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Hydrogen: Front and center in climate debate

Federal funding accelerates carbon capture and hydrogen development

By Kevin Robinson-Avila/ Journal Staff Writer Oct 9, 2023



Leona Morgan

yells and chants while leading a march and rally on Central Avenue to the Clyde Hotel, protesting the "Building an Advanced Energy Ecosystem in New Mexico" conference in Downtown Albuquerque. Chancey Bush/ Journal

Kit Carson Electric Cooperative in Taos already generates 100% of its daytime electricity with solar power, and now, it's turning to hydrogen to help extend its renewable generation around the clock.

The utility wants to build a new, green-hydrogen production facility that would provide hydrogen to power up clean fuel cells that could supply electricity in the evenings, or whenever the cooperative's solar and batterystorage systems aren't generating enough energy to meet customer demand. It also hopes to build a second hydrogen facility to provide fuel for heavy-duty, off-road vehicles used in remediation work at Chevron Corp.'s old molybdenum mine in Questa, which shut down in 2014.

Unlike many other emerging hydrogen projects in New Mexico and elsewhere that face intense controversy, Kit Carson's plan enjoys broad community support. That's because it's completely "green," employing solar generation to power up a clean process for pulling hydrogen out of water, which eliminates carbon emissions.

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Intense controversy, however, is gaining momentum as the country prepares for a dramatic, nationwide acceleration in hydrogen development for use in everything from power generation and transportation to heavy industrial processes like steel and cement production. Some \$20 billion in federal funding is feeding an industry frenzy to ramp up hydrogen development, and, along with it, carbon capture and sequestration, or CCS, technology, which is needed to trap carbon emissions when using natural gas to produce hydrogen.

It's part of a broad, global movement that's gaining ground as the world seeks additional technologies to decarbonize economies as fast as possible to slow, or stave off, climate change.

But society is divided about pursuing those technologies. Many environmental organizations oppose CCS in general as a strategy for combatting global warming, and specifically its use as an enabling technology to pull hydrogen out of natural gas rather than water, which emits a lot of carbon in the process.

Kit Carson, meanwhile, deliberately chose the green, water-based production process for its hydrogen projects, greatly softening any potential opposition, said cooperative CEO Luis Reyes. And, since launching the planning process early last year, the utility has worked closely with local officials, environmental groups and energy experts to build public support through nearly two dozen community meetings.

As a result, Kit Carson could become the first utility in the nation to develop a commercial-scale project that incorporates hydrogen-based generation into its energy mix, potentially serving as a model for other local utilities and communities.

"Our criteria from the start is that this had to be totally green," Reyes told the Journal. "...We may be the first utility to deliver green hydrogen to its own power grid. This is really cutting-edge technology."

Federal fundingToday's controversy is multifaceted, reflecting environmental opposition to both CCS technology and to hydrogen production that relies on natural gas, or methane, as a feedstock rather than pulling hydrogen molecules from water. It also reflects a fundamental difference in strategies to combat climate change, with many environmental groups promoting an all-renewable approach to eliminate carbon emissions through solar, wind and battery-storage development, and CCS and hydrogen supporters who say additional strategies and technologies are critical to achieve net-zero carbon emissions by mid-century.

That controversy is rapidly accelerating, largely because the federal government is now preparing to pump billions of dollars into CCS and hydrogen projects around the country.

The federal infrastructure investment law passed by Congress in 2021 includes \$12 billion in funding for CCS technology development, demonstration projects and pipeline construction to transport captured carbon to long-term underground storage, or sequestration, facilities. It also includes \$8 billion for the development of "hydrogen hubs" around the country, where state governments will work with industry to build industrial hydrogen clusters to produce and use hydrogen in many different sectors, including power generation, transportation and industrial processes.

Apart from that funding, the Inflation Reduction Act passed last year also authorizes hefty tax credits for industry investment in hydrogen production, and for long-term carbon sequesteration.

The U.S. Department of Energy, which is managing the grant awards for both CCS deployment and hydrogen hubs, is already doling out hefty sums to industry developers. In August, it awarded \$1.2 billion for two CCS projects in Texas and Louisiana to directly pull carbon out of the air that would either be permanently sequestered, or used for industrial processes like chemical production.

That technology, called "direct air capture," or DAC, is barely emerging from infancy in terms of commercial-scale deployment, potentially making the new Texas and Louisiana projects the largest investment in "engineered carbon removal" in history.

The DOE is also expected to announce multi-billion dollar awards this month for up to six or more hydrogen hubs, potentially totaling up to \$7 billion of the \$8 billion available in the infrastructure investment law. The remaining \$1 billion could be used to build consumer demand for hydrogen through price subsidies, according to a development-support strategy that the DOE began exploring this summer.

NM in the running

New Mexico and three other Rocky Mountain states that include Colorado, Wyoming and Utah are jointly competing for a \$1.25 billion slice of the DOE's hydrogen hub awards to develop a regional industrial cluster. The four states — grouped in the Western Inter-State Hydrogen Hub, or WISHH coalition — are finalists in the competitive award process, which opened last fall.

The DOE originally received nearly 80 hydrogen-hub proposals, and WISHH was one of only 33 that were encouraged to submit detailed project descriptions last April.

The DOE invited the WISHH states in August to a day-long interview in Washington, D.C. with some 25 government officials, raising local expectations that the four-state coalition may be high on the list of potential awardees, said state Environment Department Secretary James Kenney.

"It was a robust, eight-hour day of Q&A to further explain the details of our proposal and the potential benefits," Kenney told the Journal. "Now, we're just in a holding pattern, waiting for the award announcements. But we're feeling very optimistic."

The WISHH proposal specifically outlines eight hydrogen hub "anchor" projects that could receive funding. Four are in New Mexico, including:

- Libertad Power, which plans to build a green hydrogen-based production plant near Farmington to supply fuel for hydrogen-powered trucks
- A plan by renewable developer Avangrid to build two green-based production facilities in San Juan and Torrance counties
- A Navajo Agricultural Production Industries proposal to convert some farm operations to hydrogen
- A Tallgrass Energy project to convert the coal-fired Escalante Generating Station near Grants, which shut down in 2020, into a natural gas-based hydrogen plant to restart the facility using hydrogen to run the turbines

The four remaining WISHH projects include another green-hydrogen production facility in Colorado, two natural-gas based ones in Wyoming and Utah, and a proposal to use trees harvested through fire mitigation as biomass for a methane-based hydrogen project in Utah.

The coalition envisions those "anchor" projects as magnets that will attract a lot more private investment to build a sustainable hydrogen economy, developing new products and services to transport and consume hydrogen.

If the coalition receives the full \$1.25 billion, it would generate a minimum \$2.5 billion investment in the region, since all projects require matching funds. And that, in turn, could create some 26,000 jobs in the region, including 7,000 construction-related jobs, according to WISHH.

"The grant award would give a huge economic boost to move the regional hydrogen economy forward and decarbonize many industry sectors," Kenney said. "It includes extensive efforts in local communities to train the next-generation workforce for the industry."

Meanwhile, even without the grant award, today's newfound focus on hydrogen is attracting broad interest by many more companies to either convert their own fossil-fuel powered operations to hydrogen, or to establish hydrogen-related production and service businesses, Kenney said.

"That includes equipment manufacturing, transportation services and workforce training programs — all to build a sustainable hydrogen economy," Kenney said.

Support for "green" hydrogen

As a relatively-clean fuel, supporters say hydrogen can help to displace fossil fuels, lowering or eliminating emissions in hard-to-decarbonize sectors. That includes everything from long-haul trucking and maritime shipping to aviation and heavy industry. And it can provide electricity on demand through hydrogen-fueled power plants, offsetting or replacing coal and natural gas facilities to provide generating capacity when solar, wind or battery storage is unavailable.

Kit Carson, for example, specifically chose hydrogen for its noncarbon-emitting potential to generate electricity, and to power up local, heavy-duty vehicles using fuel cells, which directly convert hydrogen to electricity and emit only water as a byproduct.

The cooperative has already installed about 20 solar facilities on its grid to meet all daytime electric demand, plus about 16 megawatts of back-up battery storage to provide power in the evening after the sun goes down. But it still needs more electricity for when the battery storage is exhausted.

"By combining the hydrogen generating facility with our existing solar and battery facilities, we can get up to 80% of all our energy needs from renewable resources around the clock," Reyes said. "It's unique, and it fits well with Kit Carson's renewable development goals."

Most environmental groups support that type of hydrogen development, with some caveats — principally that the process for creating green hydrogen be powered completely by renewable generation like solar or wind.

That hydrogen conversion process is based on "electrolysis," a technology that pulls hydrogen molecules out of water with no carbon emissions. But electrolysis requires a lot of electricity to operate, and environmentalists want to make sure producers don't use grid-tied fossil-fuel generation to power it up, nor displace current consumers who are already drawing electricity from existing solar and wind facilities.

Environmentalists say such green hydrogen projects should rely on newly-built renewable facilities, and if not, they should directly offset their fossil fuel consumption through indirect investments in renewable energy credits, or RECs, to support other renewable development projects.

"We don't want to see hydrogen producers competing with other existing users of renewable energy," Environmental Defense Fund spokesman Jon Coifman told the Journal. "That could just force others to go back to fossil fuels."

To ensure that balance, the U.S. Treasury Department is now working on guidelines for investors to access the new Inflation Reduction Act tax credits for hydrogen production, which authorizes up to \$3 for each kilogram of green hydrogen produced. That guidance could contain some of the requirements environmentalists suggest, but with flexibility to give investors time to build the new renewable generation needed to support electrolysis.

Natural gas-based hydrogen opposed

Much deeper controversy, however, revolves around natural gas-based production, whereby producers pull hydrogen molecules out of the methane in natural gas. A lot of carbon is emitted in that conversion process, which producers expect to trap through carbon capture and sequestration technology.

The problem is, CCS has yet to be proven effective on a commercial scale. To date, all CCS projects attached to fossil fuel facilities have only demonstrated partial carbon capture far below the 95% capture rate that promoters say they can obtain.

In addition, when using a full "life-cycle" analysis of production — which includes methane released when natural gas is pulled from well heads and then compressed and transported to hydrogen production facilities — total emission levels mount up to well beyond the carbon emitted just in the hydrogen conversion process itself.

The DOE will enforce a life-cycle emission standard for producers to receive Inflation Reduction Act tax credits, allowing eligibility if carbon released in the process is limited to four kilograms of CO2 for every one kilogram of hydrogen produced. The amount of credit awarded will vary depending on the carbon intensity reported, ranging from the maximum \$3 per kilogram for the cleanest hydrogen to just 60 cents for hydrogen production that hits the ceiling of four kilograms of CO2 per kilogram of hydrogen.

But some environmental organizations say even that maximum carbon intensity level will be impossible for producers to achieve, largely because of the current inefficiencies of CCS technology, plus the extensive methane leakage in natural gas production.

The Institute for Energy Economics and Financial Analysis, or IEEFA — a national think tank that favors renewable energy — released a new report in September that says the model the DOE is using to determine life-cycle carbon intensity for natural gas-based hydrogen production is fundamentally flawed. For one thing, it assumes only a 1% emissions rate for upstream methane leakage, when the national average for gas production today is at least 2.5%, according to IEEFA. And, in some oil and gas zones — such as the Permian Basin in Southeast New Mexico and West Texas — it's much higher.

In addition, the DOE assumes a 95% capture rate for CCS technology even though no commercial projects to date have reached anywhere near that level.

Apart from that, IEEFA says the DOE model completely excludes all "downstream" emissions, ignoring carbon releases and energy consumed by companies when compressing and transporting hydrogen to end users. It also disregards the climate-warming potential of hydrogen leakage itself, which tends to prolong ambient methane when mixed together in the atmosphere.

Finally, the model calculates carbon intensity based on the 100-year climate-warming potential of methane and hydrogen, rather than considering the first 20 years of release into the atmosphere, when the warming potential of both gasses is an order of magnitude higher.

IEEFA concluded that, using more realistic assumptions, no natural gas-based hydrogen facility will achieve the four kilograms of CO₂ per 1 kilogram of hydrogen ratio, and, depending on the model assumptions, emissions could climb to four times higher than that.

It's unclear how the government will actually determine if a particular facility is meeting the DOE carbonintensity standard once up and operating. But funding for hydrogen hub proposals that include natural gas-based production — commonly referred to as "blue" hydrogen — could lead to even higher carbon emissions over time than without those hydrogen facilities, said David Schlissel, IEEFA director of resource planning and co-author of the September report.

"They could be funding projects that will actively be hurting the environment," Schlissel told the Journal. "They use overly optimistic assumptions that contradict the science. The idea of using a 100-year life cycle for global-warming potential is just crazy when we're facing a crisis today — it's here and now, not in a hundred years."

Environmental groups divided

Environmental groups differ in their outlooks regarding both hydrogen development and CCS technology. Most support green hydrogen development, albeit with the caveats that electrolysis be powered by renewable resources.

But "Blue" hydrogen and CCS elicit varying reactions among organizations, with some mainstream groups like the Environmental Defense Fund, or EDF, and the National Wildlife Federation adopting more moderate positions that recognize the need for and potential benefits of those types of technology to accelerate decarbonization alongside solar, wind and batteries.

In New Mexico, environmentalists tend to be more adamantly opposed, to some extent reflecting the entrenched prominence of the oil and gas industry here and its lopsided impacts in some rural communities. An alliance of Indigenous, climate, environmental justice and youth advocates grouped in the "New Mexico No False Solutions" coalition is particularly active, regarding CCS and hydrogen-development as strategies to keep fossil fuel production alive for decades to come.

That group spearheaded an opposition movement that defeated proposed state incentives for hydrogen production in last year's legislative session. It's also organized frequent protests, including a 300-strong march and demonstration on Sept. 14 at the Clyde Hotel in Downtown Albuquerque, where scientists, researchers and energy industry representatives from across the state were participating in a two-day "advanced energy" conference.

"No hydrogen is clean," the group said in a recent letter to the DOE opposing all funding for hydrogen hubs.

"Hydrogen itself is an indirect greenhouse gas that extends the life of methane in the atmosphere," the group said. "Hydrogen leakage from WISHH and other production sites could contribute significantly to global warming." The EDF also recognizes the fundamental challenges in producing and using hydrogen to lower carbon emissions, particularly given the excessive methane leakage in natural gas-producing basins. That group, for example, spearheaded a six-year study in New Mexico that showed methane emissions in New Mexico were 60% higher in 2018 than reported by the Environmental Protection Agency, and it heavily lobbied state officials to enact strict emissions standards and requirements.

But rather than opposing blue hydrogen outright, the group believes hydrogen production can be useful for hardto-decarbonize sectors, targeting things like long-haul trucking, shipping, aviation and heavy industry, said EDF spokesman Jon Coifman. But tight government standards and requirements are critical to effectively monitor and control carbon emissions.

"We're at the dawn of this industry now and money is starting to flow, so it's important that public officials, project developers and investors understand hydrogen isn't a silver bullet," Coifman said. "It comes with challenges, and they must design effective mitigating measures into its development, because it's not a plug-andplay solution."

In fact, EDF designed a "Better Hubs" website to educate the public about the challenges of hydrogen development and the safeguards that are needed to set up hydrogen hubs.

Likewise, CCS technology could help to achieve net-zero carbon emissions by mid-century alongside aggressive development of renewable generation, said EDF Director and Senior Attorney Adam Peltz. But government and industry need to carefully evaluate its deployment, targeting only those sectors where it could be most useful and discarding its application in places where it's ineffective.

"Modeling by the International Energy Agency and others predict we'll need a lot of innovative technologies like carbon capture and sequestration to reach net-zero by 2050," Peltz told the Journal. "...Some sectors will be extremely hard to achieve that, if not impossible, without hydrogen and CCS, such as cement and steel manufacturing."

But if those technologies are deployed, developers need to work with local communities to accommodate their concerns and execute strategies that don't add to the burdens of marginalized communities that have historically born the largest impacts from fossil fuels, he added.

"We're out of time, and if we don't try different potential solutions, we'll lose," Peltz said. "Is blue hydrogen the future? It's too soon to tell, but we can try it out and see what happens."

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