Challenges of Decarbonizing the US Natural Gas Industry

Thomas N. Russo

The term "decarbonization" is very commonplace in global energy circle discussions and almost synonymous with the Paris Agreement reached at COP 21.[1] I believe most US natural gas industry executives either largely discount decarbonization of natural gas or think the present gas narrative is sustainable because the United States withdrew from the Paris Agreement.[2]

Given the shale gas revolution and infrastructure investments, some executives might believe a future without natural gas is unrealistic. Despite natural gas's superior qualities, it might be risky to think the fuel has gotten a pass from its contribution to climate change and from federal and state regulators and policymakers who wish to decarbonize the energy sector. If the US natural gas industry ignores the signs discussed herein, it could find itself challenged by the same forces as the coal industry.

NATURAL GAS INDUSTRY MUST EXPAND CURRENT NARRATIVE

The current narrative of the US natural gas industry touts the domestic and global environmental gains of oil- and coal-to-gas switching and using natural gas as a backup fuel for renewables in electricity generation. That's a sound argument, especially when utility-scale electric storage is still a nascent technology. However, the real question is "How long will these reasons convince legislators and policymakers, regulators, and ratepayers that natural gas should still be part of the energy transition and not just a bridge fuel until 2050 or earlier?"

There are signs at the federal, state, and city levels that natural gas has no place in the future decarbonized energy world. Federal regulators like the Department of Energy (DOE) and the Federal Energy Regulatory Commission (FERC) have, until recently, been fuel-agnostic. Their message, though, seems to be supportive of natural gas until

[1] "The Paris Agreement came out of the COP 21, the 21st Conference of Parties of the UNFCCC (United Nations Framework Convention on Climate Change), held in Paris from November 30th to December 12th, 2015. The agreement was adopted on December 12th, 2015." What is the history of the Paris Agreement (2015)? (n.d.). Ask DAG! Retrieved from http://ask.un.org/faq/120272.

[2] Every country that signed the Paris Agreement must commit to a long-term pathway for deep decarbonization aiming to reduce net emissions to zero by 2070. Sachs, J. D., Schmidt-Traub, G., Williams, J., Segafredo, L., Colombier, M., Ribera, T., & Waisman, H. (2015). *Why climate policy needs long-term deep decarbonization pathways.* Retrieved from http://unsdsn.org/resources/publications/why-climate-policy-needs-long-term-deep-decarbonization-pathways/.

Thomas N. Russo (tom@russoonenergy.com) is an energy and environmental expert with unique regulatory knowledge of energy infrastructure, environmental impact assessment, markets, and physical/cybersecurity. Prior to starting Russo on Energy LLC, he worked for over 30 years as a manager and senior energy industry analyst at the Federal Energy Regulatory Commission. There, he gained experience in hydropower licensing, National Environmental Policy Act environmental impact assessment of projects, business process reengineering, natural gas and crude oil market oversight, and applicable federal statutes.

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such time markets dictate a different scenario. Climate change is on everyone's mind—even traditional supporters of natural gas, like Senator Lisa Murkowski (R-AK) and the Senate Energy and Natural Resources Committee, which held a hearing on climate change on March 6.

The states have very different ideas about decarbonization, and the role renewable energy should play in the transition to a cleaner energy economy. Many states have also committed to reducing greenhouse gas (GHG) emissions aligned with the Paris Agreement COP 21 goals. The growth in renewable electricity generation is at the forefront of policies to decarbonize the power sector. All but 13 states have renewable energy portfolios with specific targets (**Figure 1**).

Legislators, policymakers, and regulators in California, New York, and Minnesota are discounting the role natural gas can have in reducing GHG emissions. These three states are advocating for either eliminating or significantly curtailing natural gas use. Some cities are also joining the transition away from gas. The mayor of Los Angeles announced in February 2019 plans to eliminate the use of natural gas from the city's power operations. The city's Department of Water and Power plans to begin phasing out Scattergood, Haynes, and Harbor gas-fired power plants along the Southern California coast that represent 38 percent of the city utility's gas generation and, collectively, 1,662 MW.[3]

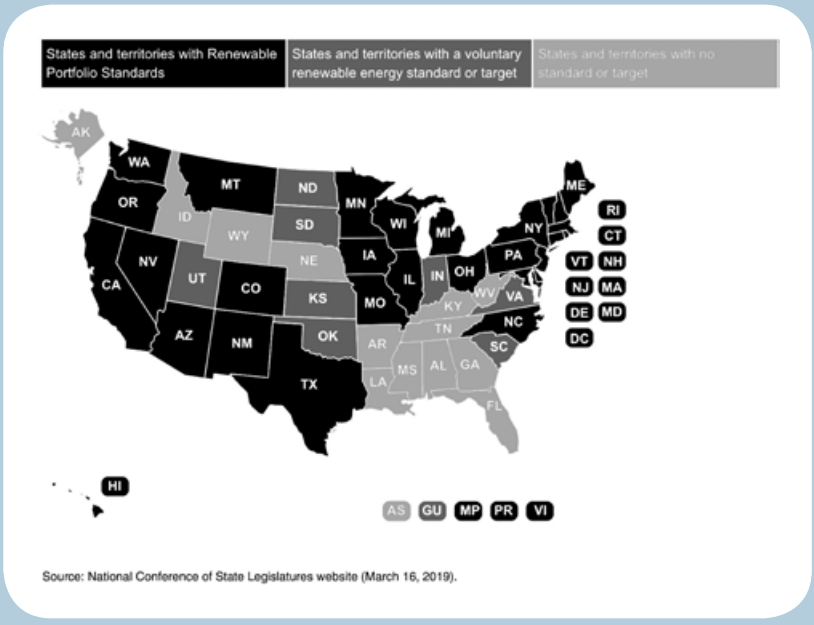
The exception to the above transition might be renewable natural gas (RNG), or biomethane obtained from landfills and agricultural wastes. As part of its decarbonization efforts, the Oregon Public Utilities Commission (PUC) recently required gas utility NW Natural to analyze more low-carbon options, such as RNG and power-to-gas (P2G), in efforts to decarbonize its natural gas–only utility business. The Oregon PUC also authorized the gas utility to purchase RNG, and it expects to be approved to invest in more biogas production in the future.[4]

The Oregon PUC's and NW Natural's efforts provide an example of how to move toward decarbonizing the natural gas business. However,

[3] LA to phase out 3 natural gas plants, replace them with clean energy. (2019, February 12). Retrieved from https://losangeles.cbslocal.com/2019/02/12/la-phase-out-3-natural-gas-plants-replace-clean-energy/.

[4] Nemec, R. (2019, March 6). NW Natural planning more RNG purchases as decarbonization continues. Retrieved from https://www.naturalgasintel.com/articles/117627-nw-natural-planning-more-rng-purchases-as-decarbonization-continues.

Figure 1. States With Renewable Energy Standards or Targets



Source: National Conference of State Legislatures website (March 16, 2019).

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biomethane comprises only a small percentage of production and demand. In California, the largest biomethane-producing state, only 3 percent of California's current demand for natural gas would be met with biomethane.

FUTURE SOURCES OF NATURAL GAS DEMAND

In December 2018, the average daily volume of natural gas demand in the United States was 85 billion cubic feet per day (Bcf/d).[5] Use in power generation grew by 12.8 percent due in large part to gas replacing coal and nuclear power. Industrial use of gas grew by 4 percent, while commercial and residential use combined grew 9.9 percent.

Cross-border exports of pipeline gas to Mexico average 5 Bcf/d, while US liquefied natural gas (LNG) exports are currently at 6 Bcf/d.[6] US natural gas exports to Mexico have increased under the energy reforms instituted in 2013 by then President Enrique Peña Nieto. However, Mexico's new president, Andrés Manuel López Obrador, has been critical of the energy reforms and building of numerous combined-cycle gas power plants and related natural gas infrastructure. Therefore, Mexico's imports may not grow as fast.

Exports of US LNG are driven by fuel-switching from oil and coal to natural gas, and in European countries due to energy security concerns. The anticipated completion of LNG trains at Corpus Christi, Cameron, Elba Island, and Freeport by 2021 will increase US LNG capacity to 10 Bcf/d. These projects are likely to be completed, enabling natural gas to serve as a bridge fuel in LNG-importing countries. The second wave of LNG export terminals will provide additional export capacity after 2021. There are 12 applications currently pending at FERC and another five in the prefiling stage. Shell's LNG Canada Export Terminal and Mexico's Costa Azul LNG Export Terminal in Baja are also part of the second wave of projects. Competition among these projects will be fierce and will also compete with LNG exporters from Russia, Australia, Indonesia, Mozambique, and, possibly, Argentina.

Globally, things look challenging for natural gas. Lazard's 2018 Least Cost of Energy Report illustrated in **Figure 2** shows that utility-scale solar and wind plants are competing economically with gas-fired power plants.[7] Current utility-scale solar and wind projects remain intermittent, requiring availability of gas-fired units that can ramp quickly. However, if utility-scale electric storage follows the path of renewables and costs continue declining, that might change. Lazard's latest annual Levelized Cost of Storage Analysis shows significant reductions in cost across most use cases and technologies especially for shorter-duration applications.

Countries including China, Japan, and South Korea have imported more expensive LNG to replace coal as a power and heating fuel, and now might be reconsidering their decisions for economic and environmental reasons. For example, Japan has restarted five nuclear power reactors in 2018.[8] The nuclear unit additions will reduce demand on LNG and coal imports and decarbonize Japan's power sector further.

THE PARIS AGREEMENT AND THE EUROPEAN GAS INDUSTRY

While the United States pulled out of the Paris Agreement, the rest of the world, and especially the 28 member states of the European Union, seem intent on meeting the 2050 Paris Agreement COP 21 goals. In general terms, this means European countries need to have substantially decarbonized their power sectors by 2030 and their heat sectors by 2050. In 2017, Professor Jonathan Stern, noted natural gas expert, observed that the European Commission began

[5] FERC natural gas markets. (n.d.). Retrieved from https://ferc.gov/market-oversight/mkt-gas/overview/ngas-ovr-sup-dmd-cns.pdf?csrt=1456589524985231562.

[6] RBN Energy, U.S. Gas Price Billboard, March 8, 2019.

[7] Lazard. (2018, November 8). *Lazard releases annual levelized cost of energy and storage analysis.* Retrieved from http://roedel.faculty.asu.edu/sec598f18/pdf/Lazard_LCOE12.pdf.

[8] Energy Information Administration. (2018, November 28). *Japan has restarted five nuclear power reactors in 2018.* Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=37633.

Out of the remaining fleet of 34 operable reactors, nine are currently operating. Six others have received initial approval from Japan's Nuclear Regulation Authority, and another 12 units are under review. Nine reactors have yet to file a restart application.

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to challenge the optimistic "gas-as-a-bridge-and-ideal-back-up for renewables" narrative of the European gas industry. He believed that the gas industry's narrative was at odds with the European Commission's decarbonization goals and summarized his concerns in two papers.[9] He concluded the current gas narrative would not suffice beyond 2030. While the use of natural gas does "result in early emission reductions," he concluded "these will not be sufficient to meet 2050 COP 21 commitments." Eurogas, which represents the European gas industry, acknowledges the need to switch to "decarbonized" or "renewable" gases by 2050[10] if the Paris Agreement goals are to be met, but to date little has been done to achieve these goals.

In a third paper published in 2018,[11] Stern warned that the European gas industry will have to start developing a new "narrative" and start taking real action to make that narrative come true. He adds, "Actions that are not profitable today may not be profitable for a long time to come." A part of the new narrative must include substantial corporate investments in decarbonization projects now, to alert legislators, policymakers, and

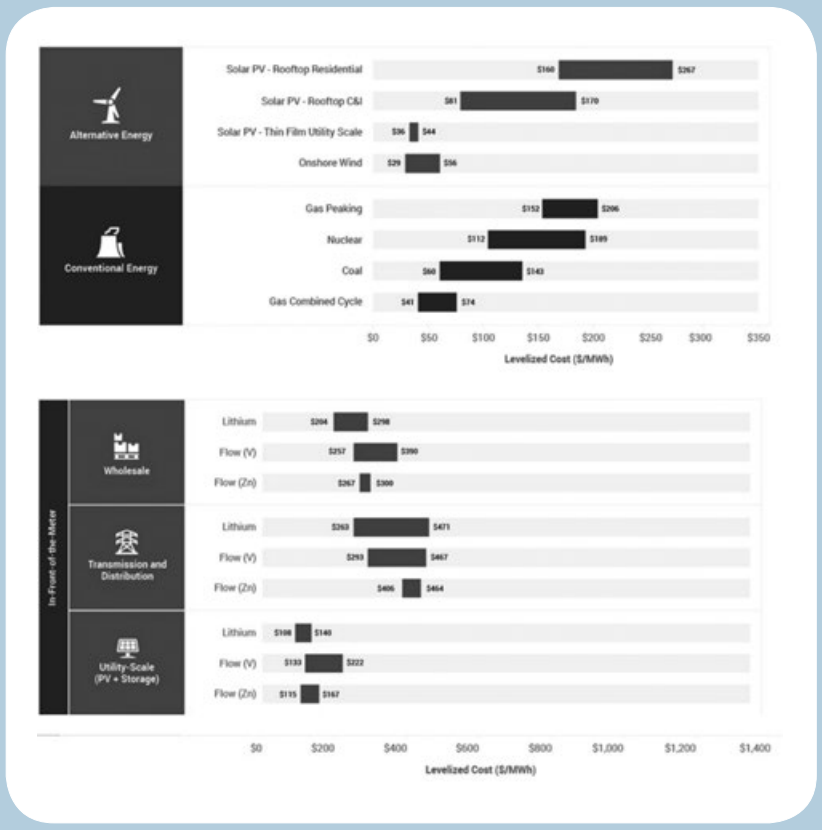
[9] Stern, J. (2017, January). *The future of gas in decarbonising European energy markets: The need for a new approach.* OIES Paper: NG116. Retrieved from https://www.oxfordenergy.org/wpcms/wp-content/uploads/2017/01/The-Future-of-Gas-in-Decarbonising-European-Energy-Markets-the-need-for-a-new-approach-NG-116.pdf.

Stern, J. (2017, December). *Challenges to the future of gas: Unburnable or unaffordable?* OIES Paper: NG125. Retrieved from https://www.oxfordenergy.org/wpcms/wp-content/uploads/2017/12/Challenges-to-the-Future-of-Gas-unburnable-or-unaffordable-NG-125.pdf.

[10] European Commission. (2018, November 28). *A clean planet for all.* Retrieved from https://ec.europa.eu/clima/sites/clima/files/docs/pages/com_2018_733_en.pdf.

[11] Stern, J. (2019, February). *Narratives for natural gas in decarbonizing European energy markets.* Oxford Energy Research Studies. OIES Paper: NG141. Retrieved from https://www.oxfordenergy.org/publications/narratives-natural-gas-decarbonising-european-energy-markets/.

Figure 2. Lazard's Latest Annual Levelized Cost of Energy and Storage Analysis 2018



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regulators that gas can be part of a decarbonized energy future.

WHAT MIGHT DECARBONIZING GAS LOOK LIKE IN THE US

As stated previously, the US natural gas industry and FERC are not even discussing the goals of some large states to eliminate natural gas use or addressing when the narrative of natural gas as a bridge fuel will end. If we can draw anything from Eurogas and Stern's work, Europe's power and heating sectors might not be allowed to burn natural gas after 2050. Renewable and electric storage technology improvements and cost reductions could accelerate the end of natural gas as a significant fuel much faster.

Will the same happen in the United States? Maybe not, but the introduction of the Green New Deal[12] and its call to eliminate fossil fuels should not be summarily dismissed or ignored by the gas industry either. The Green New Deal has received a great deal of criticism; however, it has distracted the gas industry from asking the more important question of what the industry will look like in a much more decarbonized world. While we might disagree on a specific date, we certainly can agree that the United States will be more decarbonized in the future just by coal-to-gas switching alone. After that, competitive electric storage with more extended-duration applications would challenge gas-fired generation ramping and possibly heating in the United States.

OPTIONS FOR DECARBONIZING NATURAL GAS

Fortunately, the possibilities for decarbonizing natural gas are well-known, but the costs and scale of projects are not. The following products and processes contribute to decarbonizing gas:

- Biogas and biomethane, and bio-SNG (or syngas) via gasification
- Hydrogen and syngas from renewable power: power-to-gas and power-to-methane (methanation)
- Hydrogen from methane via steam reforming or auto-thermal reforming with carbon capture, utilization, and storage (CCUS)
- Methane cracking with storage/utilization of solid carbon.

Stern's work in Europe indicates that even the highest estimates of biogas, biomethane, and power-to-gas would not maintain anything close to the scale of the gas market in the late 2010s. The industry would have to reform methane into hydrogen accompanied by CCUS. Biogas, biomethane, and P2G in the United States would probably be even lower, so reforming methane with CCUS is the only viable alternative.

The International Energy Agency and some large companies have developed models that estimate the effects of the Paris Agreement COP 21 decarbonization goals on European gas demand (**Figure 3**). Gas consumption in the European Union begins to decline in 2030 and sharply declines in 2050 under most of the scenarios.[13]

The US Energy Information Administration (EIA) does not show a natural gas consumption scenario that captures the refusal of states to burn natural gas. However, the EIA's Low Oil and Gas Resource Technology Scenario may be a proxy for US gas consumption under this scenario. In that case, natural gas consumption would be about 75 Bcf/d, or 82 percent, of today's demand (**Figure 4**).

FUTURE RELEVANCE OF US GAS INDUSTRY A CHALLENGE

The gas industry can always elect to do nothing and not challenge the mindset of state legislators, regulators, and policymakers who believe that natural gas cannot be decarbonized and has no role in the US energy future. Taking no action would entail a slow retreat from gas markets over time in California, New York, and other states that see no other alternative to natural gas than eliminating its sale and use. To do so would strand

[12] Russo, T. (2019, March). New Green Deal's effects on the US energy transition. *Natural Gas & Electricity, 35*(8), 28–32. Retrieved from https://onlinelibrary.wiley.com/doi/epdf/10.1002/gas.22112.

[13] See Note 11.

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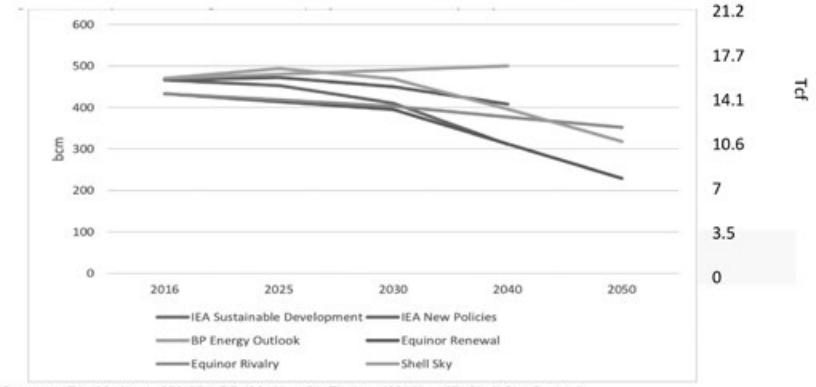
Figure 3. European Union: Gas Demand Projections as Paris Agreement and Decarbonization Goals Are Reached (bcm) [28.3 bcm = 1 Trillion Cubic Feet (Tcf)]



Sources: IEA (2018), pp.550-551. BP (2018), p.54. Equinor (2018), p.57. Shell Sky Scenario.

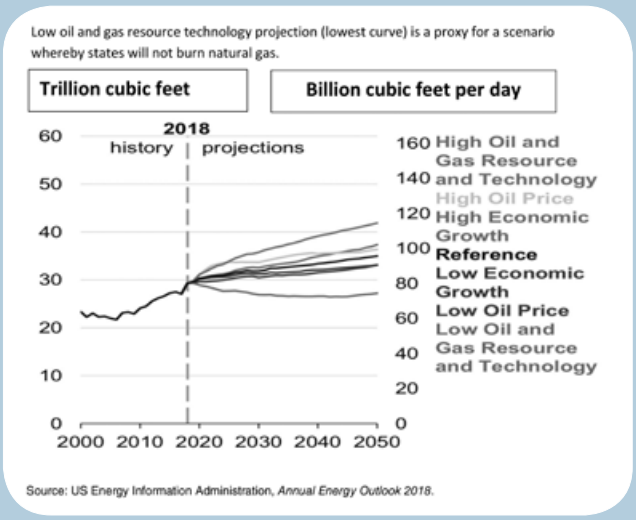
natural gas pipeline assets with adverse economic effects rippling to upstream and midstream gas operators as well as oil producers.

Ultimately, not engaging the states and FERC could also make producers, pipelines, and LNG suppliers entirely dependent on Mexican and global markets for LNG. However, after 2030, importing countries might demand that US pipeline gas and LNG suppliers progressively decarbonize their gas to make it saleable. If that happened, natural gas pipeline networks would face an existential threat unless they can maintain current throughput while simultaneously adapting to decarbonized gas. If US gas suppliers shift the burden of decarbonizing gas to importing countries, then those costs may be reflected in natural gas prices.

If the gas industry changes the existing narrative to decarbonization, then FERC will need to change the current policy and regulatory framework to include decarbonization investments in FERC Form 2 and pipeline tariffs. Likewise, gas utilities will have to engage with state regulators and gain their approval on gas-decarbonization investments. In addition to regulatory support, the gas industry will have to enlist the help of the DOE research laboratories to help commercialize gas-decarbonization processes. The lion's share of the investment may be incurred by companies that have made big bets in natural gas and LNG. There will need to be a very substantial corporate investment in projects for which there is currently no business case.

Finally, if the US gas industry fails to change the current narrative and follow up with credible decarbonization investments and results, then electrification rather than decarbonized gas will play a significant role in the future of US power and heating sectors.

Figure 4. Energy Information Administration Projections of US Natural Gas Consumption Under Various Scenarios



Source: US Energy Information Administration, *Annual Energy Outlook 2018*.

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