RNG: Life Cycle Analysis, Carbon Intensity and Carbon-Negativity

Renewable natural gas (RNG) is captured methane from decomposing organic wastes. RNG has a *life-cycle carbon intensity* (CI) that is significantly lower than geologic natural gas. Depending on the feedstock (landfill gas, food waste, livestock manures, wastewater) RNG can be *carbon-positive, carbon neutral*, or significantly *carbon negative*.

Life Cycle Analysis (LCA). Life-cycle analysis looks at total emissions from a fuel from cradle- to-grave— from the point it is extracted/captured/produced to the point when it is consumed. This includes emissions from energy used to extract or produce the fuel, and from energy used to refine, transport and dispense it. LCA provides a much more complete picture of the environmental impacts of a fuel than looking simply at "tailpipe emissions". For instance, an electric vehicle may have no tailpipe emissions, but the emissions associated with generating the electricity it uses may be substantial.

Because RNG is derived from organic wastes, the CO_2 released when it is combusted is classified as ***biogenic***— part of the natural carbon cycle. Consequently, carbon accounting systems classify any tailpipe emissions from RNG to be zero-added or neutral. By contrast, combusting fossil fuels that have been sequestered beneath the ground for millions of years *adds CO_2 back into the environment*.

Carbon intensity. Carbon intensity (CI) is a measure of the greenhouse gas (GHG) content of a fuel, on a lifecycle basis. Widely accepted standards of emissions measurement[1] calculate CI in *grams of carbon-dioxide-equivalent per megajoule of energy consumed* (gCO_2e/MJ).[2]

According to the California Air Resources Board (CARB), conventional natural gas has a CI of about 80. Conventional gasoline has a CI of roughly 101, and conventional diesel comes in at roughly 100.

Carbon positive? Carbon neutral? Carbon negative?

A fuel that is *carbon positive* on a lifecycle basis has emissions that come in above zero. This may not sound exciting, but a fuel with a CI of 40 (e.g., landfill gas and wastewater RNG) represents a 50% reduction in emissions compared to conventional natural gas; a fuel with a CI of 10 (some food waste RNG) represents an 87.5% reduction.[3]

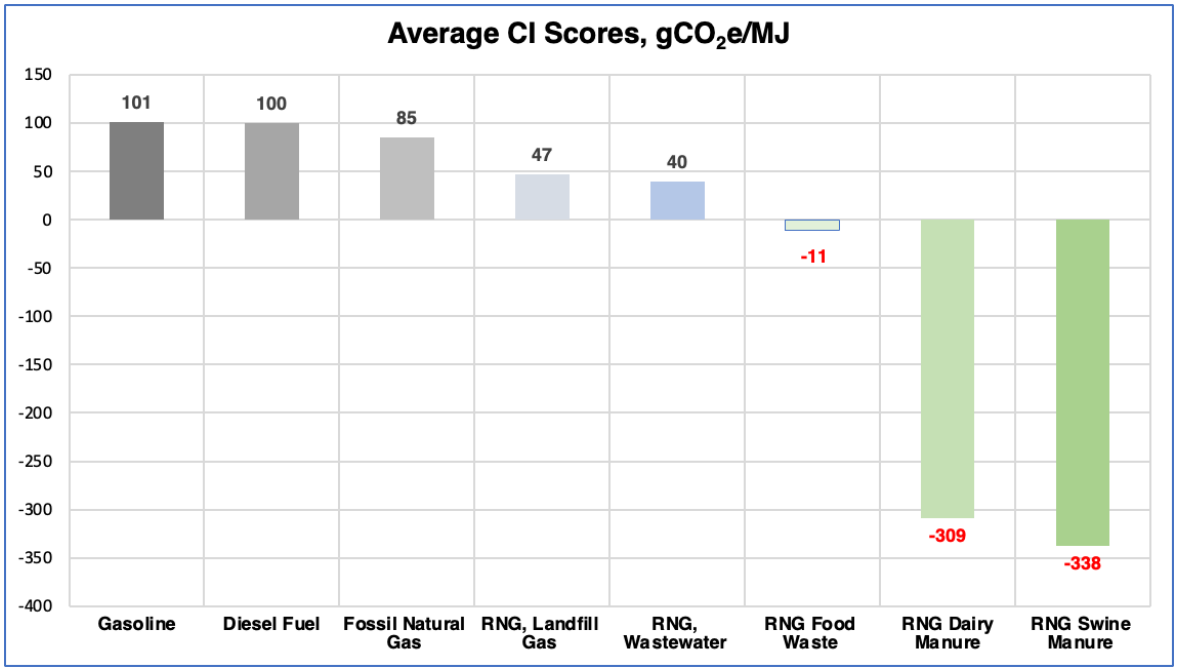
A fuel that is *carbon neutral* has lifecycle emissions equivalent to zero. That means that producing the fuel, transporting it, and using it adds no new emissions to our atmosphere. Electricity produced from solar or wind energy is carbon neutral; some RNG produced from food waste has a CI that is neutral, or even slightly lower.[4]

The table below compares the CIs of various conventional fuels, and RNG made from

[1] For instance, Intergovernmental Panel on Climate Change (IPCC), Argonne National Laboratory, California Air Resources Board (CARB), and US EPA.
[2] 1 MJ = 948 British Thermal Units (BTUs); there are 3.6 MJ in a kiloWatt hour (kWh), and 1,055 MJ per MMBTU (million BTUs).
[3] CARB, "LCFS Pathway Certified Carbon Intensities," Current Fuel Pathways table, https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/fuelpathways/current-pathways_all.xlsx
[4] Ibid.

THE COALITION FOR RENEWABLE NATURAL GAS

different feedstocks, based on data from CARB. The values shown are *averages* across multiple samples; for instance, wastewater RNG can have CIs in the teens and twenties; some food waste RNG has been scored at -75.[5]



(California Air Resources Board, Current Fuel Pathways, Feb. 2023)

Regardless of the feedstock, renewable natural gas represents a reduction in GHG emissions of **between 45% and 398%** compared to conventional natural gas – and even greater emissions benefits compared to gasoline and diesel.

Renewable natural gas is produced by capturing methane from decomposing wastes that would otherwise escape into the atmosphere. RNG is completely compatible with existing gas infrastructure and appliances, and its significantly lower emissions make it an important source of clean energy for current applications. It is also a valuable input for sustainable aviation fuel (SAF) and clean hydrogen. Crucially, it is available *today*, making it a critical and flexible component in GHG mitigation and the clean energy transition.

[5] Ibid.