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Regulatory Pathways for Advancing Low-Carbon Gas Resources for Gas Distribution Companies

Executive Summary

An American Gas Foundation Study Prepared by:

Acknowledgements and Disclaimers

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About AGF and Concentric

Founded in 1989, the American Gas Foundation is a 501(c)(3) organization focused on being an independent source of information, research and programs on energy and environmental issues that affect public policy, with a particular emphasis on natural gas. When it comes to issues that impact public policy on energy, the AGF is committed to making sure the right questions are being asked and answered. With oversight from its board of trustees, the foundation funds independent, critical research that may be used by policy experts, government officials, the media, and others to help formulate fact-based energy policies that will serve this country well in the future.

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Authors of this Study

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This nonpartisan study is based on independent analysis and research and is not intended to advocate a particular view on any specific legislation or encourage readers to act with respect to specific legislation. Concentric interviewed a relatively small set of North American utility regulators representing a wide spectrum of perspectives on the challenges associated with advancing low-carbon gas resources at scale in the gas distribution system. The regulatory views expressed by interviewees do not necessarily represent the views of all regulators in the U.S. nor are they universally applicable to all gas utilities across the country. Conclusions reached in this report are the product of objective research and interviews and do not necessarily represent the opinions of Concentric Energy Advisors, Inc.

Table of Acronyms

AFW	Agriculture, Forestry, and Waste Management
AGA	American Gas Association
AGF	American Gas Foundation
AUTUVA	Average Use True-Up Variance Account
BCUC	The British Columbia Utilities Commission
BEIS	Business Energy and Industrial Strategy
BEW	Bio Energy Washington
CARB	California Air Resources Board
CARE	California Alternate Rates for Energy
CC&S	Carbon Capture, Usage and Storage
CCA	Community Choice Aggregation
CHP	Combined Heat and Power
CI	Carbon Intensity
CNG	Compressed Natural Gas
CPUC	California Public Utilities Commission
DC	District of Columbia
EIA	Energy Information Administration
ESG	Environmental Social and Governance
FCG	Florida City Gas
FCH JU	The Fuel Cells and Hydrogen Joint Undertaking
FEI	FortisBC Energy Inc.
FPL	Florida Power Light
GDN	Gas Distribution Network
GDU	Gas Distribution Utility
GHG	Greenhouse Gas
GTI	Gas Technology Institute
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Resource Plan
ISO	Independent System Operator
ITC	Investment Tax Credit
LCEP	Low-Carbon Energy Project
LCFS	Low-Carbon Fuels Standard
LDC	Local Gas Distribution Company
LNG	Liquified Natural Gas
LRAM	Lost Revenue Adjustment Mechanism
MDPU	Massachusetts Department of Public Utilities
MPUC	Minnesota Public Utilities Commission
M-RETS	Midwest Renewable Energy Tracking System
NGO	Non-Governmental Organization
NGT	Natural Gas for Transportation

NIA	Network Innovation Allowance
O&M	Operating and Maintenance Expense
OCEC	Okeechobee Clean Energy Center
OPUC	Oregon Public Utilities Commission
Pepco	Potomac Electric Power Company
PGA	Purchased Gas Adjustment
PGVA	Purchased Gas Variance Account
PTC	Production Tax Credit
PTC	U.S. Federal Production Tax Credit
CPUC	Colorado Public Utilities Commission
PURA	Public Utilities Regulatory Authority
QRAM	Quarterly Rate Adjustment Mechanism
REC	Renewable Energy Credit or Certificate
RFP	Request for Proposal
RFS	Renewable Fuel Standard
RGGI	Regional Greenhouse Gas Initiative
RNG	Renewable Natural Gas
RPS	Renewable Portfolio Standard
RTC	Renewable Thermal Certificate
SB-98	Senate Bill 98
SIF	Strategic Innovation Fund
SJI	South Jersey Industries
SLCP	Short-Lived Climate Pollutants
Summit	Summit Natural Gas of Maine
TCI	Transportation Climate Initiative
TREC	Thermal Renewable Energy Credit
UK	United Kingdom
VGS	Vermont Gas Systems
VGT	Voluntary Green Tariff
WGL	Washington Gas Light Company
WRRF	Water Resource Recovery Facilities
WTE	Waste-to-Energy

Definitions

Blue Hydrogen - Hydrogen generated from natural gas, where CO_2 is separated and stored or reused such that Hydrogen production is carbon-neutral.

Carbon neutral - Carbon neutral refers to the carbon emissions generated that may be offset or counteracted by another action. For example, it is possible to have carbon-emitting resources in a gas portfolio if combined with gas resources that reduce carbon such that there is no incremental carbon impact.

Clean Hydrogen – hydrogen produced using an electrolyzer for which the electricity used is produced from qualified renewable energy resources, or by any other process which has been determined to have a rate of carbon dioxide produced equal to or less than 2 kilograms of carbon-dioxide equivalent produced at the site of production per kilogram of hydrogen produced as defined in the 2021 Infrastructure Investment and Jobs Act ("IIJA"). The IIJA provides that the Secretary of Energy may adjust the standard after its consultation with the EPA.

Decoupling – a regulatory mechanism that removes the pressures on utilities to sell as much energy as possible by eliminating the relationship between revenues and sales volume.

Green Hydrogen - Hydrogen that is produced by water electrolysis, where water is split into hydrogen and oxygen by an electric current and with the help of an electrolyte. If the electricity required for electrolysis comes exclusively from carbon-free renewable resources, the entire production process is completely CO_2-free.

Gray Hydrogen is hydrogen obtained from fossil fuels, where for example natural gas may be converted to Hydrogen, but the CO_2 byproduct is not captured and stored.

Low-Carbon Gas Resources – Low-carbon gases such as biogas, bio methane (renewable natural gas), natural gas consumed such that carbon dioxide is captured and stored, hydrogen produced via electrolysis by using renewable-generated electricity (green hydrogen), or hydrogen produced from natural gas and carbon capture and storage (blue hydrogen).

Net Zero - Net-Zero typically considers all greenhouse gases, such as methane, nitrous oxide, as well as CO2. It can include a combination of both reducing and offsetting greenhouse gas emissions such that no incremental greenhouse gases are emitted.

Renewable Natural Gas ("RNG") - any pipeline compatible gaseous fuel derived from biogenic or other renewable sources that has lower lifecycle CO_2 emissions than geological natural gas.

Renewable energy certificate ("REC")- a market-based instrument that represents and conveys the property rights to the environmental and other non-power attributes of renewable generation.

Selective Electrification - the selective use of electric appliances, equipment or vehicles that have been determined for a specific region to achieve consumer cost savings, greenhouse gas emissions reductions and reliability improvements relative to alternative energy options for the same applications.

Turquoise Hydrogen – Hydrogen that is produced through methane pyrolysis, applying heat produced from electricity to methane and splitting the methane into hydrogen and solid carbon. The solid carbon can then be used in industrial applications or is easily stored.

Zero carbon Resources - resources that produce no carbon at all.

Executive Summary

Concentric was engaged by the American Gas Foundation ("AGF") to assess enabling policies that could be used to establish regulatory frameworks for incentivizing the production and use of low-carbon gas resources at scale to achieve environmental, waste management, economic development, and other objectives. The study also examines the impact of such policies on the gas utility business model and on the gas utilities' ability to assist in achieving public policy objectives.

Expanding the production and use of low-carbon gas resources could include developing and transmitting renewable natural gas, blending hydrogen with existing natural gas supplies, or building dedicated hydrogen gas systems. Each of these potential approaches have varying technical/regulatory challenges, timelines, costs and impacts on greenhouse gas emissions. Scaling the integration of low-carbon gas resources in a safe, efficient, and effective manner will require technological innovation as well as opportunities to market such products to end-users. Expanding the adoption of low-carbon resources will require addressing concerns over resource potential and scaling, validating the environmental benefits, and moderating the costs. Where gas utilities adopt operational plans to advance low-carbon fuels and technologies, they must continue to manage consumer affordability as well as safety and reliability objectives.

Policymakers are and will continue to be influential in guiding economy-wide emission reduction pathways over time. Emission reduction efforts will necessarily evolve as pathways are refined, technologies emerge (or submerge), and best practices and lessons learned materialize. Policymakers face important issues such as who will bear responsibility for the cost of reducing emissions and balancing equitable access to energy alternatives with the tendency of higher cost energy supplies to disproportionally burden low-income customers. These policy considerations could even potentially impact the nature and extent of continued operations of gas utilities and suppliers in a lower carbon energy future.

Major Findings:

- Policy support and clear regulatory authority is key.
- Utilities and stakeholders must educate on the benefits.
- Achieving scale allows for greater realization of the benefits of lower carbon gas supplies.
- Gas and electric incentives for renewables are not on equal footing.
- "Highest and Best Use" principles help prioritize low-carbon resources into the natural gas supply mix.
- No one-size-fits-all approach.

Gas utilities have consistently provided solutions for meeting energy needs and environmental goals, and they have an important, enduring role to play. This study reviews policies that have enabled utilities to evolve to meet changing societal goals and lessons learned in other regulated jurisdictions and industries.

Goals of Study

This study focuses on regulatory pathways that address barriers that impede the introduction of low-carbon gas resources into the natural gas system at scale, so that a utility may continue to meet customer energy needs in a lower carbon environment.

Specifically, the focus of the study is to address:

1. What barriers/obstacles exist in the current regulatory landscape at the state level for natural gas utilities to advance low-carbon resources at scale?
2. What are the best regulatory practices to enable gas utilities to pursue carbon reduction strategies?
3. What rate design characteristics could allow utilities to recover costs and earn an adequate rate of return while pursuing a long-term sustainable energy future?
4. What policy changes could allow utilities to introduce higher-priced gases like RNG and hydrogen at scale into the distribution system?

The study provides examples of specific barriers that have arisen but were successfully addressed, and where barriers could not be overcome. Further, the study provides examples of modified regulatory frameworks that were adopted to advance the role of low-carbon gas and support economy-wide emission reductions. The regulatory pathways vary widely by jurisdiction and are situationally dependent, and thus should not be construed as a one-size-fits-all pathway for all gas utilities.

This study is the culmination of research and interviews with identified regulators and utilities. The research reviewed includes regulatory proceeding submissions, news articles, articles in trade publications, and third-party studies. The research was supplemented by interviews with utility regulators from six North American regulatory jurisdictions, one international regulatory expert, and managers from two utilities. Through the research and interviews, Concentric has identified enabling regulatory policies and assessed which policies or group of policies show the greatest potential to enable the expansion and use of low-carbon gas resources at scale.[2]

Major Findings

Legislative Support and Clear Regulatory Authority are Key to Establishing a Workable Regulatory Framework to Expand Renewable Natural Gas Supply and Demand through Gas Utility Systems.

Clear authority to allow or promote utility investment in low-carbon fuels is key to introducing low-carbon gas resources into the distribution system at scale. This authority may be the product of legislation or may be embedded within the responsibilities and authority conferred to the utility regulator in its charter or legislation laying out the specific

[2] Any policies discussed in the Regulatory Pathways for Advancing Low-Carbon Gas Resources for Gas Distribution Companies report ("Report") are not an endorsement or recommendation - rather the Report sought to identify and examine the options available to gas utilities and their jurisdictions that could reduce regulatory barriers.

authority of the regulatory agency. Regulatory objectives such as "promoting the public interest" or "considering the impact on health and environment" may allow some regulatory leeway to adopt regulatory policies outside of least-cost principles but may not provide the explicit legislative policy support that regulators often look to for implementing policies that impact the traditional gas utility business model.

Overwhelmingly, regulators that were interviewed look to their respective legislative bodies for clear guidance on implementing climate and/or other public policy goals. Legislative directives often provide the needed guidance for actionable regulatory frameworks that can help achieve stated climate goals. Regulators are hesitant to "fill in the gaps" left by oblique legislation. As one commissioner stated, "Regulators will always use the 'just and reasonable'[3] test; [we are] not mandated to affect climate change." Indeed, Concentric identified several instances where legislation would have prohibited the procurement of low-carbon gas resources, and where utilities successfully worked with stakeholders to secure the passage of enabling legislation.[4] During interviews, several regulators indicated their willingness to participate in the legislative process to assist in developing enabling legislation. Though regulators may have broad authority to approve investment in low-carbon fuels without the explicit support of legislation, they will be reticent to take positions that may be perceived as overstepping their authority and leaving them vulnerable to regulatory challenges by stakeholders.

Utilities Must Educate

Gas utilities have a critical role in educating their legislators, regulators, and the public on the benefits of lower carbon alternatives. Regulators that Concentric interviewed expressed that gas companies should engage in education and outreach efforts regarding the technologies and approaches they can deploy.

Gas system infrastructure has been relied upon for decades in most jurisdictions for electric generation, heating, and industrial applications, and has provided core benefits such as improving optionality for stakeholders, minimizing customer impacts, maintaining reliability, and improving energy system resilience. Gas utilities have an important and enduring role to play and have actively participated in advancing low carbon resources in

[3] "Just and reasonable" is a term of art in the regulated utility industry that relates to the fairness of utility rates to both utility shareholders and customers. This principle has evolved through decades of regulatory proceedings, most notably through two seminal case proceedings, Hope and Bluefield. Hope instructs that that the fixing of just and reasonable rates for natural gas by the Federal Power Commission involves a balancing of the investor and the consumer interests; and that it may be the product of expert judgement such that it is the result reached and not the method employed that is controlling. Bluefield directs regulators to set rates that entitle a public utility to earn a return on the value of its property that is comparable to that earned on similar investments of like risk and that rates that are not sufficient to earn a reasonable return on the value of property are unjust, unreasonable, and confiscatory.

[4] See, for example, CenterPoint Energy's involvement in Minnesota in passing the Natural Gas Innovation Act (Case Study #1 of this Report), a RNG developer/utility initiative in securing the passing of Senate Bill ("SB") 896 (2021) in Florida (Case Study #2 of this Report) and Northwest Natural's involvement in Oregon passing of SB 98 RNG legislation.

some jurisdictions.[5] That progress can continue through infrastructure modernization and continued or expanded gas utility initiatives in energy efficiency, renewable fuels, and methane emissions mitigation, for example.[6]

Gas Local Distribution Companies ("LDCs") and their market participants (e.g., retail marketers and low-carbon gas developers and producers) must educate policymakers, regulators, and customers on the benefits of developing or acquiring low-carbon gas resources (e.g., RNG and hydrogen) toward meeting economy-wide emission reduction targets or other objectives. Decision makers and stakeholders need to understand all of the potential energy pathways and the associated costs and benefits specific to their jurisdictions' objectives. Active gas utility participation in such efforts could lead to a larger, more-inclusive set of solutions. The interviews suggest that proponents of low carbon resources have been engaged, vocal and narrowly focused on the issues of electrification for some time, whereas the gas industry's messaging on pathways and strategies to promote a lower carbon energy future and other benefits needs to be amplified.

Achieving Scale Allows for Greater Realization of the Benefits of Lower Carbon Gas Supplies

The level of future societal benefits that can be derived from the gas system will be proportional to the economies of scale that can be achieved in the development of low carbon energy supplies. Since 2010, extensive policy support in the electric sector has produced significant economies of scale and has contributed toward bringing down the costs of some technologies to near-competitive levels.[7] Without the cost reductions typically achieved through scale, it may become difficult to meet ambitious emissions reductions goals and maintain energy affordability.

There are comparatively small, but meaningful LDC programs aimed at developing a market for low-carbon gas resources. Voluntary green tariff ("VGT") programs, for instance, are becoming more prevalent with U.S gas utilities. VGT programs provide opportunities for customers to opt into purchasing low-carbon gas supplies for some or all of their usage. While beneficial, experience from the electric sector over recent years suggests that VGT programs alone have not driven comparable adoption and economies of scale when measured against compliance programs.[8] Policymakers looking to achieve higher utilization of low-carbon gas resources may wish to consider programs that

5 In recent years, gas utilities have effectively played an important part in reducing emissions in the transportation sector under California and Oregon's market-based low-carbon fuel standards by using their pipeline and storage assets to deliver low-carbon gas resources. According to the California Air Resources Board ("CARB"), the certified carbon intensities of RNG sources sold, supplied, or offered for sale under that program range from around 50 percent to well over 100 percent less carbon-intensive than fossil fuels, see Rebecca Gasper and Tim Searchinger, The Production and Use of Renewable Natural Gas as a Climate Strategy in the United States, at 18, World Resources Institute (April 2018), https://www.wri.org/publication/renewable-natural-gas.

6 ICF, American Gas Association, Net-Zero Emissions Opportunities for Gas Utilities (2022) at 127, at 15.

7 Based on the experience in the electric sector, a virtuous circle of support policies driving increased deployment, technological improvements and cost reductions has seen onshore wind become one of the most competitive options for new generation capacity. The levelized cost of solar PV fell 58% between 2010-15, making it increasingly competitive at utility scale. IRENA (2016), The Power to Change: Solar and Wind Cost Reduction Potential to 2025.

8 See, Figure 5 in Lessons learned from the Electric Industry, below.

incorporate greater percentages of these resources into the mainstream gas acquisition strategy for utilities. Initiatives examined in this study range from relaxing the least cost mandate for an LDC to direct procurements to renewable portfolio standards ("RPS")/biomethane targets.

Gas and Electric Incentives are not on Equal Footing

Federal and state policy incentives for the gas industry currently lack parity with the electric industry in providing emission reduction opportunities. Over the last decade, incentives have largely been available to the electric generation and transportation sectors.

Renewable generation resource development has flourished over the last decade in part from powerful federal and state incentives. Federal tax credits (Investment Tax Credit ("ITC") and Production Tax Credit ("PTC"), state RPS and other incentives have provided financial and regulatory certainty and created significant project cash flows for the development of renewable generation, allowing those resources to reach scale. However, such incentives have not been as widely available for the development of low carbon gas resources. Up until just recently, biomass used in certain combined heat and power ("CHP") applications could earn tax credits for generating power, but the same resource was not eligible for federal tax credits if used in a gas distribution system. While there are state programs to support biomass or RNG development in the electric and transportation sectors, such as RPS and low-carbon fuel standards, programs aimed at reducing LDC emissions are comparatively scarce. Today, there are only a few U.S. states with a renewable gas standard. In contrast, as of September 2020, 38 states and the District of Columbia had established an RPS or renewable goal, and in 12 of those states (and the District of Colombia), the requirement is for 100% clean electricity by 2050 or earlier.[9] Similarly, carbon pricing has been focused primarily on electric generation and transportation sector emissions.

While much recent legislative and regulatory attention has been focused on reducing emissions in the power generation and transportation sectors, many states have since committed to or are considering economy-wide emissions reductions. As a result, greater focus may be given to understand extent to which the gas sector operating in those jurisdictions can effectively contribute to the goals and the costs and benefits of doing so. Increased scale in the production and use of low-carbon gas resources like RNG and hydrogen may be realized through comparable policies that have enabled growth and economies of scale in the power generation and transportation sectors.

Recent action has been taken at the federal level to develop impactful quantities of clean hydrogen. The U.S. Department of Energy ("DOE") launched Hydrogen Shot to invest $8 billion in up to ten regional hydrogen hubs capable of producing a minimum of 50 to 100 tons per day of clean hydrogen. According to developers, the minimum production level target represents a "good size" at this stage, and the funding could bring forward projects that otherwise would not have been built. However, to make green hydrogen projects

[9] Renewable energy explained – portfolio standards – U.S. Energy Information Administration, see https://www.eia.gov/energyexplained/renewable-sources/portfolio-standards.php

viable, industry stakeholders cite an ongoing need to address issues such as sourcing renewable power to run electrolyzers in partnership with regulators and public utilities. Additionally, Hydrogen Shot program addresses the cost of production, while end-use sectors will face additional expenses such as supplying fueling stations in the mobility sector and compression costs for industrial customers that require gas at varying pressure.[10]

It is incumbent on the gas utility industry to continue to work to close funding gaps and apply best practices from utility experience with electric and other programs. Policies/regulatory frameworks that were successful in the electric transportation sector could provide a solid foundation for LDCs to contribute significantly toward a low carbon energy future.

"Highest and Best Use" Principles can Help Prioritize Low-Carbon Resources into the Gas Supply Mix

Gas and electric utility partnerships and alliances provide opportunities for innovation, program funding, and joint planning based on "highest and best use" principles to deliver low carbon energy future to end-users. Further, participation in regulatory proceedings and joint utility planning (i.e., joint integrated resource plans, or "IRPs") can help quantify the full costs and emissions impacts between gas and/or electric service.

Following recent industry consolidation, alliances between electric and gas utility companies have emerged to coordinate services and provide the highest and best use to meet consumer needs. Coordinated long-term IRPs between gas and electric utilities can be a useful tool for regulators to assess the benefits and costs of low-carbon gas resources against other options to decide where the highest and best use for each resource will occur and when.

Regulators in some jurisdictions are viewing integrated resource planning between gas and electric holistically to identify the best resource for each application. While some jurisdictions are considering full electrification, gas may be seen as a better choice economically, for resource adequacy/diversity, or where the required application simply favors the use of gas, such as certain industrial processes or cooking applications. In interviews with regulators, we've heard concern about the ability of current electric systems to accommodate a more significant winter peak without increasing costs to customers and acknowledgement of the reliance on gas supplies for meeting electric generation loads. This concern is similar to that of the gas utility industry.[11]

Due to the intersection of the electric and gas industries, future policy aimed at reducing emissions and meeting changing energy demands may be well served to consider how the gas system can be leveraged to achieve energy and environmental objectives.

[10] S&P Global Market Intelligence, As DOE bets $8B on Hydrogen Hubs, Scale Will Be Critical and Challenging – Panel, July 14, 2022

[11] Over the last five years, the demand for natural gas during the coldest winter month has been about 58% higher than the demand for electricity during the peak summer month within the building sector, and about 84% higher than the demand for electricity for all end-uses. ICF, American Gas Association, Net-Zero Emissions Opportunities for Gas Utilities (2022), p. 127.

Additionally, Gas utilities bring unique abilities and expertise related to financing and constructing new infrastructure, operational safety, and efficiency, convening stakeholders, and customer interactions.

Each Jurisdiction is Unique

Regulatory requirements, public policy objectives, and the availability of conventional gas or alternatives vary significantly by jurisdiction. As such, there is not a one-size-fits-all approach.

Energy policy involves determinations made across federal, state/province and local entities on issues concerning production, transportation, and consumption of energy resources – and the gas industry overlaps all levels of oversight. Federal regulators oversee interstate gas transportation and related services while state commissions regulate intrastate local distribution networks and related services. Local authorities play a key role in overseeing the siting and permitting of energy facilities. Gas utilities have substantial experience working with all of these entities.

States or provinces are often not similarly situated regarding the development/use of conventional or alternative forms of gas resources. Some have prolific production resources to oversee, while other have dense distribution networks. Similarly, the technical and economic potential to develop, transport and store alternative energy resources, such as RNG and hydrogen, varies significantly across locations.

The jurisdictions we reviewed have varying resource requirements, environmental/other public policies, and economic circumstances. A small but growing list of jurisdictions already have programs focused on gas utilities, while others have seen legislation stall. A core mission cited among all regulators we interviewed, however, is the need to balance reliability, resiliency, and affordability. Therefore, it is critically important for gas utilities and stakeholders to maintain situational awareness and educate where needed to ensure that the benefits of low-carbon gas resources can be realized where its cost-effective.

Regulatory Pathways to Overcome Barriers to Introducing Low-Carbon Resources into the Existing Natural Gas System at Scale

The study team has identified six significant barriers to advancing low-carbon gas resources into the gas system at scale. Those primary barriers are listed in Figure 1 below:

Figure 1: Primary Barriers to Introducing Low-Carbon Gas Resources at Scale

Ambiguous authority	The clarity of regulatory authority to enact policies that promote low carbon fuels at scale with little basis for regulatory challenge.
Cost	The pure economic cost of low-carbon fuels, i.e., excludes the social cost of GHG emissions.
Environmental concerns and uncertainty	Concern over the viability of low-carbon fuels and hydrogen systems to reach commercial scale.
Aligning utility incentives with social policy objectives	Creating regulatory policies that remove disincentives for utility investment in low-carbon fuels and creating a regulatory framework that will ensure cost recovery, including a return on investment.
Cost causation and who will pay	Regulators and legislators must consider the fair allocation of costs among utility customers, consumers and taxpayers. Policies must ensure equitable access to energy alternatives and should not disproportionately burden any subset of utility customers.
Technical Considerations	Technical considerations such as gas quality standards, availability and location of low-carbon fuel supplies, interconnection standards, infrastructure requirements, retrofitting requirements, siting and transportation are all considerations that must be addressed successfully.

Regulatory pathways to introducing low-carbon fuels at scale require navigating each of these potential barriers with a host of enabling activities/mechanisms to alleviate or minimize barriers. The pathway(s) to advancing low-carbon resources into existing gas systems at scale are likely different for each gas utility. Stand-alone gas companies may have a different approach than a gas utility that is part of a combination electric-and-gas entity. Each regulatory jurisdiction will have varying predispositions to these barriers depending on the availability and cost of low-carbon fuels, whether enabling legislation has been passed in the state, the availability of RNG feedstocks or excess renewable power to create hydrogen, whether there are opportunities to market such products, the age and condition of local gas infrastructure and ongoing pipeline replacement efforts, emissions reduction goals (if any), affordability of utility rates, etc. Each set of circumstances will result in a unique regulatory pathway conducive to the state and utility's environmental, energy and economic needs.

Figure 2, below, shows at a high level the barriers to scale implementation and the criteria we have used to evaluate the effectiveness (e.g., opportunities, causes and effects, and limitations upon achieving this goal) of the specific activities that contributed to achieving a successful pathway. Each barrier must be successfully navigated, and each regulatory pathway will encompass a host of enabling tools and activities that minimize or alleviate barriers.

Figure 2: Navigating Primary Barriers to Low-Carbon Resources in Gas System

The study team has identified enabling activities/mechanisms through our research to overcome the barriers shown in Figure 2. Any combination of the identified activities/mechanisms (listed in Figure 7 in the Conclusions to this study) may result in a successful "pathway" – the path taken to achieve meaningful expansion of low-carbon gas resources into the gas system that results in the attainment of the goals of the state policymakers, regulators, and the utility. Each enabling activity/mechanism has been evaluated in accordance with the following criteria:

- Creates opportunities for investment in low-carbon gas resources.
- Whether the activity/mechanism will positively affect (i.e., reduce) end user costs.
- Whether the activity/mechanism will expand customer fuel choice.
- A timeline at which the policy could be expected to reduce GHG.
- Extent to which a policy could be expected to reduce GHG – whether the activity/mechanism could promote low-carbon fuel at commercial scale.
- Whether the activity/mechanism would have a significant impact on the utility's ability to serve its customers.
- Whether activity/mechanism can be employed without significant limiting factors.

We conclude this report with two scenarios of potential regulatory pathways, given a hypothetical set of circumstances to illustrate how a utility might navigate a successful regulatory pathway. In

the absence of clear legislative or regulatory authority, the utility may need to develop its own path. This could include working collaboratively with stakeholders to develop enabling legislation and engaging in legislative discussions, education, and outreach. Even in the absence of legislation, the utility may secure regulatory authorization to embark on voluntary RNG programs, pilot programs, demonstration programs, which if successful could lead to expanded low-carbon fuel programs. While pilot programs typically lack commercial scale, they nonetheless provide an important intermediate step that leads to greater understanding of technology viability and garner added stakeholder support for future policy changes to enable scalable low-carbon resources.

Financing may come from a variety of sources such as those recently set out in the Bipartisan Infrastructure and Jobs Act and the Inflation Reduction Act. The Act provides funding for grid reliability and resiliency, supporting clean energy technologies such as carbon capture, hydrogen, direct air capture, and energy efficiency as well as energy demonstration projects.[12] Other funding sources might include joint ventures among partners with a shared interest in developing lower carbon energy technologies, such as universities, utilities, environmental laboratories, agricultural partners, manufacturing and electrolyzer companies. Further, carbon taxes and carbon pricing schemes typically allocate some portion of tax proceeds towards lower carbon energy initiatives. Some states have included such funding in their state budgets. The finance community also provides relatively inexpensive debt capital for green or sustainability project funding.

Aligning utility incentives (or at least removing disincentives) with the policy objectives requires careful attention to the rate frameworks and recovery mechanisms of the subject utilities. Some jurisdictions have employed alternative regulatory frameworks to align utility incentives with societal goals and new innovative tools and mechanisms continue to emerge, bound only by the creativity of the utility and its regulators. Such tools and mechanisms that were observed through research and interviews include but are not limited to: clean energy standards and programs, innovation funds, targeted incentives, decoupling or lost revenue adjustment mechanisms, pilot programs, voluntary tariffs, infrastructure replacement or investment, fuel adjustment mechanisms, integrated resource planning and competitive procurement strategies. These regulatory mechanisms and others can be effective in expanding low-carbon fuels into the gas system.

It is important to note that regulatory policies to enable preferred policy resources have the potential disproportionately impact low-income customers depending on commodity pricing and if costs are not carefully managed. A key challenge for regulators and policymakers is balancing equitable access to lower carbon energy and the impacts of certain policies on low-income and vulnerable populations. For this reason, it is important to consider the merits of low-carbon gas resources against not only conventional gas sources, but whether and to what extent these resources produce the desired reliability, affordability and sustainability objectives of the jurisdiction cost-effectively compared to other options.

This study concludes that the following policies hold the greatest potential for the development of low-carbon gas resources to scale: explicit regulatory authority to authorize the renewable gas initiatives and/or or recover the renewable fuel costs through the purchased gas adjustment

[12] Bipartisan Infrastructure Investment and Jobs Act Summary, A Road to Stronger Economic Growth, (November 2021) at 3.

mechanism (i.e., eliminating “least cost” mandates), gas-specific renewable portfolio standards, low-carbon transportation fuel standards, economy-wide emission reduction goals, opportunities for utility investment, innovation funding program incentives, and setting interconnection and gas quality standards. Though, as indicated above, each regulatory pathway will be unique to the utility and its regulatory jurisdiction. The study’s research suggests that these and other policies may be influential in achieving scale in the development of low-carbon gas resources.