG. In a 2019 survey⁸ of biogas plants, the average leakage rate was 4.6 percent, roughly double the gas industry average even before including transmission, distribution, and combustion. At this leakage rate, RNG retains over two-thirds the emissions of fossil gas. Wastewater treatment plants, a major source of biogas, were even higher at 7.5 percent on average with some plants as high as 15 percent. A 2020 report⁹ found that for leakage rates above 6 percent, the equivalent emissions of intentionally produced RNG is actually higher than that of conventional fossil gas. That is, for leakage rates observed in existing facilities, emissions from RNG are just as high as fossil gas.

As for other fossil gas alternatives, we note that even the highest grades of ‘certified gas’ - which refers to gas from a facility with a low rate of methane leakage - still allow for some methane leakage. Further, certification only focuses on methane leakage from production and does nothing to address leaks in distribution.¹⁰ For hydrogen blends, the problem is even more complex. Earthjustice reports that even “the most optimistic scenarios estimate that the gas system that serves homes and most businesses could only handle up to 20% hydrogen by volume—representing just 7% of the energy in the gas pipeline system because hydrogen is less energy dense than methane.”¹¹ Furthermore, “because hydrogen molecules are much smaller than methane molecules, utilities may also need to upgrade their infrastructure to prevent it from leaking into the atmosphere. When a pipeline carries a blend of hydrogen and methane, hydrogen can leak at three times the rate of methane.”¹² These are not clean alternatives to traditional fossil gas.

⁷ Burns, Diana, et.al. Attribution of production-stage methane emissions to assess spatial variability in the climate intensity of US natural gas consumption. *Environmental Research Letters*. 16 044059. 2021.

<https://iopscience.iop.org/article/10.1088/1748-9326/abef33>

⁸ Scheutz, Charlotte and Anders M. Fredenslund. Total methane emission rates and losses from 23 biogas plants. *Waste Management*, Volume 97.

<https://www.sciencedirect.com/science/article/abs/pii/S0956053X19304842>

⁹ Grubert, Emily. 2020 *Environ. Res. Lett.* 15 084041. <https://iopscience.iop.org/article/10.1088/1748-9326/ab9335>

¹⁰ https://miq.org/document_categories/miq-standards/

¹¹ https://earthjustice.org/sites/default/files/files/hydrogen_earthjustice_2021.pdf

¹² https://earthjustice.org/sites/default/files/files/hydrogen_earthjustice_2021.pdf

Proponents of RNG often tally potential large emissions reductions by assuming the biogas waste stream being turned into RNG would otherwise be vented directly to the atmosphere. This is disingenuous in two ways. First, the total amount of capturable methane sources currently being vented is less than 1 percent of the current fossil gas resource.¹³ Applying the climate benefits of these sources to a hypothetical RNG system capable of meeting any significant portion of current fossil gas demand is not realistic. To have an RNG system that can meet our demands, the feedstocks would very likely be intentionally produced.¹⁴ Because RNG from such intentionally produced methane streams does not mitigate an existing source of emissions, it has approximately equivalent emissions to fossil gas.

Second, even with existing methane waste streams, emissions would likely be eliminated by flaring (i.e., burning) rather than by production of RNG.¹⁵ Because the emitted carbon dioxide is approximately 75 times less potent than methane,¹⁶ nearly all of the equivalent emissions are eliminated by this method. Such flaring is commonplace at landfills across the country. If methane can be captured for RNG, then it can also be captured for flaring. Critically, given that the leakage rate of downstream gas infrastructure is generally larger than the combustion efficiency of flaring, flaring delivers at least as much emissions reduction as RNG.

There is Not Enough RNG to Go Around

Besides the fact that RNG isn't actually clean, there's also not enough of it to be relevant to meeting current demand for fossil gas. Argonne National Lab tracks RNG facilities and maintains up-to-date counts of existing and planned facilities.¹⁷ As of 2020, there were approximately 60 trillion BTU per year of RNG produced. Of these, approximately 46 trillion BTUs came from landfills, 7 trillion from livestock, 4

¹³ Grubert, Emily. 2020 Environ. Res. Lett. 15 084041.

¹⁴ Grubert, Emily. 2020 Environ. Res. Lett. 15 084041.

¹⁵ Grubert, Emily. 2020 Environ. Res. Lett. 15 084041.

¹⁶ Abernethy, Sam and Robert B Jackson 2022 Environ. Res. Lett. 17 024019.

<https://iopscience.iop.org/article/10.1088/1748-9326/ac4940>

¹⁷ Argonne National Laboratory. Renewable Natural Gas Database. Accessed February 22, 2022.

<https://www.anl.gov/es/reference/renewable-natural-gas-database>

trillion from food waste, and 3 trillion from wastewater treatment. This amounts to approximately 0.2 percent of U.S. natural gas consumption, according to the EIA.¹⁸

If all the potential sources of RNG in the U.S. were developed (requiring building out massive new gas infrastructure to do so), the RNG has the potential to meet just 1 percent of U.S. fossil gas consumption. The USDA's Biogas Opportunities Roadmap¹⁹ estimates there exist about 13,000 sites in the U.S. that could host a biogas system (about 2,000 of them are currently built out). Taken together, these potential sites could generate 650 billion cubic feet of gas per year (or about 350 trillion BTU per year). Critically, this biogas is made up chiefly of methane (40-60 percent) and carbon dioxide (30-50 percent). This means the usable (methane) portion of this biogas is roughly 360 billion cubic feet. In NREL's Biogas Potential of the United States,²⁰ the authors estimate the methane potential from landfill material, animal manure, wastewater, and industrial, institutional, and commercial organic waste at 420 billion cubic feet (430 trillion BTU per year).

While this may sound like a lot of gas, the U.S. consumption of fossil gas in 2020 was over 30 trillion cubic feet per year according to the EIA.²¹ This means if the infrastructure required to convert, harvest, collect, transport, and distribute the biogas from all potential sources in the U.S., the total technical potential of methane production by organic sources is just 1.3 percent of national consumption. Note that some studies have quoted higher percentage estimates, but this generally refers to the percentage of natural gas used for electricity generation (about 11 trillion cubic feet), rather than the full set of uses including residential, commercial, industrial, and transportation sectors.

Additionally, a California study²² found the state had the theoretical potential to produce approximately 90 billion cubic feet. In 2020, California consumed 2.1

¹⁸ US Energy Information Administration, Natural Gas Consumption by End Use, Retrieved February 22, 2022. https://www.eia.gov/dnav/ng/ng_cons_sum_dcunusa.htm

¹⁹ US Department of Agriculture. Biogas Opportunities Roadmap. August 2014. https://www.usda.gov/sites/default/files/documents/Biogas_Opportunities_Roadmap_8-1-14.pdf

²⁰ National Renewable Energy Laboratory. Biogas Potential in the United States. October 2013. <https://www.nrel.gov/docs/fy14osti/60178.pdf>

²¹ US Energy Information Administration, Natural Gas Consumption by End Use, Retrieved February 22, 2022.

²² Jaffe, Amy Myers. Final Draft Report on The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute. California Air Resources Board. Contract No. 13-307. 2016.

trillion cubic feet of fossil gas, an upper bound of 4 percent of the supply that could potentially be met with RNG. A study for Philadelphia Gas Works found that “decarbonized gasses...are limited in terms of commercialization or total availability” and that “a full transition to decarbonized gasses in Philadelphia would likely require significant amounts of synthetic natural gas, a source of methane that is not yet commercialized.”²³

Despite the limited resource, proponents of RNG count it as a key component of any net-zero target. For instance, a 2021 American Gas Association report²⁴ assumes over 5 quadrillion BTUs of RNG will be used (excluding any used for electricity generation), over ten times higher than the NREL bound on maximum methane potential quoted above.

Given the limited supplies of methane waste streams capable of supporting RNG production, and the remaining hard-to-decarbonize industries and processes that could use such fuels, we cannot afford to use RNG where electrification is a clean, affordable alternative, as is the case for residential and commercial heat.

²³ Energy & Environmental Economics. Philadelphia Gas Works Business Diversification Study. December 2021.

²⁴ ICF International for the American Gas Association. Net-Zero Emissions Opportunities for Gas Utilities. 2021.
<https://www.aga.org/globalassets/research--insights/reports/aga-net-zero-emissions-opportunities-for-gas-utilities.pdf>