

FROM WASTE TO WEALTH – RNG IS A WIN/WIN.

White paper by Cummins, Inc.

The phrase, “Renewable Natural Gas” (RNG), puts a positive face on the recovery and reuse of methane gas leaching out of landfills. One that is entirely justified, as RNG is every bit as green from a financial aspect as it is from an environmental one. This is particularly important today, as the United States has rejoined the Paris Accord with a renewed commitment to reducing greenhouse gases and is looking seriously at options including carbon credits and carbon taxes to drive down the use of fossil fuels and preserve a cleaner world for future generations.

In this paper, we will discuss how the reclamation of methane gas is transforming what used to be an environmental liability into an economic opportunity – not just for refuse collectors and landfill companies, but for municipalities and the transportation sector as well. That’s why RNG usage has recently surpassed CNG and LNG combined – and is expanding exponentially with a 267% increase from 2016 to 2020, according to the Coalition for Renewable Natural Gas.



RNG – A Rising Trend

Clean-burning natural gas is a widely accepted, proven fuel source that has significant benefits in terms of environmental impact. That’s why it is a primary source of energy for residential homes, buildings and more. The natural gas in most pipelines is derived primarily from wellheads tapping into petrochemical reservoirs deep within the earth. Renewable natural gas is different. It is a purified form of methane (CH₄) captured in landfills, where organic matter (cardboard, plants, etc.) aided by bacteria, decomposes and produces a gas that has tremendous potential – both for good or bad.

Left alone, an uncapped landfill releases methane into the atmosphere, where it negatively affects the ozone layer and impacts global climate change for over a century. Studies have shown that, according to an article in Popular Mechanics, “over a 20-year period a kilogram of methane warms the planet as much as 80 times more than a kilogram of carbon dioxide (CO₂).” It is also a contributor to the thermal expansion of oceans (and glacial melting) that “continues for centuries even after the gas has dissipated from the atmosphere.”



COMMON SOURCES OF METHANE



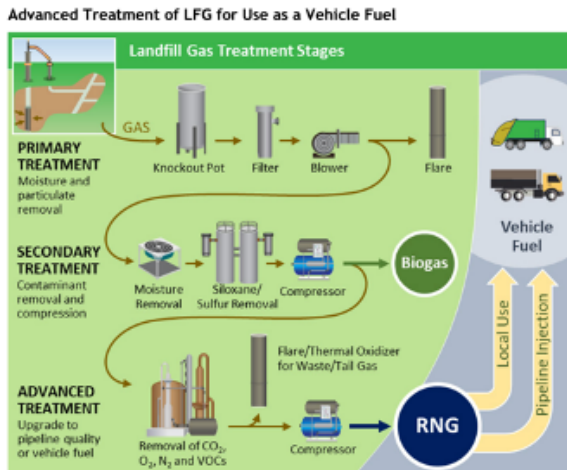
Landfill emissions are estimated to account for 16% of global methane emissions. The good news is that proven technology already exists to capture this gas and convert it into a powerful source of natural energy that can be used to displace a corresponding amount of fossil fuels. Plus, when RNG is refined to 96-98% purity, it can be utilized as a vehicle fuel in natural gas engines that are simpler in design (no diesel particulate filter or diesel exhaust fluid needed) and meet or exceed ultra-low emissions standards.

Today, 53% of all the natural gas being used to fuel vehicles produce electricity and heat homes is RNG, with LNG and CNG accounting for the remaining 47%. This has been aided by an exponential growth in the number of RNG methane reclamation facilities, with almost as many under construction or in development (155) as are currently in operation (157). The increased use of RNG over the past five-year period has saved the equivalent of 3.5 million tons of carbon dioxide being released into the atmosphere. The California Air Resource Board (CARB) has confirmed that the energy-weighted Carbon Index value of RNG in their Low Carbon Fuel Standard Program is carbon negative and below zero at $-17.95 \text{ gCO}_2\text{e/MJ}$.

The RNG movement has been embraced by virtually all major players in both the energy development sector (Mobil, Exxon and Conoco Phillips), the retail sector (Walmart, Amazon and UPS), refuse/recycling firms (Waste Management, Republic and Browning-Ferris), as well as states and municipalities (Madison WI, Louisville KY, Washington LA). While the number of RNG sites has doubled in recent years, there still exists a tremendous opportunity to expand further, as only 15% of all U.S. landfills (300 out of 2,000 potential sites) currently are tapping into this natural energy resource.

WASTE TO WHEELS – A CLOSED LOOP

RNG and its conversion to a fuel source for refuse collectors, as well as landfill operators, create a closed-loop system bringing in revenue as it decreases costs. People pay to have their trash collected and taken to the landfill where it is buried. In as little as six months, the organic matter starts to decompose and produce methane, which is collected via a series of pipes and undergoes primary treatment (removing moisture and excess particulate matter), secondary treatment (removing contaminants and compressing to create biogas) and finally a third stage where CO₂, oxygen and nitrogen gases along with volatile organic compounds (VOCs) are removed. The purified RNG is then compressed for use in vehicles/equipment onsite – or injected into a natural gas pipeline, producing a revenue stream.



Source: Landfill Methane Outreach Program Newsletter – May 2020.

A refuse/recycling truck can offload at one end of the landfill and refuel for free at the other end. The RNG produced can also be used to fuel other types of equipment at a landfill from dozers, and dump to skid steers or even fuel electric generators. Any piece of equipment that uses an LNG or CNG engine can use RNG as fuel.

The experience has been eye-opening for Waste Management's Moreno Valley operations, who have had natural gas engines since the 1990s (full disclosure – Cummins Westport is their primary provider). In addition to the fiscal benefits, they cite advantages of slow fuel facilities, minimizing labor hours, reduced noise and of course, an enhanced public image, as byproducts of this “greener” approach to the industry. You can view their testimonial [here](#).

One of the most recent RNG construction projects is Minnesota's Inver Grove Heights, where a \$40 million plant is scheduled to be operational by March 2022, and will convert biogas from its landfill and send it to the Xcel Energy pipeline. The Inver Grove Heights facility processes straight 6,000 square cubic feet per minute of landfill gas into RNG – the equivalent of 50,000 gallons of vehicle fuel per day. The RNG produced at this facility qualifies for credits under the Renewable Fuel Standard law, part of the Energy Policy Act, from 2005. It is anticipated that the company will be able to sell customers fuel with a “near zero carbon imprint” at a price less than diesel fuel. <https://www.startribune.com/renewable-natural-gas-plant-planned-for-landfill-in-inver-grove-heights/600045459/>

PRESSURE IS BUILDING.

While the benefits of transforming an existing landfill to enable RNG production have huge benefits from an environmental and financial standpoint, costs for putting in an engineered liner, plumbing the site with vertical and horizontal lines, collecting the gas and leachate while preventing migration into the air, land or water and then processing the LFG into methane are also substantial. That's where national, state and local governments come into play. On Earth Day, President Biden announced that the U.S. was renewing its commitment to the Paris Accord. “Building a clean and equitable energy economy and addressing the climate crisis is a top priority of the Biden Administration...putting the United States on a path to achieve net-zero emissions, economy-wide, by no later than 2050.” (Executive Order 14008, “Tackling the Climate Crisis at Home and Abroad.”) Funding is being made available for research and development projects to decarbonize both cars and trucks through the Department of Energy (DOE), including \$61 million for BioFuels research.

There is considerable debate on the best methodology to achieve this goal. The Climate Leadership Council (CLC) has invited business leaders from companies, including ConocoPhillips, Exelon Corp, Exxon Mobil Corp., Ford Motor Company, General Motors and more, to help develop workable proposals to achieve this goal.

The CLC is currently proposing a \$40-per-ton carbon fee and a border carbon adjustment, with revenues returned to the public in the form of a dividend check in exchange for elimination and simplification of greenhouse gas regulations. Majority Whip Dick Durban's "America's Clean Future Fund Act" would price carbon at \$25/ton, increasing \$10/ton over inflation annually. The average truck hauling freight in the U.S. is estimated at 7-9 tons of CO₂ per year – so for fleets with hundreds or thousands of trucks running 500 miles per day, the penalties could be substantial. That's why there's such a great impetus to final alternative technologies, from biofuel and hybrid vehicles to fuel cells and fully electrified trucks. (Editor's Note: Cummins is actively developing all these alternative technologies and can provide pros/cons to each upon request.) A carbon tax is an element of the Paris Accord, and the U.S. is one of the last industrialized countries without a carbon tax strategy, with projected prices ranging anywhere from \$41-\$125 per ton.

The writing is on the wall, and the quickest way for fleets and large retailers to avoid future carbon tax penalties with a net-zero carbon impact is by using RNG-fueled vehicles. The increased demand for RNG will fuel more and more conversion of mid-size landfills to RNG production based on economics alone.

BENEFITS FOR ALL.

As a reader of this publication, you are well-versed in the environmental and financial advantages involved with the conversion of biogas in landfills to fuel-grade methane. The more you know, the harder it is to explain it simply to the general public or to sway those that are skeptical. One tool that can help is the [Environmental Protection Agency \(EPA\) equivalencies calculator](#). It is a "wizard" that lets you input a specific number of metric tons of CO₂/year, and it provides you with what the equivalent reduction would be in terms that everyone can appreciate. For example, if you were to convert a fleet of 100 trucks producing 8.558 metric tons of carbon dioxide per year to natural gas use, it would be equivalent to taking 1,522 passenger cars off the road, or eliminating the greenhouse gas emissions created by burning 18,500 barrels of oil in electrical usage, or the greenhouse gas emissions emitted from heating/powering 942 homes for an entire year.



Lowers GHG emissions equivalent to nearly 8.8 billion miles driven by average passenger car



Reduces CO₂ emissions equivalent to nearly 394 million gallons of gasoline consumed



Environmental benefit equivalent to growing 57 million tree seedlings for 10 years



Equal to the carbon sequestration achieved by 4,288,221 acres of U.S. forests for 1 year

WASTE NOT, WANT NOT.

RNG has already surpassed LNG and CNG combined, and it's a trend that's only going to accelerate in the near future. It utilizes scalable, proven technology that can have an immediate impact, both by lessening methane release into the atmosphere and reducing the world's dependence on fossil fuels. RNG turns waste into wealth, creating a better pipeline to a greener, healthier future. While other promising technologies are on the horizon, RNG is here now – the ideal combination of positive environmental impact and sound economic policy, and one that's backed by government large companies and earth advocates all across the globe.

BE RESOURCEFUL.

In an age when everything can be researched at your fingertips on the internet, it's helpful to know what you are looking for – and who has the most trustworthy information. Here are some places to start:

- Learn more about the EPA's Landfill Methane Outreach Program (LMOP) at www.epa.gov/lmop. A map of RNG projects in the United States and other EPA resources can also be found on this site.
- Detailed information about laws and incentives relating to natural gas vehicles and RNG can be found [here](#). A list of 90+ coalitions interested in partnering with developers on fleet usage within the DOE's Clean Cities Coalition Network is available at www.cleancities.energy.gov/. Detailed information about laws and incentives relating to natural gas vehicles and RNG can be found [here](#).
- A good primer on methane (ignore the somewhat dated political references) is Popular Mechanics, "[What is Methane. Anyway?](#)"
- Want to learn what goes into the design of a modern landfill? Click [here](#).
- The Cummins Westport Well-To-Wheel Calculator lets you choose between three locations to figure out greenhouse gas emissions from natural gas engines. Click [here](#).
- The U.S. Department of Energy website has a vast library of information pertaining to alt-fuel vehicles and regulations, grants, research opportunities, performance and reliabilities releases and much, much more [here](#).
- Trade organizations that specifically promote RNG usage include NGVAmerica.org and the [Coalition for Renewable Natural Gas](#).

Renewable natural gas (RNG) has already surpassed liquified natural gas (LNG) and compressed natural gas (CNG) combined, and it's a trend that's only going to accelerate in the near future. It's scalable, proven technology that can have an immediate impact, both by lessening methane release into the atmosphere and reducing the world's dependence on fossil fuels. It turns waste into wealth, creating a better pipeline to a greener, healthier future. It's the perfect marriage of environmental impact with sound economic policy, backed by large companies and earth advocates alike.

**HAVE QUESTIONS ABOUT THIS WHITEPAPER
OR CUMMINS NATURAL GAS ENGINES?**

Click [here](#) to fill out a contact form

THE NATURAL CHOICE – CUMMINS

For decades, Cummins has been a world leader in the development, design, testing, manufacture, technical and field support for natural gas engines throughout the world, primarily through Cummins Westport Inc. Tens of thousands of these engines are currently in operation across a vast array of industries ranging from agriculture and construction to light industrial equipment to delivery vans and transit buses to 18-wheelers and power generation equipment, plus vocational vehicles. Engine offerings include the Cummins B6.7N, L9N and ISX12N, with power ranging from 200 hp to 400 hp. These engines set the industry standard for performance and reliability while offering near-zero emissions capability:

- NOx levels 90% below current EPA standards
- Particulate matter levels 90% below current EPA standard
- CO2 equivalents 16% below current EPA standard
- Can achieve sub-zero emissions when using renewable natural gas (RNG)

They also meet U.S. energy source goals while contributing to energy independence initiatives. For a complete overview, click [here](#).

If you have questions about this whitepaper or would like to receive more information on Cummins natural gas engines, click [here](#) and fill out the contact form.



Cummins Inc.
Box 3005
Columbus, IN 47202-3005
U.S.A.

1-800-CUMMINS™ (1-800-286-6467)
cummins.com

Bulletin 5676506 Produced in U.S.A. 5/21
©2021 Cummins Inc.