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Building The Hydrogen Sector Will Require New Laws, Regs

By **James Bowe and William Rice**

Law360 (January 13, 2021, 4:23 PM EST) -- Decarbonization of the world's energy sector is increasingly acknowledged as imperative given the increasingly evident impacts of climate change. Under the 2016 Paris Agreement, 190 nations have agreed to pursue a goal of net zero carbon emissions by 2050.[1]

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Companies active in most industrial sectors are adopting similar goals.[2] These commitments are driving a movement to adopt hydrogen as an energy carrier suitable for use as a fuel and energy storage medium that can be produced and used without generating carbon emissions.

During 2020, hydrogen's potential has been embraced by international organizations, individual nations, government agencies and participants in the fuels, transportation, power generation and industrial end-use sectors.[3] Environmental advocacy organizations are advocating for hydrogen as a way of displacing fossil fuels.[4]

Scaling up hydrogen production and expanding its role in energy markets as an alternative to fossil fuels will require massive investments in infrastructure. Goldman Sachs has estimated that the green hydrogen market in Asia, Europe and the U.S. could be worth as much as $11.7 trillion by 2050.[5]

Deployment of hydrogen at the scale required to achieve decarbonization goals will introduce hydrogen into segments of the energy, transportation, metals processing, manufacturing and utility industries for the first time. This will require significant government support, including economic subsidies. It will also require development of new rules and standards governing the production, transportation, storage and use of hydrogen.

The U.S. has lagged other nations in the promotion of hydrogen development. But President-elect Joe Biden has promised to change this, through his commitments to rejoin the Paris Agreement and to make $1.7 trillion in government funding available for renewable power projects — including projects exploiting hydrogen.[6]

The incoming administration will not have to start at square one here: The U.S. Department of Energy has recently announced programs intended to encourage hydrogen use, such as the Hydrogen Program Plan, which emphasizes coordinated research and development activities designed to promote the adoption of hydrogen technologies across multiple applications and sectors.[7]

Investors are flocking to hydrogen opportunities.[8] For example, in October 2020, TechnipFMC PLC entered into a strategic collaboration with McPhy Energy SAS, making an equity investment as part of the company's $211 million capital raise intended to accelerate the development of green hydrogen projects.[9]

These funds will support McPhy's research and innovation efforts focused on the development of world scale hydrogen production projects, as well as large-capacity hydrogen vehicle refueling stations. Similar private sector hydrogen investment initiatives seem to be announced daily.

Hydrogen's Current and Potential Uses

Hydrogen is currently used in a variety of industrial applications, including petroleum refining, electronics manufacturing, steelmaking and fertilizer production. But hydrogen can be used much more broadly — as a transportation fuel, in vehicles, trains, vessels and airplanes; as an alternate fuel for industries that are difficult to decarbonize (e.g., by replacing coal in steelmaking); supplementing and even displacing natural gas in distribution systems; as a fuel for electric generation; and as a means of storing energy for long durations.

Hydrogen can be transported through pipelines, and can be liquified and transported in vessels and containers. Hydrogen can be stored in pressure vessels or in underground salt cavern formations.

Combustion of hydrogen yields only water vapor and heat. Thus, hydrogen offers a substantial environmental advantage over fossil fuels. But hydrogen development faces substantial economic and some practical hurdles.

Although hydrogen is the most abundant element in the universe, it must be extracted from other compounds. The process by which this is done determines the degree to which hydrogen production and use can assist in achieving decarbonization goals.

"Green hydrogen" is extracted from water through electrolysis, using electric power generated by renewable resources, such as solar or wind facilities. Green hydrogen is the Holy Grail, from a decarbonization perspective, since where the electrolysis process consumes only renewable power, the entire cycle from hydrogen production through consumption yields no carbon emissions.

Next best, in terms of carbon emission reductions, is "blue hydrogen," which is produced from natural gas, but with carbon emissions captured and sequestered or put to beneficial use. As much as 90% of the carbon emitted in the production of blue hydrogen from natural gas can be captured.

Blue hydrogen is today considerably cheaper to produce than green hydrogen, but blue hydrogen's potential is constrained because underground formations suitable for the long-term sequestration of carbon dioxide are required for the production of blue hydrogen at scale.

Most hydrogen currently produced for industrial use is designated as "gray hydrogen," since it is produced from natural gas through steam-methane reforming, from which carbon dioxide is an unavoidable byproduct. Gray hydrogen production is currently the most economical method of extracting hydrogen, but is a significant source of carbon emissions.

Government and the Hydrogen Industry

Green hydrogen is currently not cost-competitive with fossil fuels, or with the less environmentally friendly blue and gray hydrogen. Hydrogen produced by electrolysis currently costs approximately $4 to $6 per kilogram.[10] By comparison, the cost of gray hydrogen is generally less than $2 per kilogram.[11] Observers have projected that green hydrogen could be cost-competitive by 2030 due to economies of scale and efficiency enhancements.[12]

Government support will be essential to overcome this cost disadvantage and encourage green hydrogen development in the near term. Government sponsored R&D, financial incentives, tax breaks, elimination of fossil fuel subsidies and/or a carbon tax on combustion of fossil fuels all would help promote hydrogen development. Biden's commitments to decarbonization, clean energy projects and hydrogen development are prime examples of the types of government support that should provide a level playing field for hydrogen.

Through the H2@Scale initiative, initiated in 2016, the DOE has sponsored a number of hydrogen R&D programs intended to encourage market expansion and increase the scale of hydrogen production, storage, transport and use.[13] The DOE reportedly has authorization — untapped since the Obama administration — to make over $40 billion in low-interest loan guarantees available for clean energy projects, which could include hydrogen infrastructure.[14]

Economic Regulation of Hydrogen Pipelines

The Federal Energy Regulatory Commission regulates interstate activities of natural gas companies, electric utilities and oil pipelines. In terms of its physical characteristics and potential end-use applications, hydrogen is most analogous to natural gas.

FERC has broad authority under the Natural Gas Act to regulate the construction of interstate natural gas pipelines, as well as the rates and tariffs governing the interstate transportation of natural gas. The NGA defines "natural gas" to mean "either natural gas unmixed, or any mixture of natural and artificial gas."[15] Hydrogen is not "natural gas," as that term is generally understood; it is debatable whether hydrogen could be considered an "artificial gas" given the history of "artificial gas" production from coal and other fossil fuel feedstocks.

It would therefore appear that as currently written, the NGA does not grant FERC jurisdiction to regulate interstate pipelines transporting pure hydrogen. It is likely, however, that FERC would have jurisdiction under the NGA to regulate the introduction of hydrogen into interstate natural gas pipelines to supplement or displace natural gas.

It might be logical to develop a federal process for approval of interstate hydrogen pipelines that would be analogous to the NGA certification process. The NGA prohibits construction of interstate natural gas pipeline facilities unless FERC has granted the pipeline a certificate of public convenience and necessity.[16] The certification requirement is intended to protect consumers from the monopoly power of pipelines, to protect markets against over-building, to minimize environmental impacts and to protect landowners.

Pipelines generally benefit under the federal certification process because it provides certainty, as compared to a piecemeal process under state laws, and affords a pipeline the opportunity to exercise the federal power of eminent domain. FERC certification is a rigorous process that includes evaluation of the need for the proposed pipeline project, review of the proposed pipeline design, assessment of environmental impacts, mitigation of impacts on affected landowners and communities, and review of proposed rates and services.

FERC's environmental review must be conducted in compliance with the National Environmental Policy Act and a variety of federal environmental and land use laws. These reviews could be readily adapted for use in the evaluation of interstate hydrogen pipeline projects.

Federal Regulation of Hydrogen Pipeline Safety

Regulations intended to ensure the safety of pipelines transporting natural gas, other combustible gases and hazardous liquids are administered and enforced by the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration. Pursuant to various acts of Congress, PHMSA has adopted a comprehensive series of regulations applicable to pipelines transporting gases at Title 49 of the Code of Federal Regulations, Part 192 — Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards.

Part 192 defines "gas" to mean "natural gas, flammable gas, or gas which is toxic or corrosive."[17] Hydrogen falls within this definition because it is a flammable gas. Approximately 700 miles of hydrogen pipelines are currently subject to PHMSA's pipeline safety jurisdiction.[18]

PHMSA's existing pipeline safety regulations were primarily designed for natural gas pipelines. Hydrogen-specific safety regulations will be needed because of hydrogen's unique properties. Hydrogen's small molecular size permits it to penetrate the steel of pipelines operated at high pressures through a process known as absorption.

Absorption can result in embrittlement of certain high strength steels and pipeline welds. Existing natural gas and hazardous liquid pipelines were not constructed with hydrogen transmission in mind, and are likely to include materials or welds that will be vulnerable to absorption and embrittlement.

PHMSA's regulations will need to be modified to specify the types of steel and welding techniques that are necessary to address hydrogen embrittlement. Accordingly, conversion of many existing pipeline systems and components to hydrogen service may not be possible or economically attractive.

Natural gas pipeline safety regulations require that natural gas be odorized so that leaks may readily be detected.[19] The substance used in natural gas systems to impart odor, mercaptan, is heavier than hydrogen and is therefore not usable as an odorant for hydrogen pipeline systems. Other means of signaling leaks will need to be developed for use in hydrogen pipelines that traverse populated areas.

State Regulation of Hydrogen Production and Distribution

State utility regulatory commissions typically regulate the rates and services offered by natural gas and other utilities. The purpose of this regulation has generally been to protect consumers from abuses of monopoly power at the hands of utilities and transporters.

Developers of hydrogen facilities are unlikely to be in a position to exercise market power as suppliers of fuel or providers of service. Hydrogen production for widespread use as an energy carrier will target markets — e.g., vehicles, vessels, power generation and steel production — for which alternatives currently exist. Hydrogen developers will have to compete with these existing alternatives to win market share.

The predicate for the existence of market power therefore generally will not exist as to hydrogen production and sales. Accordingly, there would seem to be little basis for the application of the traditional utility regulatory framework to hydrogen production. Nonetheless, state commissions may have jurisdiction to regulate certain hydrogen facilities — such as electrolyzers producing hydrogen for distribution gas blending or as a fuel for electric generation — when they are owned by utilities.

The siting and construction of hydrogen production facilities will be subject to the same requirements as those that apply to the siting and construction of industrial and commercial facilities. These requirements, usually found in state laws, national and local building codes and local zoning ordinances, are administered and enforced by state, county and municipal planning authorities, zoning boards, and building departments.

Modifications to these codes and standards will be necessary to address safety concerns specific to hydrogen facilities. A number of jurisdictions outside the U.S. are addressing this need.[20] U.S. jurisdictions will need to follow suit.

EPA Regulations Addressing Hydrogen

The U.S. Environmental Protection Agency's Mandatory Greenhouse Gas Reporting Program addresses facilities that produce hydrogen gas by reforming, gasification, oxidation, reaction or other transformations of feedstocks.[21] The operator of a facility that emits 25,000 metric tons or more per year of CO2 equivalent must report these emissions.[22]

These regulations should not be applicable to green hydrogen production facilities, because electrolysis is not a listed process, and because such facilities do not emit greenhouse gases. It is less clear whether blue hydrogen production facilities would be subject to these regulations, because, while their CO2 emissions are substantially lower than those associated with hydrogen produced by steam methane reforming without carbon capture, they still produce some such emissions.

Hydrogen production is addressed in the EPA's Clean Water Act effluent limitation guidelines. Like the greenhouse gas regulations, the effluent regulations address hydrogen production by reference to fossil fuel activities.[23] The EPA's chemical accident protection regulations, adopted pursuant to the agency's administration of the Clean Air Act, also address hydrogen.[24] Those regulations include hydrogen production within the scope of a "petroleum refining process unit."[25]

But the EPA's regulations were adopted before hydrogen became the focus of decarbonization efforts. Given this, they do not specifically address methods of hydrogen production, which are likely to dominate hydrogen markets going forward.

Moreover, by their terms, these regulations may not apply to the production of green hydrogen by electrolysis, since this process yields no pollutant emissions. As green hydrogen production becomes more prevalent, the EPA should revisit its regulations and make changes that acknowledge green hydrogen's nonexistent carbon footprint.

Conclusions

Hydrogen's potential as a clean fuel, energy storage medium and renewable energy enabler has seemingly overnight captured the imaginations of governments, environmental advocacy groups, energy sector players and potential users. Hydrogen is mentioned prominently in almost every serious discussion of efforts to reduce greenhouse gas emissions.

For hydrogen, which has been discussed as a potential replacement for fossil fuels for nearly 50 years, the time may finally have come. But making hydrogen viable as a green fuel will require truly massive public and private investment. It will require changes in policies that currently favor fossil fuels, as well as technological advances that reduce the cost of hydrogen production and make hydrogen transportation and use viable at large scale.

Current U.S. laws and regulations generally do not address hydrogen production, transportation, storage and use in ways that will be relevant to the proliferation of hydrogen as an energy carrier. The few laws and regulations that address hydrogen do not contemplate the proposed scale at which hydrogen production, transportation, storage and use are expected to grow.

Hydrogen project developers will need to work with legislators and government agencies to develop use-appropriate laws and regulations addressing hydrogen projects and hydrogen-related activities. This will take time — and work will need to begin soon if hydrogen is to play a central role in the world's efforts to achieve the target of net zero carbon emissions by 2050.

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[1] Conference of the Parties, Adoption of the Paris Agreement, Dec. 12, 2015, U.N. Doc. FCCC/CP/2015/L.9/Rev/1 (Dec. 12, 2015). The agreement on climate change targets stabilizing the global average temperature increase at 1.5 degrees Celsius above pre-industrial levels by mid-century. This has been translated into a goal of achieving carbon neutrality by 2050.

[2] See, e.g., Lauren Goode, Apple Sets Climate Goals for 2030, Joining Amazon and Microsoft, Wired (July 21, 2020), available at: https://www.wired.com/story/apple-sets-climate-goals-for-2030/.

[3] See, e.g., Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions — A hydrogen strategy for a climate-neutral Europe, European Commission (Aug. 7, 2020), available at: https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf.

[4] See, e.g., Green Hydrogen: A game changer in the fight for our climate, Green Hydrogen Coalition, available at: https://www.ghcoalition.org/.

[5] Steven Goldstein, 'Green Hydrogen' Could Become a $12 Trillion Market. Here's How to Play It, Barron's (Sept. 23, 2020), available at: https://www.barrons.com/articles/goldman-sachs-says-so-called-green-hydrogen-will-become-a-12-trillion-market-heres-how-to-play-it-51600860476.

[6] The Biden Plan for A Clean Energy Revolution and Environmental Justice, Biden for President, available at: https://joebiden.com/climate-plan/.

[7] Department of Energy Hydrogen Program Plan, U.S. Department of Energy available

at: https://www.hydrogen.energy.gov/pdfs/hydrogen-program-plan-2020.pdf.

[8] See, e.g., Carbonomics — The Rise of Clean Hydrogen, Goldman Sachs Equity Research (July 8, 2020), available at: https://www.goldmansachs.com/insights/pages/gs-research/carbonomics-the-rise-of-clean-hydrogen/report.pdf.

[9] Josh Lewis, Hydrogen collaboration: TechnipFMC teams up with France's McPhy, Upstream (Oct. 15, 2020), available at: https://www.upstreamonline.com/energy-transition/hydrogen-collaboration-technipfmc-teams-up-with-frances-mcphy/2-1-893588.

[10] See, e.g., Hydrogen vs. Natural Gas for Electric Power Generation, Seeking Alpha (Dec. 2, 2020), available at: https://seekingalpha.com/article/4392471-hydrogen-vs-natural-gas-for-electric-power-generation.

[11] See, e.g., How Hydrogen can Fuel the Energy Transition, S&P Global Ratings (Nov. 19, 2020), available at: https://www.spglobal.com/ratings/en/research/articles/201119-how-hydrogen-can-fuel-the-energy-transition-11740867 (gray hydrogen prices in October 2020 averaged about $1.25/kg in the Gulf Coast versus $2/kg in California).

[12] See, e.g., Marian Willuhn, Green hydrogen to reach price parity with grey hydrogen in 2030, PV Magazine (July 16, 2020), available at: https://www.pv-magazine.com/2020/07/16/green-hydrogen-to-reach-price-parity-with-grey-hydrogen-in-2030/.

[13] Five Things You Might Not Know About H2@Scale, Office of Energy Efficiency & Renewable Energy (Oct. 8, 2020), available at: https://www.energy.gov/eere/articles/five-things-you-might-not-know-about-h2scale.

[14] See, e.g., Jordan Davidson, Trump Admin Sits on $43 Billion Intended for Clean Energy Loans While Unemployment Soars, EcoWatch (May 1, 2020), available at: https://www.ecowatch.com/clean-energy-loans-trump-doe-2645892812.html?rebelltitem=1#rebelltitem1.

[15] 15 U.S.C. § 717a(5).

[16] 15 U.S.C. § 717f(c)(1)(A).

[17] 49 C.F.R. § 192.3 (Definitions).

[18] PHMSA notes this on its web site, at https://primis.phmsa.dot.gov/comm/hydrogen.htm.

[19] 49 C.F.R. § 192.625 (Odorization of gas).

[20] See, e.g., Eight International Standards Adopted by Australia for a Hydrogen Future, FuelCellWorks (July 21, 2020), available at: https://fuelcellsworks.com/news/australia-eight-international-standards-adopted-by-australia-for-a-hydrogen-future/; Installation permitting guidance for hydrogen and fuel cell stationary applications: UK version, Health and Safety Laboratory (2009) available at: https://www.hse.gov.uk/research/rrpdf/rr715.pdf.

[21] 40 C.F.R. Part 98, Subpart P; 40 C.F.R. § 98.160.

[22] 40 C.F.R. § 98.161 (referencing 40 C.F.R. §§ 98.2(a)(1) and (a)(2)).

[23] See 40 C.F.R. § 415.410 ("The provisions of this subpart are applicable to discharges resulting from the production of hydrogen as a refinery by-product").

[24] 40 C.F.R. Part 68.

[25] 40 C.F.R. § 68.3.