

Renewable Natural Gas: The Fuel of the Future
The Coalition for Renewable Natural Gas
December 2016

What if we told you that a simple, elegant solution to many of America's climate and energy problems is staring us in the face?

What if you learned that in one fell swoop we could reduce greenhouse gas emissions, provide power for utilities, develop sustainable waste practices, fuel transportation and reduce our dependence on foreign oil?

Would you believe? Or would you scoff?

Choose to believe. The solution is here. The time is now. This is not a magic silver bullet - implementation will require commitment and resources, but innovation is the heartbeat of the American spirit, and Americans are not accustomed to backing down.

We are the Coalition for Renewable Natural Gas, and we want you to know about the most promising – and largely untapped – alternative energy source in America: Renewable Natural Gas.

What is Renewable Natural Gas?

Renewable Natural Gas (RNG) is natural gas produced from organic waste products found in landfills, water treatment plants, farms, dairies and more. When the organic waste decomposes, it releases a biogas composed primarily of methane. If we capture and process the gas before it escapes into the atmosphere, not only are we protecting the environment from harmful greenhouse gas emissions, we are providing an affordable, plentiful source of natural gas that is fully interchangeable with traditional fossil-fuel natural gas.

You probably already use natural gas every day. Your hot water heater, stove, dryer and furnace provide soothing warmth for your home by using the cleanest fossil fuel available. As good as this is, though, we can do better.

RNG can change the face of the fuel and energy industry in a clean way that's good for the environment. It does not require extensive operational changes, and it makes use of already-existing infrastructure. It's a good product that is ultra-clean, domestic, abundant, affordable and sustainable.

And people are starting to notice. The use of RNG is gaining momentum throughout North America as industry leaders bring increased awareness to its attributes through advocacy and policy successes.

Where RNG Comes From

While traditional fossil-fuel natural gas is found deep underground, renewable natural gas comes from organic waste. Sources of this organic waste are abundantly available, but they have not yet been used to their full potential.

In an effort to reach that potential, two basic technologies have been developed to capture and process biogas to pipeline-ready status.

Anaerobic Digestion

Anaerobic digestion is generally used for biogas sources with a high water content such as waste water, animal waste and food waste. It occurs in an environment without oxygen (such as a tank), where microorganisms (usually bacteria) break down the waste product into gas – primarily methane. This gas is then dried, and trace constituents and CO₂ are removed. Anaerobic digestion can be adapted for use at a single farm or by wastewater plants that process hundreds of millions of gallons a day.

Biogas from landfills is also collected and processed using anaerobic digestion. When bacteria break down the organic portion of the waste into gas, it is collected by perforated pipes and then processed.

An anaerobic digester is effective enough both in results and cost that it can easily be built anywhere a large quantity of organic waste is generated. If a city is willing, for instance to collect separate organic waste, anaerobic digestion may produce enough RNG to power city trash trucks.

Thermal Gasification

Thermal gasification works well with lower-moisture sources like wood chips, agricultural waste and energy crops. Oxygen and heat are added to a biomass to produce a synthesis gas that is cleaned and then converted to methane. This gas must be dried out and compressed before it is pumped into the natural gas pipeline system.

This technology is not yet fully developed on a commercial scale in the United States, but is on the horizon. Once it comes into its own, the potential to expand the production of RNG grows exponentially.

Myths and Facts

One of the biggest misconceptions about renewable natural gas is the idea that it is inferior to traditional natural gas. In fact, the opposite is true. “Regular” natural gas comes from underground, where it has been left by decaying organic matter. It’s made up of about 95 percent methane, with the remaining portion a mixture of hydrocarbon and non-hydrocarbon constituents. These are substances like ethane, trace amounts of compounds and even water.

Renewable natural gas from organic waste sources consists of one main substance: methane. It may occasionally have trace amounts of other constituents, but it is actually a purer gas to burn than traditional natural gas.

Sources of RNG are all around us – anywhere you find organic waste, you will find RNG. This includes landfills, waste water treatment plants, food waste, wood and agricultural residues, dairy farms, energy crops and even waste from certain industrial processes, such as a brewery.

To give you an idea of the scale, here are some of the biggest organic sources of waste in the United States:

- Food Waste (66.5 million tons/year)¹
- Wastewater (17,000 facilities)²
- Agricultural Waste (8,000 large farms and dairies)³
- Landfill Gas (1,750 landfills)⁴

So what do those numbers mean? If you put together the landfill material, animal manure, wastewater and industrial, institutional and commercial organic waste in the U.S., about 7.9

million tonnes of renewable natural gas could be produced each year. This amount could displace about five percent of current natural gas consumption by the electric power industry and 56% of natural gas consumption in the transportation industry.⁵

While the supply of fossil-fuel natural gas in the U.S. is playing an increasing role in the domestic energy supply, that same infrastructure can be used to transport renewable natural gas to utilities and transportation companies around the country.

RNG gives the United States a fantastic opportunity not only to reduce greenhouse gas emissions, but also to diversify our energy supply, create jobs and use existing infrastructure to make a difference. The knowledge and technologies are available to expand the RNG industry in a major way. No major barriers exist on the production side; using this abundantly available energy resource rests mainly in the hands of regulators and policymakers, who are beginning to make strides.

Renewable Fuel Standard

RNG has seen some success in government policies. The Renewable Fuel Standard was authorized by Congress as part of the Energy Policy Act of 2005 and then expanded by the Energy Independence and Security Act of 2007.

In an effort to build sustainable energy practices, the RFS requires transportation fuel sold in the United States to include a minimum volume of renewable fuel. Gasoline and diesel companies are obligated to adhere to this standard, and while fossil-fuel natural gas does not qualify as a renewable fuel, renewable natural gas does qualify – it is categorized as a cellulosic biofuel.

This means that these obligated parties must purchase a specified amount of RNG every year. When a set amount of RNG is dedicated to transportation fuel use, it generates a Renewable Identification Number (RIN). Obligated parties may purchase RINs instead of actually buying the gas, which makes RINs extremely valuable on the open market. This drives up the value of RNG, which in turn makes it more competitive with fossil-fuel natural gas and petroleum.

There has been some question as to whether implementation of the RFS is resulting in the production of cellulosic biofuels, as Congress intended it to, but the acceleration of RNG fuel production for the transportation industry proves otherwise.

Production of RNG under the RFS increased from 32.5 million gallons (also known as ethanol gallon equivalents or EGE) in 2014 to 139.8 million EGE in 2015 – a four-fold increase. Production will reach more than 200 million EGE in 2016, with 350 million EGE projected for 2017. By this time, RNG producers will have multiplied production of RNG transportation fuel by more than 10 times in just three years as a cellulosic biofuel under the RFS.

BENEFITS OF RNG

Renewable Natural Gas is not a one-hit wonder. It is the Swiss Army Knife of the energy industry because it has the potential to revolutionize multiple aspects of life in the United States – everything from climate change to energy supply to waste management to the economy. It also has a ready-made distribution network – RNG can tap right into the 2.5 million miles of natural gas distribution and transmission pipeline in use in the United States. In fact, 55 projects in North America are already adding RNG into natural gas pipelines.⁶ Most other renewable or alternative fuels don't have this built-in advantage, so the overall cost of implementing RNG is much less.

Here's a look at the biggest tools in the RNG toolbox:

Fighting Climate Change

The best reason to support and invest in RNG is the benefit it provides to the environment. This occurs in a number of ways:

Reduced GHG Emissions

When organic waste is broken down, it turns into biogas, which is released into Earth's atmosphere, increasing the amount of greenhouse gases (GHG) in the atmosphere. This waste gas is sometimes also flared off, releasing additional CO₂ into the atmosphere. Converting this waste gas into RNG not only avoids the release of GHG and CO₂, it also replaces non-renewable fuels, including fossil fuel-natural gas, oil and diesel. Instead of increasing our carbon footprint as traditional fossil fuels do, RNG simply recycles carbon already circulating in the environment.

Developing RNG as an energy source could lead to the reduction of up to 146 million metric tons of CO₂ per year – the equivalent of taking 29 million cars off the road.⁷

Cleaner Air (less smog and air pollution)

When RNG is used in natural gas engines for heavy duty vehicles in place of diesel, the amount of pollutants, GHGs and air toxins released into the atmosphere drops immediately. This is one of the best ways to substantially reduce the amount of emissions due to transportation. This reduction in toxic air contaminants is also a major benefit to communities located next to freeways and interstates where the highest concentration of diesel activity occurs.

Carbon Neutral

As policymakers and legislators try to enact a comprehensive energy policy that deals with climate change, one of the biggest considerations is a low-carbon future. RNG fits this framework beautifully: in most cases where it is replacing a traditional fossil fuel, RNG is carbon-neutral, meaning it does not add any new carbon to the environment.

When RNG replaces diesel fuel, for example, carbon emissions from production to consumption are reduced by 88 percent or more.⁸ Some RNG actually ends up carbon negative⁹, which means it sequesters GHG during its life cycle as a fuel.

Complementary Renewable Resource

RNG works as a complementary piece to other renewable energy alternatives, including wind energy and solar energy. Because RNG provides a steady supply of fuel, it's an effective base layer that provides stability when more intermittent forms of renewable energy (such as wind and solar) are at a low point.

Producing more fuel from natural resources every year saves Earth from harm and improves our future. RNG is a big part of that effort simply because it is renewable and will not run out.

Promoting Economic Development and a Diverse Energy Supply

RNG is not only good for the environment, it's good for the economy. The United States imports more than nine million barrels of petroleum products a day from more than 80 countries¹⁰, many of which have interests at odds with ours. Increasing RNG production to displace just 16 percent of diesel fuel used by heavy duty vehicles would free more than \$17 million per day⁷ – money that could stay right here at home while increasing our independence from the rest of the world.

Developing enough RNG as an alternative energy source to replace 45 percent of the U.S. diesel demand could also result in the creation of more than 250,000 new jobs to design, construct and operate RNG plants.⁷ This is not limited to urban areas, either – every small town and rural area in America produces waste that can be converted to RNG. In fact, RNG projects are under construction or already operating in about half of the 50 states.

Diversifying our energy supply by replacing foreign oil with domestic RNG will also protect the U.S. from volatility caused by price fluctuations, political conflicts, hurricanes and foreign competition. Many of our communities rely heavily on vehicles that run on oil products, such as emergency vehicles, sanitation fleets, public transportation and road repair crews. Providing these fleets with a locally-produced source of energy protects the local and national economies.

A domestic energy supply is also more secure than foreign oil imports. An RNG system is much less vulnerable to attacks that could cripple the U.S. economy than the foreign supply chain could ever hope to be.

Developing Sustainable Waste Practices

It's no surprise that we produce a lot of waste in the United States. We throw away about 250 million tons of solid waste every year, including 70 million tons of food and yard waste.¹¹ (If global food waste were a country, it would be the third largest GHG emitter in the world, behind only the U.S. and China.¹²)

Why not take advantage of the waste in the U.S.? Turning it into a source of energy could power truck and bus fleets around the country, for example, without any harmful emissions or even drilling.

RNG provides an actionable, innovative solution to the waste management issues in our country. The waste industry is trending towards a “zero waste” concept that includes the goal of capturing and repurposing food waste from the system. If that food is turned into RNG, we are not only meeting industry goals, we are thinking ahead.

Because RNG is derived from organic sources, and because humans and animals will always produce organic waste, we are guaranteed a continuous supply of RNG. It only makes sense for communities to work together to put this affordable, clean and secure energy supply to work in a sustainable way.

Modernizing the Transportation Industry

RNG has the potential to radically change the transportation industry as we know it. The industry as a whole has already been moving to use natural gas as a fuel in the form of compressed natural gas (CNG) and liquid natural gas (LNG). Close to 17 percent of transit buses run on natural gas¹³ and more than 60 percent of new orders for trash trucks include natural gas engines.¹⁴

Renewable natural gas provides another, more affordable alternative. The amount of organic waste that cities, towns and rural areas in the United States throw away every day can be turned into enough RNG – using technologies we already have – to displace 16 percent of all diesel fuel used in the country.

RNG has the lowest carbon intensity of all transportation fuels. It reduces carbon dioxide emissions by 80 percent compared to diesel¹⁵, but we will need much more of it. The 10 million

trucks and buses on our roads make up only four percent of all vehicles, but they use 23 percent of all fuel as they haul goods worth 70 percent of the country's GDP.¹⁶ Traditional natural gas and RNG are the only alternative fuels able to replace the large quantities of diesel needed to fuel these vehicles.

Increased RNG production for transportation is already underway. Production multiplied five times from 2013 to 2015, and is expected to triple in volume by 2018. Forty projects in North America currently produce RNG for use in transportation - that number is on pace to double to 80 by the end of 2018.¹⁷

Between 20 and 35 percent of natural gas used for transportation today is renewable natural gas.¹⁸ That number will only increase from here.

Where do I fit in?

Now that you have a basic orientation to the world of renewable natural gas, the next logical question is where you and your company fit in that world. Here are a few possibilities.

Utilities

Whether local utilities are municipal or investor-owned, they can use renewable natural gas as a fuel source. Because it provides so many benefits, RNG is in high demand. Many RNG developers lock in contracts before they begin a project, but local utilities that want to get in the RNG game should always check for existing local RNG sources. If none exist, they can approach potential producers to develop their own RNG project.

Landfills and wastewater treatment plants, for instance, both produce significant amounts of biomethane. A local utility could work with these producers to process the biomethane into RNG and gain a steady supply of base-load power. Using RNG typically qualifies utilities for renewable energy credits as they meet state renewable energy mandates. RNG provides a clear advantage as a renewable fuel – it's much more consistent and reliable than wind and solar, which vary according to the weather.

As the Environmental Protection Agency's recent Clean Power Plan requires power plants to reduce their carbon emissions more and more (they are the nation's largest source of such pollution), utilities will increasingly be looking for clean, reliable and affordable ways to replace traditional fossil fuels. RNG fits the bill like none other. It will enable electric utilities to reduce their dependence on coal and clean up their power generation methods so they can comply with the new law.

Transportation

Transportation is perhaps the most obvious industry that can benefit from increased use of renewable natural gas. It can make a difference to fleets that use the gas, stations which dispense it, pipeline companies which move it and compression and liquefaction operators which turn it into fuel.

RNG can directly replace traditional fuels such as gasoline or diesel. Where natural gas is already used to fuel vehicles in the form of Compressed Natural Gas (CNG) or Liquefied Natural Gas (LNG), renewable natural gas can be used without making any changes to the CNG or LNG systems.

About 35 percent of the natural gas used in the transportation industry is RNG; in California,

RNG is half of all natural gas used in transportation.¹⁹ This percentage will only continue to grow as companies continue the search for clean, affordable and reliable sources of energy.

Natural Gas Industry

While natural gas is already considered one of the cleaner fossil fuels, the natural gas industry has renewed its focus on decarbonizing their pipelines and lowering their greenhouse gas footprint as much as possible. With much of the current spotlight on electrification, the natural gas industry is perfectly primed to put renewable natural gas in the front and center of their environmental efforts because of its green attributes.

This market is a natural fit for pipeline companies. Once biomethane has been correctly processed, it is indistinguishable at the molecular level from fossil fuel natural gas. The industry is committed to reducing carbon emissions and decarbonizing the pipelines that span North America and reach nearly every home and business. RNG fits this goal because it is the same product, but comes with reduced greenhouse gas emissions.

Gas marketers who buy, sell and arrange transport for natural gas through the interstate pipeline system need to know that RNG is a viable alternative to traditional natural gas. Particularly if their company is an advocate of environmental awareness, they could make an impact by buying and/or selling RNG to unlock its environmental attributes.

Corporate Sustainability

Corporate sustainability is a hot topic as many companies (oil and chemical companies especially) look for ways to significantly reduce their carbon footprint. The Paris Climate Agreement is referenced by corporations and governments as the standard to which they should attain. That agreement lays out a Greenhouse Gas Protocol that helps companies measure their progress in reaching their sustainability goals.

RNG is an ideal resource for companies committed to following the GHG protocol, which is laid out in three stages or scopes, as follows:

Scope 1

This scope measures a company's direct emissions, such as the amount of GHG company fleet vehicles give off in a year's time. This scope is especially effective for manufacturers which use a lot of energy, such as plastics and chemical companies.

Many companies may not know where to start when their CEO declares they will become carbon neutral by complying with the Paris Climate Agreement. RNG is a great place to begin. For example, switching vehicle fleets to natural gas vehicles powered by RNG would be an effective first step for this scope.

Scope 2

Scope 2 measures emissions based on a company's electricity procurement. That is, how much GHG was emitted into the atmosphere by the company's electricity provider as they generated the electricity necessary to keep the company running? This especially affects local utilities with large companies as their biggest clients.

If local utilities generate their electricity from ultra-low-carbon sources, their GHG emissions will dramatically decrease. To make this happen, the utility needs a low-carbon base load of power. RNG is again an ideal candidate because it proves to be a steady source of power. Whether the utilities generate RNG themselves or import it from elsewhere, the resulting decrease in GHG

emissions can only benefit the company.

Scope 3

This scope takes into account a company's entire value chain, including everything its product touches: where materials are sourced, how they reach customers, the vehicles and fuel they use, the electricity consumed, and more. This is a comprehensive look at the environmental impact of the company's entire reach.

Increasingly, major companies with buying power are asking their suppliers and distributors to meet certain clean energy standards. This helps the company reduce its Scope 3 emissions while encouraging its business partners to do the same.

Large companies should encourage other companies in their value chain to power their facilities with RNG; they can also encourage others to transition their fleets to natural gas-powered vehicles fueled by RNG.

Small companies in the value chain of larger corporations also have the opportunity to put themselves in a forward-thinking strategic position. When the larger companies commit to Scope 3 reductions, your business can already be at an advantage by using RNG available in your region.

RNG Producers

If you are sitting on a source of renewable natural gas, you may be more fortunate than you realize. Landfills, wastewater treatment plants, dairies, farms – many of these types of operations are the gold mines of the RNG industry. Your site is producing biomethane whether you do anything with it or not. If you do nothing, you'll be contributing to the country's greenhouse gas problem and the environment will suffer.

If, however, you capture and process it, you will have created a renewable energy source that will benefit the environment and may reduce your costs by fueling your own operation. Landfills that capture RNG, for example, would do well to replace their garbage trucks with models that run on natural gas. As the landfill creates more biomethane, it is continuously processed into natural gas, which fuels the garbage trucks, which bring more garbage, which creates more biomethane. This self-sustaining closed loop does not require outside assistance. The same principle can apply to other situations where RNG can be used as a fuel as well – self-sustaining renewable fuel projects are the future.

Related Fields

Renewable natural gas has implications for several other fields as well, including engineering, which is vital to the cause of renewable natural gas. Engineers must be involved in site selection and development for RNG projects, they must help design and evaluate the projects, and they must make sure everything is operating correctly. In fact, companies should engage engineers in whatever RNG projects they decide to undertake.

Lawyers are an important part of the RNG puzzle as well. Companies will need legal agreements and they will need to develop a good understanding of state and local federal laws and regulations. CPAs and tax specialists must be consulted as well.

Lobbyist, Politicians, Government

Because policy success drives industry success, government has a large role to play in the success of renewable natural gas. Good policies bring about good results, so it is in the best

interest of the RNG industry to find ways to get in front of policymakers.

For their part, policymakers would do well to educate themselves and their staffs on the benefits of RNG for both the environment and the economy. Creating and supporting policies that drive the production and use of RNG is both the right thing to do and a savvy public relations move – it's the rare solution that has the dual advantage of actual effectiveness paired with a positive image.

Local city and county governments should also investigate options for their communities. They may have access to renewable fuel in a way they don't even realize.

What's Next?

Now that you're convinced of the need for America to put its full weight behind the potential of renewable natural gas, what's next? How can you get involved on behalf of your company?

One of the best ways to practically advance the cause of RNG is to join the Coalition for Renewable Natural Gas, a nonprofit organization focused squarely on promoting renewable natural gas as a clean, environmentally-friendly, renewable and domestic energy resource.

What the one cannot do alone, the many can do together. The RNG Coalition gives a platform and a voice to companies involved in the renewable natural gas industry. The Coalition's membership includes every part of the industry – waste management and recycling, engineers, environmental advocates, renewable energy developers, gas marketers and transporters, research organizations, local utilities, ratepayers and even major oil companies.

Pull quote:

The mission of the RNG Coalition:

The RNG Coalition advocates for renewable natural gas derived from cellulosic waste sources so that present and future generations will have access to domestic, renewable, clean fuel and energy supply.

If you are part of the energy industry in any way and you are concerned about the country's future energy supply, you need to be a part of the RNG Coalition. As a member, you will have input in forming and carrying out the Coalition's priorities, which are centered around public policy advocacy and public education.

Membership benefits include the following:

- Real-time updates on industry legislative and political activity
- Participation in conference calls and working groups
- Input into how the industry seeks to shape policies and regulation impacting RNG
- Leadership roles in the annual RNG Conference
- Company advertisements on promotional materials
- Invitation to membership reception and dinner at the annual RNG Conference
- Invitation to all coalition events and meetings

RNG Coalition Annual Conference

Each December, members of the RNG industry gather in San Diego for the industry's premier annual policy gathering - the Fuel, Heat, Power and Policy Conference. Held at the historic Hotel del Coronado, the event brings together all the major players in the industry. The conference is an ideal place to network and make the connections that help move the industry forward. If you are new to the RNG field, this conference will be the perfect introduction for you.

Find out more about the RNG Coalition's Annual Conference - including how to register - on our website, www.rngcoalition.com.

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³ "Biogas Opportunities Roadmap: Voluntary Actions to Reduce Methane Emissions and Increase Energy Independence." *U.S. Department of Agriculture, U.S. Environmental Protection Agency, U.S. Department of Energy*. August 2014. http://www.usda.gov/oce/reports/energy/Biogas_Opportunities_Roadmap_8-1-14.pdf.

⁴ (U.S. Environmental Protection Agency (EPA). 2010a. *Landfill Gas Energy Cost Model (LFGcost)*, Version 2.2. LMOP, Climate Change Division, U.S. EPA. July 2010.)

⁵ "Energy Analysis: Biogas Potential in the United States." *National Renewable Energy Laboratory*. October 2013. <http://www.nrel.gov/docs/fy14osti/60178.pdf>.

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⁷ "The Potential for Renewable Gas: Biogas Derived from Biomass Feedstocks and Upgraded to Pipeline Quality." *American Gas Foundation*. September 2011. <http://www.gasfoundation.org/researchstudies/agf-renewable-gas-assessment-report-110901.pdf>.

⁸ California Air Resources Board: Low Carbon Fuel Standard Report 2009. <http://www.arb.ca.gov/fuels/lcfs/lcfs.htm>.

⁹ U.S. Department of Energy, Clean Cities Program, "Turning Waste Into Vehicle Fuel: Renewable Natural Gas (RNG): A Step-By-Step Guide For Communities; Page 6. <http://energy-vision.org/ev-publications/EV-RNG-Community-Guide.pdf>.

¹⁰ "How much petroleum does the United States import and export?" *U.S. Energy Information Administration (EIA)*. <http://www.eia.gov/tools/faqs/faq.cfm?id=727&t=6>.

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¹² "Food Wastage Footprint: Impacts on Natural Resources," *United Nations, Food and Agriculture Organization*, 2013. <http://www.fao.org/docrep/018/i3347e/i3347e.pdf>.

¹³ "Public Transportation Industry Is a Green Industry 41.3% of U.S. Public Transit Buses Use Alternative Fuels or Hybrid Technology." *American Public Transportation Association*.

¹⁴ NGV America, "Vehicles." <http://www.ngvamerica.org/vehicles/>.

¹⁵ According to CA-GREET, version 1.8B and Argonne National Laboratory, "Waste-to-Wheel Analysis of Anaerobic-Digestion-Based Renewable Natural Gas Pathways with the GREET Model," September 2011.

¹⁶ "RENEWABLE NATURAL GAS: The Solution to a Major Transportation Challenge." *Energy Vision and CALSTART*. Page 4. <http://www.eia.gov/tools/faqs/faq.cfm?id=727&t=6>.

¹⁷ Coalition for Renewable Natural Gas.

¹⁸ Coalition for Renewable Natural Gas and NGV America – Derived from two U.S. Energy Information Administration data sources providing different estimates.

¹⁹ "RNG in California: More Than You Think." *Fleets and Fuels*, April 20, 2016. <http://www.fleetsandfuels.com/fuels/cng/2016/04/rng-in-california-more-than-you-think/>.