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Decarbonization and Electrification: The Case for Innovation

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Highly reliable and resilient energy infrastructure is the bedrock of the US economy. Energy availability and certainty of supply and delivery are more important now than ever. This is particularly the case for electricity and natural gas in support of sustaining economic recovery as the COVID-19 pandemic wanes. Large segments of the

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economy, including electric generation, heating, and industrial processes, are dependent on reliable and economically priced natural gas, now the dominant fuel in the United States. Policy initiatives aimed at reducing the use of fossil fuels, including natural gas, and expanding transportation and building electrification are bringing forth challenges and opportunities that are at times in conflict.

The *Infrastructure Investment and Jobs Act* (IIJA) of 2021 was passed by Congress and signed into law by President Biden on November 15, 2021. This bill provides a range of funding opportunities that could significantly accelerate state and federal government efforts to deploy clean energy at scale, reduce greenhouse gas (GHG) emissions, and expand high-paying clean energy sector jobs. Similarly, the Biden administration's proposed Build Back Better (BBB) reconciliation package approved by the House of Representatives on November 19, 2021, if passed in some form in 2022, can be expected to provide additional funding for clean energy development, environmental and social justice initiatives, and tax incentives to fund research and development, while advancing states' and the federal government's decarbonization goals. However, the bill might also include a fee per metric ton of methane produced, potentially decreasing investors' willingness to make further investments in upgrading critical natural gas infrastructure and replacing leak-prone pipes to reduce GHG emissions.

Large segments of the economy, including electric generation, heating, and industrial processes, are dependent on reliable and economically priced natural gas, now the dominant fuel in the United States.

Decarbonizing the economy through improved energy efficiency and the adoption of renewable energy technologies, coupled with carbon capture and sequestration (CCS), offers promise in helping mitigate GHG emissions and the negative impacts of a changing climate. The IIJA and proposed BBB legislation together represent the largest effort by the federal government to date to support, in coordination with states and private industry, technology innovations and commercialization to address the existential threat posed by a warming climate.

Along with federal government efforts, electrification and eliminating fossil fuel use in buildings and transportation are also priorities for several states. For example, states are approaching the future of natural gas use in power generation, heating, cooling, cooking, and energy-intensive industrial processes in different ways. Some municipalities in a handful of US states are adopting bans on new gas pipeline expansions and use, while some states are passing legislation prohibiting such bans. This uncertainty casts doubt on the future of the natural gas industry and its potential role in reducing GHG emissions in the immediate and near future, as natural gas is used as a substitute for higher GHG-emitting fossil fuels, such as coal, in power generation. In addition, the natural gas distribution system is being used to demonstrate the role of hydrogen, green or otherwise, as a lower-carbon fuel alternative when blended with natural gas.[1] Renewable natural gas (RNG)[2] is also being blended with natural gas as a lower GHG-emitting fuel source to speed progress toward clean energy and climate goals. There are near-term challenges of pursuing electrification at the expense of a broader portfolio of potential solutions for electrification and decarbonization. Utilities and regulators must balance several considerations when prioritizing both near- and long-term electrification and decarbonization strategies.

STATE OF ELECTRIC AND GAS INDUSTRIES AND DECARBONIZATION

Current State

The modern electric grid is transforming from a simple grid with power flowing in one direction to a distributed, multidirectional power flow grid with two-way multipoint communications. The need for electric transmission and distribution infrastructure

[1] Green hydrogen is hydrogen produced by splitting water into hydrogen and oxygen using renewable electricity.

[2] Renewable natural gas (RNG) is pipeline-quality biomethane produced from biomass.

to remain balanced, while providing reliable and resilient service is more important than ever to support the grid of tomorrow. Simultaneously, existing electric and natural gas industry infrastructure is aged and requires significant upgrades. This provides the United States with a once-in-a-generation opportunity with federal and state funding to redefine how and where infrastructure investments are made, how energy supplies are sourced and delivered, and how equipment and materials are procured and used. Each of these factors can prioritize sustainability and decarbonization while maintaining grid performance, safety, and reliability.

The need for electric transmission and distribution infrastructure to remain balanced, while providing reliable and resilient service is more important than ever to support the grid of tomorrow.

Natural gas is the dominant fuel in the United States, representing approximately 43 percent of electric generating capacity.[3] Across the US natural gas industry, there are 1,670 natural gas pipeline companies,[4] operating over 1.3 million miles of pipe,[5] serving over 75 million customers.[6] These natural gas pipeline companies include inter- and intrastate pipeline companies, investor- and municipally-owned local distribution companies (LDCs), and private owners. Recently, more than 876,000 residential natural gas customers have been added between 2019 and 2020 alone.[7] The American Gas Association reports capital investment totaling $35.8 billion in 2019 for new and replacement pipes, with the largest investment in gas distribution systems by LDCs serving end-use customers (60.4 percent) followed by transmission companies (25 percent).[8]

Combusting natural gas in power generation produces roughly half the amount of carbon dioxide (CO_2) per million British thermal units of coal for an equal amount of energy.[9] However, natural gas is mainly methane, which is a potent GHG and can leak into the atmosphere from natural gas wells, storage tanks, processing plants, and leaking pipes, accounting for 29 percent of the total US methane emissions and 3 percent of the total US GHG emissions.[10] When averaged over 100 years—the period often used in annual GHG inventories—methane's global warming potential (GWP) is 25 times greater than that of an equivalent mass of CO_2. Over 20 years, methane's GWP is 72 times greater than that of CO_2.[11]

As some states move toward total electrification and look to shift away from natural gas as a dominant fuel source, a challenging situation emerges. Natural gas companies, specifically LDCs, are working to reduce GHG emissions produced by natural gas by replacing methane leak-prone pipes and piloting new carbon-free fuel sources, such as green hydrogen and RNG. However, the states that these natural gas LDCs operate in are looking to eliminate natural gas as a fuel. These competing interests demonstrate that interested parties are often in conflict with one another regarding the future of natural gas in a lower-carbon or carbon-free energy system.

BALANCING NATURAL GAS BANS WITH ELECTRICAL SYSTEM NEEDS

Natural gas LDCs are facing competing interests, navigating the rapidly changing political and regulatory landscape. In some regions of the country, state policymakers and regulators are demanding greater investment in cleaner and renewable energy

[3] Power plant summary. (2022, February 6). *S&P Capital IQ.* https://bit.ly/3B6zNqP

[4] Annual report of volumes, revenues, and customers by company (2002–2020). (2021, October 27). *American Gas Association.* https://bit.ly/3uBtZ7u

[5] By-decade inventory. (2020, March 16). *US Department of Transportation: Pipelines and Hazardous Materials Safety Administration.* https://bit.ly/3GxVgK9

[6] US Energy Information Administration. (2022, January 31). Number of natural gas customers. *EIA.* https://bit.ly/361fvn7

[7] Energy insights: Residential natural gas end-users. (2022). *American Gas Association.* https://bit.ly/3rAlis8

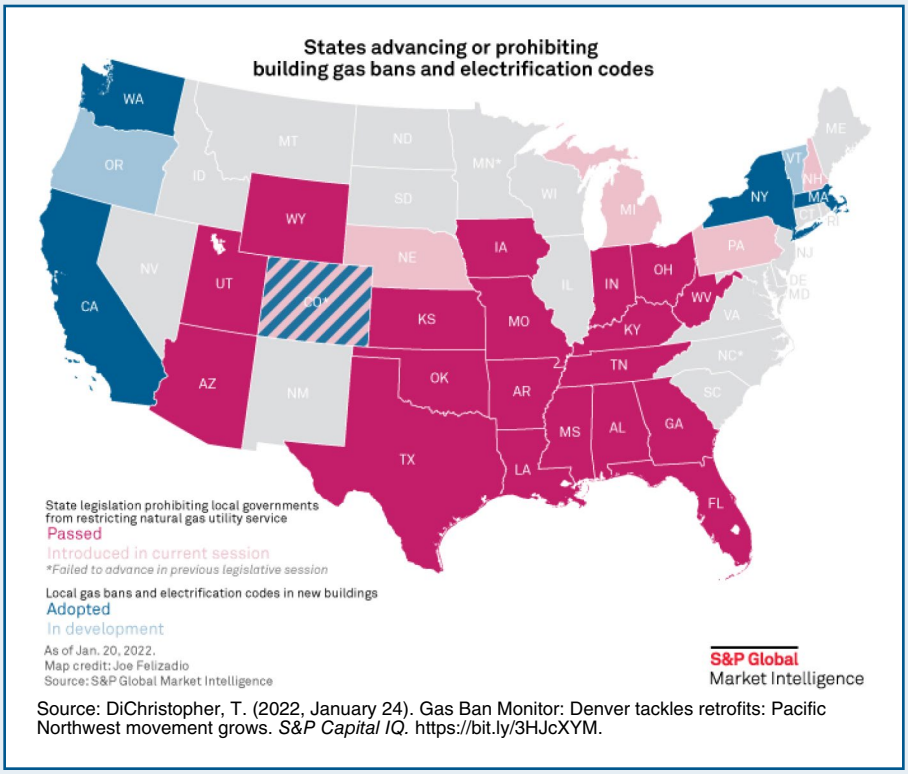
[8] Table 12-1: Gas utility construction expenditures by type of facility 1972–2019. (2022). *American Gas Association.* https://bit.ly/3rEbihA

[9] US Energy Information Administration. (2021, December 8). Natural gas explained: Natural gas and the environment. *EIA.* https://bit.ly/3gzkXzE

[10] Ibid.

[11] United States Environmental Protection Agency. (2021, November 19). Greenhouse gas emissions: Overview of greenhouse gases. *EPA.* https://bit.ly/3spqxKt

Figure 1. States Advancing or Prohibiting Building Gas Bans and Electrification Codes



Source: DiChristopher, T. (2022, January 24). Gas Ban Monitor: Denver tackles retrofits: Pacific Northwest movement grows. *S&P Capital IQ.* https://bit.ly/3HJcXYM.

resources and the eventual elimination of fossil fuel use across all sectors of the economy. Fossil fuel use in buildings, mainly for heating, is responsible for approximately 13 percent of GHG emissions in the United States, according to 2019 figures from the US Environmental Protection Agency (EPA).[12] Natural gas bans have the potential to reduce carbon emissions from buildings, especially large buildings in major metropolitan areas. S&P Global reports that municipalities within five states have bans on new natural gas pipeline construction and end-use connections, and another two states have similar bans proposed, while 19 states have enacted legislation prohibiting bans (**Figure 1**).[13]

Bans on new natural gas pipelines and service connections are gaining traction in states that do not have legislation specifically prohibiting them because states and municipalities are instead seeking ways to decarbonize their economies through the electrification of buildings and transportation. Natural gas bans create two downstream impacts—a need to ensure there is sufficient clean energy to replace natural gas and limiting the potential of cleaner fuels, such as green hydrogen or RNG, to aid in decarbonization.

Eliminating natural gas to heat buildings requires an increase in electricity production and transmission as it is the dominant fuel in power generation due to its low cost and plentiful supply. Natural gas combined-cycle power generation, like battery storage, is of value when used to balance electricity loads as more intermittent and distributed renewable energy resources are added to the electric grid and serves as black-start generation to reenergize and restore the electric grid after service disruptions and outages. Unless the electricity powering buildings is generated solely from clean energy resources, bans on natural gas will only shift emissions from the buildings sector to the power generation

[12] Brown, A. (2022, January 6). Natural gas bans are new front in effort to curb emissions. *PEW.* https://bit.ly/3gx1ZcO.

[13] DiChristopher, T. (2022, January 24). Gas ban monitor: Denver tackles retrofits; Pacific Northwest movement grows. *S&P Capital IQ.* https://bit.ly/3HJcXYM

sector, instead of reducing emissions.[14] Moreover, using natural gas in buildings is a more efficient use than generating electricity. Many of the local natural gas bans have a phased rollout over many years, potentially allowing time to build the renewable generation and new transmission and distribution infrastructure needed to meet future electricity demand. The Energy Information Agency reports that developers are expected to build 57 gigawatts (GW) of new wind and solar power generation in the next two years, causing the share of natural gas in the country's generation mix to fall to 34 percent by the end of 2023.[15] The increased capacity from renewables is expected to meet new electric demand from electrifying buildings' heating systems over the same period. California Independent System Operator (CAISO) argues that to guarantee reliability during the energy transition, regulators should ensure that replacement assets are operational or well underway before allowing utilities or power producers to derate or decommission significant gas-fired power generation.[16]

Advancing the use of green hydrogen and RNG as a supplement and potential alternative to natural gas is another pathway in support of decarbonization. In January 2022, New York Governor Kathy Hochul announced ambitions in her first state of the state address to transform the Empire State into a green hydrogen hub. New York is considering a plethora of technologies and energy sources under its *Climate Leadership and Community Protection Act* of 2019 to meet clean energy and decarbonization goals, and the state has recognized a potential role for green hydrogen as part of its multipronged strategy. At the same time, the New York City Council voted in December 2021 to prohibit the use of natural gas in most new buildings.[17] By limiting the emission threshold for CO_2 in fuel combustion, the legislation has the effect of limiting or eliminating the opportunity to use RNG and green hydrogen to heat and cool buildings. The head of National Fuel Gas Company, a New York natural gas company, has said that New York state's plan to replace natural gas and other fossil fuels with renewable energy resources could leave the state with a gap of up to 25 GW between the power it generates and the power it needs on a peak winter's day.[18]

New funding aims to uncover technological advances that will overcome many of the challenges of hydrogen blending and use, while making hydrogen power more economically viable. Ultimately, as power generation shifts from natural gas to renewable sources, decisions to discontinue new investments in natural gas infrastructure must balance the electric system's needs to maintain service reliability as the electrification of building and transportation progresses.

Pipeline Replacement Reduces Methane Emissions

The average age of a natural gas distribution pipe in the United States is 42 years, with 53 percent of pipes being 30 years or older.[19] Demand for natural gas is growing; since 1990, natural gas utilities have added nearly 760,000 miles of distribution mains and services to 20 million more customers.[20] Furthermore, nearly 90 percent of the emissions declines from gas distribution systems since 1990 are due to pipe replacements.[21] As many state regulators seek to achieve GHG emission reduction goals, they are looking to speed leak detection and pipe replacement to reduce methane leaks.

The National Association of Regulatory Utility Commissioners adopted a resolution in 2013 encouraging state regulators and industry to replace the most vulnerable pipes as quickly as

[14] See Note 12.

[15] Hodge, T. (2022, January 18). New renewable power plants are reducing U.S. electricity generation from natural gas. *U.S. Energy Information Administration.* https://bit.ly/3gxcsoD

[16] DiChristopher, T. (2022, January 26). Seeing 'perfect storm,' experts warn against ditching Calif. gas infrastructure. *S&P Capital IQ.* https://bit.ly/3HIhril

[17] The New York City ordinance, like most, has exceptions to the ban for buildings where occupants need to combust gas for manufacturing, cooking in restaurants, hospitals, and laboratories or laundromats. The ordinance also excludes power generation plants or food and sewage waste treatment facilities.

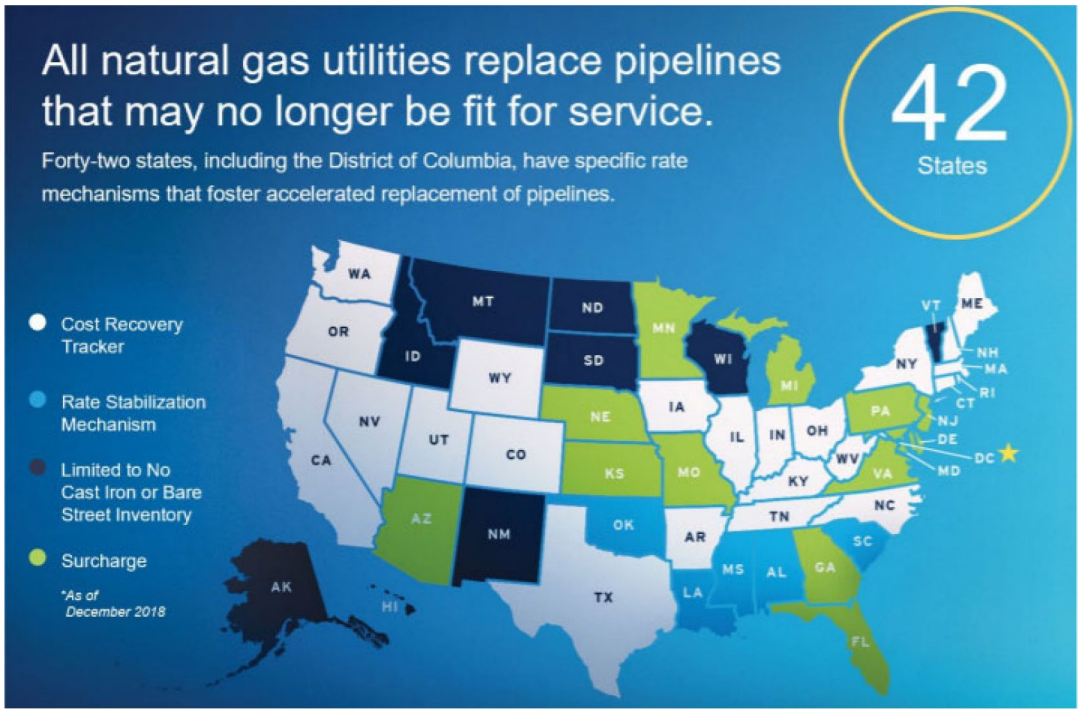
[18] Holland, B. (2022, February 4). National Fuel warns that NY climate plan cuts too much gas too soon. *S&P Capital IQ.* https://bit.ly/3oFMGmt

[19] See Note 5.

[20] An increase in safety leads to a decrease in emissions. (2019). *American Gas Association.* https://bit.ly/3gzzkEc

[21] Ibid.

Figure 2. Rate Mechanisms to Accelerate Pipe Replacements



Source: American Gas Association. (2020, May). *Building the Value of Natural Gas: A Fact Base.* https://bit.ly/3B9cpsu.

possible and to consider alternative rate recovery mechanisms to accelerate pipeline modernization and replacement and to expand the nation's natural gas pipeline systems.[22] Investment in pipe replacements to reduce methane emissions from gas leaks remains a priority for LDCs and utility regulators. As shown in **Figure 2**, 42 states, including the District of Columbia, have programs to facilitate the accelerated replacement and modernization of natural gas distribution pipes that are no longer fit for service.[23] Yet, even with programs to accelerate pipe replacement, they are still time-intensive and costly. For example, Consumers Energy, a public utility in Michigan, is spending $2 billion to replace 2,600 miles of natural gas pipelines over a 25-year period, and with over 28,000 miles of distribution pipes, it accounts for 9 percent of its pipeline infrastructure.[24] Washington Gas & Light, a distribution utility serving customers in Washington, D.C., will spend up to $110 million over 40 years to replace 8,000 bare steel service segments and 38 miles of bare or unprotected steel and cast-iron mains.[25]

Furthermore, it is currently estimated that there are 112 new natural gas transmission projects in progress across the United States, totaling nearly $89 billion, representing over 5,000 miles of pipe.[26] Installing new pipes and replacing pipes to reduce methane leaks to achieve GHG reduction goals directly competes with many states' bans on new pipeline infrastructure to phase out and eliminate gas use.

[22] Ibid.

[23] Building the value of natural gas: A fact base. (2020, May). *American Gas Association.* https://bit.ly/3B9cpsu

[24] Pipeline upgrade: Replacing natural gas pipelines across Michigan. (2022). *Consumers Energy.* https://bit.ly/34N2tZB

[25] Burman, D. X., Kimbrel, E. D., Pridemore, T., Thanos, A. D., & Zitelman, K. (2020, October). Artificial intelligence for natural gas utilities: A primer. *National Association of Regulatory Utility Commissioners.* https://bit.ly/3gxlK3Y

[26] U.S. natural gas pipeline projects. (2022, January 31). *US Energy Information Administration.* https://bit.ly/3rCLCSt

Bans on pipeline infrastructure could create unprecedented losses for investors and natural gas companies. This creates a challenging dynamic where continued investment in pipe replacement will slow or cease all together if natural gas companies risk investing in and carrying assets for which they will never fully recover. As a result, investors might shy away from making further investments in critical natural gas infrastructure, potentially threatening electric and gas system reliability and resiliency, especially as new opportunities to use green hydrogen and RNG as a decarbonization pathway emerge.

Pivoting these ongoing projects to support hydrogen and RNG blending could reduce major asset losses and contribute to decarbonization goals. It can be argued that utility depreciation policies requiring investment recovery over an asset's service life inhibits innovation and the use of new technologies, particularly if a goal of regulators is to phase out the use of gas altogether.[27] Repurposing natural gas pipelines for transmission and distribution of green hydrogen or RNG can help prevent concerns over investment recovery. Continued investment in natural gas infrastructure in the near and intermediate future benefits the electric grid by supporting reliability. Additionally, investing in natural gas infrastructure can also support state GHG reduction goals by replacing leaking pipes and ensuring utilities do not suffer major monetary and infrastructure losses.

OPPORTUNITIES FOR INNOVATION AND PORTFOLIO SOLUTIONS

The current environment provides an opportunity to rebuild and enhance existing electric grid capabilities cost-effectively and efficiently, while also considering climate change and future grid needs. Utilities need the support and backing of customers, communities, and regulators to gain approval for infrastructure investments. Customers need assurances from utilities and regulators that investments are in the best interest of customers, society, and the environment and are consistent with state decarbonization goals. Investors, providing capital for grid expansion, renewable and distributed generation, transportation and building electrification, and natural gas pipe replacement to meet decarbonization goals, need assurances that their investments will be recovered and provide a reasonable return on investment. There are many innovative and portfolio solutions that can enable all stakeholders' needs to be met.

Innovations in Leak Detection Technology

For safety and decarbonization efforts, utility regulators throughout the United States require LDCs to detect, locate, and repair or replace natural gas pipeline leaks at regular intervals. Many utilities throughout the country are using innovative methods to detect, quantify, prioritize, and repair methane leaks. New leak detection and repair tools are being developed and demonstrated with support from the United States Department of Energy (DOE) and its national laboratories, industry, and academia. Consolidated Edison (Con Edison) in New York was the first utility in the United States to deploy New Cosmos advanced metering infrastructure-enabled smart gas leak detection technology on its 376,000 gas service lines across its territory, as part of a $130 million natural gas infrastructure improvement program.[28]

Investors, providing capital for grid expansion, renewable and distributed generation, transportation and building electrification, and natural gas pipe replacement to meet decarbonization goals, need assurances that their investments will be recovered and provide for a reasonable return on investment.

Con Edison partnered with the Environmental Defense Fund and Google to build a faster and cheaper way to detect and assess the severity of gas leaks under streets and sidewalks in New York City using leak detector sensors on Google

[27] Terzic, B. (2019). Innovation requires capital recovery recognition. *Natural Gas & Electricity,* 36(1), 11-18. doi.org/10.1002/gas.22131.

[28] ConEdison Media Relations. (2020, September 28). Con Edison providing smart gas detectors in major breakthrough for customer safety. *Con Edison.* https://bit.ly/3uHihbk

cars.[29] Public Service Enterprise Group (PSEG), a New Jersey utility, is using the same technology to prioritize high-emitting leaks for repair or replacement.[30] These replacements have led to an 83 percent reduction in methane emissions and reduced the miles of pipe needing to be replaced by one-third, leading to a decrease in emissions in distressed urban areas and lowering the cost of emission reductions. Peoples Gas, a natural gas service provider in Pennsylvania, outfitted vehicles with advanced leak detection to cover 950 miles of pipeline in Pittsburgh, reducing the cost of methane emission reductions[31]

Innovations in Machine Learning

Deploying advanced metering infrastructure and connected devices has provided utilities with more customer data than ever before. Machine learning can help utilities leverage the accumulated data to assess asset health, aid in asset management, and help predict excavator damage from replacing pipes.[32] Machine learning can analyze patterns in data to improve operators' ability to understand leaks, and even predict potential leaks.[33] Machine learning can improve the information utilities and excavators have about underground infrastructure and pipeline safety risks. Third-party excavation is the leading cause of damage to natural gas distribution pipes, causing $1.5 billion in costs to utilities every year with 85,993 reported incidents in 2018 impacting natural gas infrastructure.[34]

For example, National Grid and NiSource, two northeast natural gas distribution utilities, have used predictive analytics to decrease third-party excavation damage by applying available ticket data, including street names, towns, map grids, company names, locator information, and type of work being performed, with proprietary statistical analysis methodology to identify high-risk tickets.[35] For instance, at National Grid, it was determined that 57 percent of damage incidents occurred on just 10 percent of 811 tickets, and from that insight, National Grid was able to reduce damages by up to 35 percent from 2015 to 2017. Machine-learning applications can offer immediate improvement to natural gas services by better allocating resources to target methane emissions.

Leveraging Existing Natural Gas Assets for Hydrogen and Renewable Natural Gas

The Biden administration and the DOE recognize that green hydrogen can be produced from a diverse set of resources with the potential for near-zero GHG emissions if derived from renewable energy resources through electrolysis.[36] Once produced, hydrogen generates electrical power in a fuel cell, emitting only water vapor and warm air.[37] The DOE claims that green hydrogen holds promise for growth in the stationery and transportation energy sectors. It suggests that hydrogen production, even if derived from fossil fuels but paired with CCS technology, can be GHG emission-free.[38] While transportation in the United States accounts for approximately one-third of US CO_2 emissions, the DOE claims that using sustainably sourced hydrogen for transportation can cut GHG emissions.[39]

The DOE's Energy Earthshot Initiative, launched June 7, 2021, seeks to accelerate technological breakthroughs in clean energy solutions within 10 years to help reach the Biden administration's goal of net-zero carbon emissions by 2050.[40] The initiative seeks to reduce the cost of

[29] Environmental Defense Fund. (2018, February 6). Con Edison partners with EDF & Google to map and measure methane leaks, prioritize infrastructure upgrades on NYC and Westchester natural gas system. *EDF.* https://bit.ly/3uDkqoD

[30] Environmental Defense Fund. (n.d). Collaboration with PSE&G: Data helps prioritize gas line replacement. *EDF.* https://bit.ly/3spQ7Pv.

[31] Sisk, A. (2019, January 8). Peoples Gas unveils high-tech methane leak detection system. *State Impact Pennsylvania.* https://n.pr/3uBVtd3

[32] See note 25.

[33] Ibid.

[34] Ibid.

[35] Ibid.

[36] Electrolysis is the process of using electricity to split water into hydrogen and oxygen.

[37] A fuel cell uses the chemical energy of hydrogen or other fuels to cleanly and efficiently produce electricity. If hydrogen is the fuel, the only products are electricity, water, and heat.

[38] Ibid.

[39] United States Environmental Protection Agency. (2021, July 21). Greenhouse gas emissions: Sources of greenhouse gas emissions. *EPA.* https://bit.ly/3HDLHuA

[40] Department of Energy. (2022). Hydrogen and fuel cell technologies office: Hydrogen shot. *Energy.gov.* https://bit.ly/34uYi4T

clean hydrogen by 80 percent to $1 per kilogram in one decade.[41] The Hydrogen Shot establishes a framework and foundation for clean hydrogen deployment, including support for demonstration projects. Industries are beginning to use hydrogen to reduce emissions, yet many hurdles remain, preventing large-scale deployment and the unlocking of new markets, including use in steel manufacturing, ammonia, energy storage, and heavy-duty trucks. According to Jeffrey Reed, chief scientist for renewable fuels and energy storage at the University of California Irvine's advanced power and energy program, by reducing the cost, using clean hydrogen for power generation will be the lowest-cost solution to backing up renewable generation, since most natural gas-fired power plants are already located along transmission lines. It makes sense to leave infrastructure in place to carry low-carbon fuels. The DOE suggests that the Energy Earthshot Initiative could create more clean energy jobs, reduce GHG emissions, and position America to compete in the clean energy market on a global scale.

Utilities have announced at least 26 hydrogen pilot projects in the past year as the industry works to understand how to make and transport hydrogen and migrate customers and equipment to the low-carbon fuel.[42] The goal for utilities currently is to blend hydrogen with natural gas to reduce carbon emissions. Kim Heiting, senior vice president of operations and chief marketing officer at Oregon utility operator Northwest Natural Holding Company, says that pilot projects ensure that "when we go to our regulators or other stakeholders to make a very large investment, we've got them familiar with this technology and the application of it." The pilots will help utilities understand and overcome challenges posed by the shift to hydrogen with a small investment, before embarking on an extremely expensive full-scale rollout.[43]

Alternatively, RNG is pipeline-quality biomethane produced from biomass and can come from a variety of sources, including landfills, wastewater treatment plants, livestock farms, food production facilities, and organic waste management operations. The methane from biomass sources that would otherwise enter the Earth's atmosphere is captured and combusted as RNG. RNG is fully compatible with US pipeline infrastructure and can be used locally on site where the gas is created, or it can be injected into natural gas transmission or distribution pipelines.

Since 2018, the number of RNG projects in the United States has grown by 128 percent from 74 to 169, with continued growth expected.[44] RNG has the potential to reduce GHG emissions by 101–235 million metric tons by 2040, according to a study by ICF.[45] UGI Corp., a Pennsylvania natural gas and electric power distribution company, plans to spend $1.25 billion through 2025 on lower-carbon fuels, including RNG, to help meet climate mandates.[46] Studies show that replacing less than 20 percent of the traditional gas supply with RNG can achieve GHG emissions reductions equivalent to converting 100 percent of buildings to electric-only energy by 2030.[47] Using a mix of in- and out-of-state RNG is three times more cost-effective in reducing GHG emissions than an electrification pathway.[48] With increased federal government support, RNG has the potential to diversify the energy supply while also reducing GHG emissions.

Innovations in Funding

The $1.75 trillion BBB bill, with a $550 billion focus on climate change, will likely have to pass Congress piecemeal. However, specific opportunities in the current BBB reconciliation bill will

[41] Ibid.

[42] Siccion, T. (2021, October 15). Gas utilities navigate energy transition while facing greater climate oversight. *S&P Capital IQ.* https://bit.ly/3HHKC4V

[43] Ibid.

[44] United States Environmental Protection Agency. (2021, December 16). Landfill methane outreach program (LMOP): Renewable natural gas. *EPA.* https://bit.ly/3gxFuVl

[45] Sheehy, P. & Oldham, M. (2020, September 21). Renewable natural gas as a decarbonization strategy: 4th Annual AGA RNG Workshop. *ICF.* https://bit.ly/3HDNCiM

[46] Paul, C. (2021, December 2). UGI to invest up to $1.25B in renewable gas projects through 2025. *S&P Capital IQ.* https://bit.ly/33bIOlM

[47] Southern California Gas Company. (2022). What is renewable natural gas? *SoCalGas.* https://bit.ly/35VeQU5

[48] Navigant Consulting, Inc. (2018, July 24). Analysis of the role of gas for a low-carbon California future. *Southern California Gas Company.* https://bit.ly/3uE8xPd

probably remain and can provide the foundation and funding for a plethora of private-sector investment driving toward the same goals, including:[49]

1. Additional funding beyond the funding available through the IIJA for building efficiency and resilience, including $3.2 billion available to states for clean energy, grid integration, and energy efficiency improvements at public schools, municipal government buildings, wastewater treatment plants, daycare facilities, and colleges/universities, plus an additional $3.5 billion for the Weatherization Assistance Program.
2. Extending the production tax credit, which allows energy producers to claim a credit based on electricity produced from renewable energy resources.
3. $13.5 billion allocated for the zero-emission vehicle infrastructure, including $2 billion for rebates for electric vehicle supply equipment (EVSE) located in multiunit dwellings, workplaces, and other publicly accessible places, and another $1 billion to provide technical assistance, grants, education, and outreach to locate EVSE in low-income and underserved areas.
4. Funding to boost residential home energy efficiency and appliance electrification, including $9 billion for rebates for "whole-house" energy-saving retrofits and $9 billion for rebates to homeowners and owners of multifamily buildings for qualifying electrification projects.
5. $2.5 billion allocated to support low-income households and multifamily affordable housing to install solar energy equipment.
6. Clean energy tax credits for homeowners, including providing credits for installing solar electric, solar water heating, fuel cell, small wind energy, and geothermal heat pumps; extending and increasing the energy efficiency home credit for single and multifamily homes; expanding the energy efficient commercial buildings deduction; and providing a new plug-in electric vehicle credit for individual car buyers.

If passed, BBB will provide the funding needed to spur innovations, creativity, and commercialization through public–private partnerships that might otherwise take years, if not decades, to materialize. Nearly 300 renewable power developers and manufacturers appealed to congressional leaders in support of the climate provisions in BBB, warning that major clean-energy projects hang in the balance. They noted that "each month of delay means an estimated $2 billion in lost economic activity."[50]

Using a mix of in- and out-of-state RNG is three times more cost-effective in reducing GHG emissions than an electrification pathway. With increased federal government support, RNG has the potential to diversify the energy supply while also reducing GHG emissions.

While BBB contains major incentives to encourage clean energy deployment, it also sets methane emission intensity targets, above which companies would pay a fee of $900 per metric ton of methane produced starting in 2023 and increasing to $1,500 per metric ton by 2025.[51] The methane fee provides an incentive for natural gas utilities to reduce methane emissions, most likely through preventing and eliminating methane leaks through pipe replacements. However, as noted earlier, pipe replacement programs are decades-long, even with accelerated recovery mechanisms, and only address a small population of pipe inventory. BBB would include supplemental appropriations of $775 million to the EPA to provide grants to facilities subject to the methane charge for a range of objectives, including improving and deploying industrial equipment and processes that reduce methane emissions.[52]

The American Petroleum Institute and Interstate Natural Gas Association of America have contended that the methane fee would likely increase consumers' gas and electric bills and would duplicate the EPA's regulatory efforts, diverting

[49] *Build Back Better Act 2021* (USA). https://bit.ly/35VfpgF

[50] Dlouhy, J. (2022, January 24). Clean-Power developers warn billions at risk in plea to congress. *Bloomberg*. https://bloom.bg/3GEVdfy

[51] Melvin, J. (2021, December 17). Proposed methane fee remains intact in US Senate's draft reconciliation bill. *S&P Capital IQ*. https://bit.ly/3Bd0LwU

[52] Ibid.

private-sector resources away from reducing GHG emissions.[53]

CONCLUSION

Estimates of the capital investment needed to pursue decarbonization goals vary greatly. States have clean energy goals, which aspire to all electricity generation coming from clean and renewable energy resources by 2035 (with some extending to 2040 or 2050). Many states have goals for a zero-carbon or carbon-neutral economy across all sectors by 2050. To meet these goals, utilities must be allowed to invest in (1) new transmission and distribution infrastructure; (2) new information, operations, and communications technologies to support the expanded grid and decentralized grid; (3) new electricity generation among a variety of sources, including central station and distributed energy resources; (4) new and advanced building heating and cooling technologies and appliances; and (5) electric vehicle and alternative transportation fueling stations and infrastructure.

Estimates for the level of investment needed range from hundreds of billions to trillions of dollars to complete the transition. Though much is still unknown, making more exact estimates impossible at this time, what is certain is that the transition will come at a steep cost. However, while similarly difficult to estimate, the cost of maintaining the status quo is likely to be even greater, including health and economic costs, dislocations caused by more frequent, severe, and even catastrophic health and climate events.

To meet ambitious state, federal, and global decarbonization goals, regulators, utilities, and all involved stakeholders need to look at innovations and technological advances. Choosing only one path forward to decarbonization, instead of a blended and balanced approach, alienates innovation and dismisses the needs of maintaining current infrastructure. With so much uncertainty created by states executing individual mandates and bans, utility investors might decide to slow or stop financing crucial infrastructure updates and projects that simultaneously support decarbonization efforts, such as natural gas pipeline replacement. A decrease in investment and a lack of funding for upgrading assets puts utilities at risk of being unable to recover the capital investment.

Advancing the use of green hydrogen and RNG as supplementary and potential alternatives to natural gas is another pathway in support of decarbonization.

Utility regulators could create more certainty by accelerating depreciation for assets expected to retire early. Repurposing current assets would avoid losses to shareholders, while at the same time supporting decarbonization efforts. Salvaging and improving existing infrastructure for cleaner technologies can meet multiple goals—decarbonization, the continuation of investor funding, and the promotion of innovation. For example, investing in natural gas pipeline replacement as a strategy to reduce methane emissions will require accelerated recovery methods if natural gas use is to remain stagnant or decline over time with electrification. With a renewed federal focus and targeted funding for RNG and hydrogen blending, there is an opportunity to pilot lower-emission RNG and hydrogen commodities and applications while using existing pipelines. Deploying clean energy through current infrastructure helps avoid delays in generating and distributing renewable energy while electrification is pursued.

The portfolio of strategies, technologies, and investments needed to meet clean energy and decarbonization goals while addressing and meeting social-economic and equity needs requires a carefully developed, balanced, and implemented plan. All options need to be considered as long as they are consistent in striving toward achieving federal and state emissions goals while providing investors with incentives and reasonable returns to support investment.

[53] Ibid.

