

COVER STORY

Illustration by Daniel Hertzberg

THE HYDROGEN RACE

Looking toward a greener future, the North American natural gas sector is planting its flag in the pilot projects, research and policy reforms needed to integrate hydrogen into the natural gas supply. **BY M. DIANE**

MCCORMICK

In the future, we may see energy come from a variety of sources beyond what we know today.

Does that make hydrogen the next renewable natural gas—a powerful force in the race to decarbonize those molecules? Quite possibly—and it could become the basis for much more.

“Ultimately, hydrogen can play such a wide range of roles—for industry, for heat, in electricity using fuel cells and hydrogen-fueled power plants, and in transportation,” said Neil Navin, vice president of clean energy innovations for Southern California Gas Company. “There’s a recognition that green electrons need to be paired with green molecules, specifically hydrogen, as a way of decarbonizing the energy system.”

While RNG has secured its place as a green source of fuel that can be integrated into natural gas systems, the North American natural gas sector is planting its flag in the pilot projects, research and policy reforms needed to also integrate hydrogen into the supply.



NW Natural employees (left to right) Clay Studtman, Albert Hernandez, Bill Adler and Darin Arnold test hydrogen-blended gas at NW Natural’s Training Town facility.

PHOTO COURTESY OF NW NATURAL

“We’re taking baby steps,” said Malini Giridhar, vice president, business development and regulatory, at Enbridge Gas. “But if we’re really looking at a world where we have a lot less carbon in our energy systems, then these are the pathways through which hydrogen needs to move forward. We want to make sure we can be in step with the changes when it happens.”

THE RACE TO DECARBONIZE

In the 1950s and ’60s, NW Natural delivered a hydrogen blend to customers through a mixture known as “town gas.” Now, blending hydrogen into the natural gas stream is an emerging decarbonization method, “so something old is new again,” said Chris Kroeker, NW Natural’s emerging technology program manager. “We have a bit of history. We’re focused on helping ensure a safe and efficient process as we embark on using it again.”

Donald Chahbazzpour, director, regulatory strategy—future of heat, National Grid US, compares the sudden burst of interest in hydrogen in North America to the hydraulic fracturing boom of 2008. In both cases, well-established science and technology offered a solution to contemporary issues—in the case of hydrogen, the increasing intensity of decarbonization goals across the public and private sectors. As a result, many industries, states and countries are already driving toward net zero by 2050.

As McKinsey & Company reports in its *Road Map to a US Hydrogen Economy*, hydrogen could account for 14% of U.S. energy demand by 2050, with reductions of 16% in carbon dioxide emissions and 36% in nitrogen oxide emissions.

“People have been talking about hydrogen forever,” said Chahbazzpour. “It seems like it reached critical mass, because it’s no longer in the ivory tower. There are significant projects. It’s a global scale.”

In Ontario, Enbridge has partnered since 2018 with the local electricity supplier, IESO, on North America’s first power-to-gas facility, storing surplus electrical energy in the existing natural gas pipeline infrastructure.

Now, Enbridge and Cummins, formerly Hydrogenics, are leading the North American investigation of hydrogen blending to increase the rate of decarbonized

molecules in natural gas streams. The pilot project, announced in October 2020, is reaching about 3,600 customers.

“Even though it’s small at this point, our belief is that this can be expanded in terms of other areas across the system, geographically and also over time, increasing the amount of hydrogen that’s blended in,” said Giridhar. “It’s the first of many steps.”

The test falls within Enbridge’s three-step approach to decarbonize through energy efficiency, advanced technologies and green fuels, she added. All are needed “so customers can continue to take comfort from this reliable, safe and affordable product they use today, which they love.”

Like other pilot projects across gas systems, NW Natural’s hydrogen blending project is testing such factors as appliance and infrastructure compatibility and leak detection.

“Quite honestly, it’s some of the most boring testing we’ve ever done, because nothing is different,” said Kroecker. “It’s completely compatible in every aspect we’ve seen at a 5% blend, which is what we’ve been hearing from others who are doing the same thing. We think we can leverage the existing infrastructure to a 20% blend.”

In California, a SoCalGas blending project announced in October 2020 will start blending about 1% hydrogen into the fuel going to a subdivision. Like NW Natural, the goal is testing infrastructure impact and performance in appliances in mixes up to 20%, said Navin.

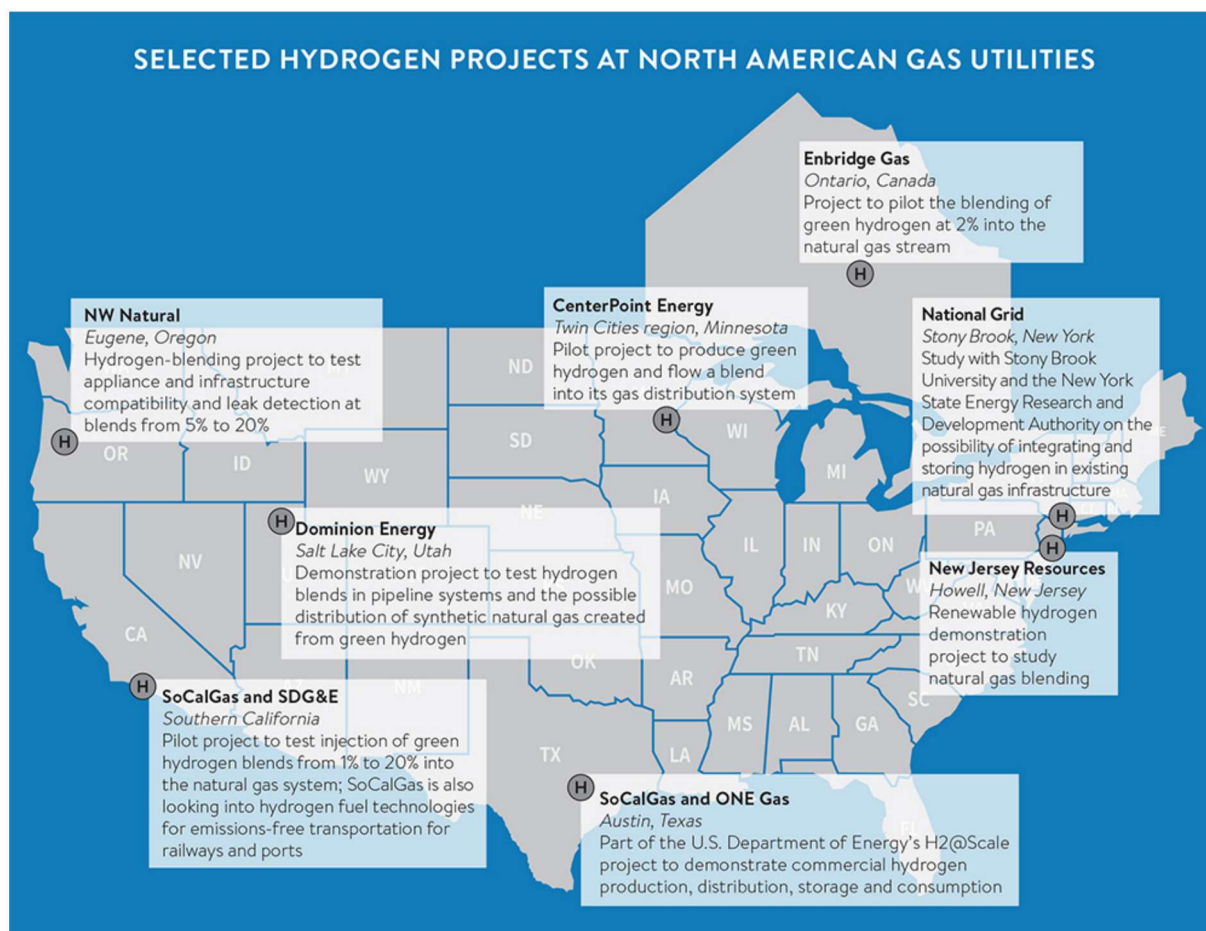
Also in California, San Diego Gas & Electric—like SoCalGas, a Sempra Energy subsidiary—has two hydrogen projects planned to begin in 2022. The projects combine renewable resources, electrolysis and fuel cells to demonstrate a range of applications, including system resiliency, long-duration storage, power-to-gas hydrogen fuel blending and vehicle hydrogen fueling.

Demonstration projects run in tandem with intensified research and development collaborations. They include the HyBlend project, which is testing remaining questions about hydrogen blending; it’s being led by the National Renewable Energy Laboratory and comprises five other national laboratories and more than 20 participants from industry and academia, including leading utility sponsor Southern Company and Southern Company Gas. There’s also the Low-Carbon Resources Initiative, a five-year project to accelerate development of promising technologies,

assess performance, and raise public awareness of technology options and pathways to a low-carbon future.

With American Gas Association members involved, the combined efforts facilitate sharing of the most effective methods of demonstrating how to integrate hydrogen and other clean technologies into energy delivery.

“We’re laying the foundation, we’re doing the science, we’re doing the demonstrations and we’ll also be doing the policy work,” said Chahbazpour.



CROSSING THE DIVIDE

In a world once demarcated by gas and electric as distinct energy sources, hydrogen is stepping in as a bridge toward decarbonization. Natural gas has always been lauded for its reliability. Hydrogen adds a further layer of reliability, especially when power-to-gas systems convert excess renewable energy into hydrogen for storage or blending, eliminating the waste of curtailing unneeded energy.

“Now, you can use the gas network as a battery,” said Chahbazpour. “Hydrogen becomes more integrated and enables more renewable energy.”

As policies continue to drive creation of renewable energy, and as more offshore wind projects come online, the potential for massive amounts of electricity generation could also mean massive curtailment. Wind and solar introduce volatility into the grid, said Kroeker, while the electrolyzers that help convert excess electricity into hydrogen “can smooth it out.”

“The gas system is going to be perfectly positioned to absorb all that energy, to store it and to move it,” he said. “I think there are going to be significant partnerships between the two grids in the short and long terms.”

Because natural gas and hydrogen can be transported across great distances, even areas lacking abundant wind and solar capabilities will discover “an important role for green hydrogen,” said Navin. “Green molecules between now and midcentury are only going to get more and more important.”

Sitting between gas and electricity, hydrogen also has the flexibility to serve as a “multisectoral” fuel for a range of uses, said Chahbazpour. For example, automakers are “excited about fuel-cell cars,” GE offers hydrogen generation equipment, and marine transportation “could be the sector that begins to embrace hydrogen before any other.”

Industries that demand high heat typically need natural gas and are “really ripe for use of hydrogen,” said Navin. The key to cracking the industrial segment, added Kroeker, is working on compatibility and helping industries become comfortable with blending hydrogen into their fuels.

Natural gas systems are also leveraging existing infrastructure and processes to make inroads with hydrogen into medium- and heavy-duty trucking, although low-cost diesel fuel remains an obstacle. Enbridge is sketching out plans to add hydrogen to the gas supply at compressed natural gas stations to lower the carbon content, while SoCalGas is testing new technology that extracts pure hydrogen from natural gas after the blended mix has moved through a pipeline.

The potential applications for hydrogen are numerous, depending on “the fuel it’s displacing and understanding the value in that particular application,” said Giridhar.

“There’s a lot of value in taking a zero-carbon fuel like hydrogen and applying it to the fuels that have the highest carbon intensity.”

POLICY AND SCALE

That future world of excess renewable energy will offer the friendly electricity prices that make hydrogen production economically viable, but for now, cost remains a barrier to scaling up. Policy frameworks and financial incentives that reduce the cost of electricity and recognize hydrogen’s value in managing surplus power are needed, say industry leaders.

Canada’s drive to achieve net zero by 2050 calls on clean hydrogen to meet 30% of the nation’s energy needs. In the United States, President Joe Biden’s call for fighting climate change is expected to rely heavily on clean energy technologies, including renewable hydrogen.

States see promise in hydrogen, too. Oregon’s 2019 law promoting RNG production and use, SB 98, also acknowledged that hydrogen could accelerate large-capital power-to-gas projects. Now, NW Natural hopes that the production tax credits and investment tax credits benefiting solar and wind energy will be extended to hydrogen and methanation plants, said Kroecker.

The use of hydrogen to help achieve a net-zero society is well underway in Europe, providing lessons learned and outcomes for North American advocates making their case. Hydrogen Europe, an industry collaborative, is partnering with the European Commission and researchers on the Fuel Cells and Hydrogen Joint Undertaking to commit 1.3 billion euros, or \$1.56 billion, to introduce hydrogen-centric clean technologies into energy and transport.

National Grid, headquartered in London, won a competitive \$12 million innovation grant from Ofgem, the U.K.’s Office of Gas and Electricity Markets, to test gas transmission for home heating and energy. In a facility separate from the U.K.’s main



Infrastructure compatibility and leak detection are among the factors that NW Natural and other utilities are testing in their hydrogen blending projects.

PHOTO COURTESY OF NW NATURAL

national transmission network, testers will study the safety and reliability of hydrogen blends of up to 100%.

“Sectors such as heat are difficult to decarbonize, and the importance of the gas networks to the U.K.’s current energy supply means projects like this are crucial if we are to deliver low-carbon energy reliably and safely to all consumers,” Antony Green, National Grid project director for hydrogen, said in an announcement of the grant.

Looking toward Europe, the U.S. is starting to recognize “that we need to establish our leadership position, as well,” said Navin. California lawmakers and regulators are “recognizing the value of green molecules” to support storage and conversion of curtailed renewables.

As for bringing down costs, Navin notes that costs of solar power fell when production scaled up. For green hydrogen, a regulatory framework that drives hydrogen to scale would create “an opportunity to drive down the cost of that equipment and then, ultimately, the cost of the hydrogen when it’s delivered to the consumer,” he said.

“You never know how much potential is out there until you put policy support behind these things,” he added. “This is being driven by policy.”



With RNG a proven technology that's being integrated into the gas infrastructure, industry leaders say hydrogen is only about a decade behind.

'TOTALLY DOABLE'

When it comes to green molecules, RNG and biomass are “here and now,” said Chahbazzpour. The technology is proven and commercially available. The output of wastewater plants, landfills and dairies is integrated into the gas infrastructure.

Hydrogen is about a decade behind, he says, but could achieve scale in the late 2020s or early 2030s.

AGA roundtables and the emergence of collaboratives—including HyBlend, the Renewable Hydrogen Alliance, LCRI, and the Fuel Cell and Hydrogen Energy Association—provide platforms for sharing knowledge that helps accelerate progress.

“It’s been reassuring that it’s totally doable,” said Kroeker. “This isn’t some dream that’s 20 years out. We’re doing it now.”

So, to answer the original question: Is hydrogen the next RNG? Industry leaders say yes. RNG has matured into a key element in the drive toward decarbonization, and hydrogen is queueing up to join the effort, especially as its potential for more than blending—such as the creation of synthetic methane by mixing it with recycled carbon dioxide emissions—grows more economically feasible.

“Existing systems cannot work with 100% hydrogen, but they can work really well with a mix of RNG and hydrogen,” said Giridhar. “In the future, if carbon-capture technologies become more economical, we can create synthetic methane by taking that captured carbon and hydrogen and creating methane. This is way in the future, but these are the building blocks.”

RNG is important, agreed Navin, but hydrogen could become even more important.

“Over the next few decades, hydrogen is going to play a major role in the development of green molecules and the moving of green molecules,” he said. “It’s going to play a larger role in the energy economy worldwide. We’re very excited about the opportunities for hydrogen.”