

WHITE PAPER / RENEWABLE NATURAL GAS RESOURCES

GENERATING VALUE FROM NATURALLY OCCURRING GASES

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The development of renewable power resources, such as wind and solar, is dramatically changing the energy portfolio. Harnessing the power of renewable natural gases provides additional opportunity to collaborate with renewable electric generators, enhance energy resilience and enable a low-carbon future.



Access to reliable, affordable energy is critical to any country's national security, economic development and prosperity. Increasingly, natural gas is relied upon for heating and electric power generation. Transportation continues to depend heavily on petroleum products, such as gasoline and diesel. Nations without their own supplies of these resources are vulnerable to market fluctuations and geopolitical forces that threaten both the supply and price of valuable commodities.

How might such nations shift to more stable, widely available resources as an alternative? Technologies exist that enable the production and capture of naturally occurring biogas, as well as sustainable local hydrogen production methods to support low-carbon electricity and zero-emissions transportation fuel.

HYDROGEN TRANSPORTATION AND ENERGY STORAGE

Transportation and electric power generation represent the two biggest sources of greenhouse gas (GHG) emissions worldwide, and they continue to rely in large part on finite fossil fuel resources found only in select regions of the world. Hydrogen, by comparison, is a potentially inexhaustible clean resource that could be available anywhere electricity and water exist. Today, hydrogen is widely used to support chemical and refining processes, as well as other industrial uses. However, the surface has barely been scratched of its potential as an energy storage mechanism and as a transportation and power generation fuel.

The use of hydrogen fuel cells for transportation is not new. However, significant research and development is underway to advance these technologies and establish a more reliable, efficient and widespread infrastructure to support them. Unlike natural gas, hydrogen fuel is viewed as a viable alternative to diesel because its energy density is approximately three times greater than any traditional hydrocarbon-based fuel while only emitting water vapor. Hydrogen fuel cell electric drivetrains can be a good alternative to pure electric vehicles, which might have limited range and require longer charging durations. Hydrogen fuel cell vehicles are ideal for drayage operations in which trucks may have continuous duty cycles and require short-duration refueling.

Another opportunity is the use of hydrogen as an energy storage option for supporting electric power. Once processed, large quantities of hydrogen can be stored in fairly small volumes, as compared to the amount of liquefied natural gas needed to achieve the same energy output. Using stored hydrogen as a fuel source for generation could provide an alternate energy storage method to put power back onto the electric grid, in times of low generation from other renewable resources.

The key challenge to moving forward with widespread hydrogen-fueled transportation and electric power generation is the production of pure hydrogen. Although it is the most abundant element on Earth, elemental hydrogen does not exist in abundance naturally. Rather, it must be extracted from compounds that contain it, such as water.

According to the U.S. Department of Energy (DOE), 95% of hydrogen production in the United States is through a process called natural gas reforming, which produces carbon emissions and other GHGs. A more sustainable production opportunity is through electrolysis, which uses electricity to split water into hydrogen and oxygen. Although electrolysis is normally very inefficient, if the electricity used in the electrolysis process comes from renewable resources, then hydrogen production becomes virtually emission-free. Per the DOE, reforming low-cost natural gas provides for a steppingstone today for hydrogen production, but hydrogen production is expected to be augmented by renewables and low-carbon domestic energy sources over the long term.

Renewable energy resources can be used to produce hydrogen locally, particularly during times of curtailment. For example, wind energy in the Upper Midwest of the U.S. is largely curtailed at night. A hydrogen production facility could use this wind power to produce and store hydrogen for power generation needs. Co-locating generation units on-site with renewables and hydrogen production also enables the use of existing electric transmission interconnections, reducing the need for additional delivery infrastructure.



RECYCLING CARBON EMISSIONS

The United States is the leading producer of natural gas worldwide, accounting for more than 20% of global production in 2018, according to the U.S. Energy Information Administration (EIA). While burning natural gas produces approximately 40% fewer carbon emissions than burning coal, the desire for lower-carbon solutions continues to grow.

The natural decay of organic materials also produces GHGs at high levels. These naturally occurring GHG emissions, or biogases, can be captured and processed to create renewable natural gas (RNG), which is comparable to conventional natural gas from a chemical

perspective. When used in place of conventional natural gas resources, RNG provides a net-zero effect with regard to GHG emissions — assuming all processing energy comes from renewable sources — because it reuses the carbon and GHG emissions that would otherwise occur through natural processes, as opposed to extracting and generating new natural gas sequestered beneath the Earth's surface.

Once captured and cleaned, RNG can be used in the same applications as natural gas, taking advantage of the more than 210 natural gas pipeline systems and 305,000 miles of transmission pipelines that exist in the U.S. RNG also qualifies as a renewable fuel under the

federal Renewable Fuels Standard and as a low-carbon fuel within California’s Low Carbon Fuel Standard.

Producing RNG requires technologies for gas capture and gas purification. Many field-proven technologies and processes already exist to support ongoing development. Feedstocks used to generate RNG are sustainable, generally readily available, and are often considered waste products, such as animal manure, wastewater, biosolids and landfill gas. Based on the available feedstock, there are numerous proven, commercially available technologies to cleanse impurities, such as carbon dioxide and hydrogen sulfide, from the biogas. These technologies include water scrubbing, amine scrubbing, gas membranes and pressure swing adsorption.

UNLEASHING POTENTIAL

RNG has the potential to turn waste into a valuable commodity. Under the right circumstances, products largely viewed as waste — such as biosolids in wastewater, landfill gas and animal manure from farms — can fuel local industries and commercial entities. The potential for energy companies to procure RNG supplies from unconventional partners enables a reduction of the carbon footprint of natural gas-fueled operations by reusing naturally occurring gas.

The rise of renewable energy and the decreasing cost for renewable energy technologies provide ample opportunity to build out sustainable hydrogen production facilities. Hydrogen ultimately could replace natural gas as a power generation fuel. As production increases, the economic viability of hydrogen-fueled transportation also should improve. Other benefits of hydrogen as a fuel source include fast fill-ups and supporting longer vehicle range, especially for long-haul trucking and transit featuring longer routes or cold-climate use cases. Additionally, batteries in hydrogen EVs are smaller and lighter, offering even greater hauling capabilities.

For countries that rely on natural gas imports to meet their power generation and building heating needs, such applications could provide greater energy independence and economic stability. No nation has a monopoly on renewable resources. Those that seek unconventional partnerships for RNG capture and use, and new applications for hydrogen production and uses, will speed to fruition the achievement of carbon reduction goals, among other community and environmental benefits.

BIOGRAPHY

CHRIS McCALL, PE, P.ENG, PMP, is a program and project manager focused on managing and executing complex transmission and distribution projects for utilities and developers at all scales. He has more than a decade of experience overseeing and designing transmission line projects from start to finish, incorporating all aspects of licensing, testimony, estimating, scheduling, permitting, engineering, construction and everything in between. In his current role, he coordinates and oversees execution planning, scope management, budgeting, scheduling, contract negotiation, proposal development, subcontractor and purchase order management, procurement management, and construction management.

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