Regulatory Pathways for Advancing Low-Carbon Gas Resources (LCR) for Gas Distribution Companies

Low-Carbon Gas Resources include Renewable Natural Gas (RNG), Hydrogen (H_2) and Certified Natural Gas (CNG).

The natural gas infrastructure has consistently provided solutions to meet energy needs and environmental goals, and it has an important and enduring role to play in addressing the challenges of climate change.

Growing the supply and demand of low-carbon gas resources through natural gas infrastructure creates many benefits for communities (e.g., environmental, economic development and waste management).

Gas utilities bring unique abilities and expertise related to financing and constructing new infrastructure, operational safety and efficiency, convening stakeholders and interacting with customers. Policies to expand low-carbon gas resources may be more successful by utilizing these gas utility advantages.

Natural gas infrastructure has been instrumental in reducing emissions in the transportation sector by using its pipeline and storage assets to deliver RNG to the market.

Key Findings

- Decarbonization policies do not have to be limited to just advancing renewable electricity.
- Legislative support and clear regulatory authorities are needed to expand the supply and demand of low-carbon gas resources at scale using gas utility systems.
- Gas utilities must educate stakeholders, including legislators, regulators and the public, on the environmental, safety and economic benefits of LCR.
- The merits of LCR should be based on regulatory mechanisms that look beyond the cost of natural gas, assessing how effective they are in achieving environmental objectives compared to other options that could be deployed.
- Policies to advance LCR must consider their resource potential at both a regional and national level, as well as the connectedness of the gas delivery system.
- Regulatory requirements, public policy objectives and resource availability require different approaches in different jurisdictions.

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Navigating Primary Barriers to Advancing LCR

Advancing LCR at scale will require navigating potential barriers, using a host of enabling pathways to alleviate or minimize barriers. In searching for solutions to these barriers, stakeholders should contemplate a range of considerations.

Examples of Overcoming Barriers to Advance LCR

Many gas utilities and stakeholders are working together to address the barriers to advancing LCR in jurisdictions across the United States, Canada and the United Kingdom. The table below provides some examples.

Barrier	Action Taken	Some Jurisdictions of Note
Ambiguous Authority	Explicit Legislative Guidance, Climate Goals and Targets, Gas RPS, Regulatory Authority to Consider Environmental Impacts in Regulatory Decisions	CA, MD, VT
Cost	Relaxing the Least-Cost Mandate, Carbon Pricing	CA, FL, OR, MN
Environmental Concerns and Uncertainty	Education and Outreach	MA, RI, OR
Aligning Utility Incentives with Policy Objectives	Rate Base Investment, Innovation Funding Programs, Pilot Programs, Incentives, Purchased Gas Adjustment (PGA) Mechanisms, Voluntary Green Tariffs	OH, ME, NJ, IL, WA
Cost Causation and Who Should Pay	Utility Rates and Riders, Public/Private Partnerships, Business Alliances, Green and Sustainability Bonds	Canada, United Kingdom
Technical Considerations	Infrastructure Replacement Programs, Rate Base Treatment of Interconnection Costs, Interconnection and Gas Standards	GA, AZ, CT, NY, NC

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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:

Concentric Energy Advisors

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.

Concentric Energy Advisors was founded in 2002 by a small group of executive-level consultants who were committed to establishing a mid-sized energy consulting firm with capabilities and a reputation unsurpassed by any firm in North America. Since its inception, Concentric has grown more than eight-fold and has significantly expanded its service offerings, while remaining focused on achieving the highest standards of consulting excellence in the energy field.

Authors of this Study

This report is the culmination of the work effort of a broad Concentric team. The primary authors of this report are Julie Lieberman, Gregg Therrien, Kelly Porter, Pieter Zwart, and Jack Gross.

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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.

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.

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.

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

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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.

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

An American Gas Foundation Study Prepared by:

CONCENTRIC ENERGY ADVISORS

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.

Concentric Energy Advisors was founded in 2002 by a small group of executive-level consultants who were committed to establishing a mid-sized energy consulting firm with capabilities and a reputation unsurpassed by any firm in North America. Since its inception, Concentric has grown more than eight-fold and has significantly expanded its service offerings, while remaining focused on achieving the highest standards of consulting excellence in the energy field.

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.

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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.

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.

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.

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 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

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

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.

Introduction

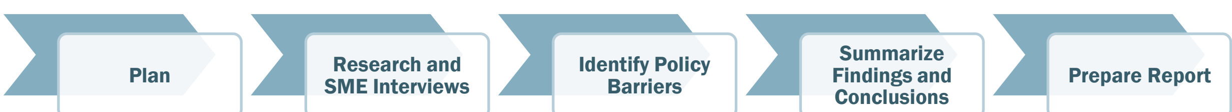
Scope of Work

Concentric was engaged by the American Gas Foundation ("AGF") to conduct a study and produce a report that provides a broad basis for understanding the limitations that exist in current state regulatory jurisdictions for gas utilities to advance low-carbon gas resources at scale. The study explores potential policies that would enable gas utilities to introduce low-carbon gas resources like RNG and hydrogen into the distribution system, which rate design characteristics could meet the needs of the gas utility and its customers, and where, in Concentric's assessment, policy and regulatory practices have been most effective.

The results of our research and interviews from this nonpartisan study, which reviews policies that have enabled the introduction of low- carbon gas resources into the gas distribution system in regulatory jurisdictions in the U.S. and abroad. We have also looked to regulatory mechanisms in other U.S. and Canadian regulated industries that are intended to encourage investment in and procurement of low-carbon resources that could be replicated in the gas utility industry. The goal of the study is to assist with education and outreach to policymakers and other stakeholders on whether the existing regulatory framework can support the advancement of low-carbon gas resources or if modifications to the regulatory framework are needed. **Figure 3** below.

Study Approach

Figure 3: Steps to Preparing Study



Concentric's approach to the study is summarized above. The Concentric team performed detailed jurisdictional research to identify where low-carbon gas programs have been introduced and what challenges were encountered in implementing those programs. The research for this study was obtained from publicly available sources such as state commission and utility websites, private and public studies, and government agency reports and data.

Concentric conducted ten interviews with individuals from regulatory bodies and associations, utility representatives, and gas analysts/experts from the U.S. and Canada. Our interviewees included seven regulatory commissioners, of which four are state or provincial jurisdictional chairpersons. A copy of sample interview questions is provided in Appendix A.

Concentric has developed several case studies where regulatory pathways that have introduced low- or zero-carbon gas into the gas distribution system have been identified. Concentric has assessed the regulatory policies that have allowed low-carbon gas resources in accordance with the following considerations:

- Whether the policy creates or restricts opportunities for gas utility investment;
- Effects on end user costs for natural gas service;
- Implications for customer fuel choice;
- Reporting and regulatory burden on gas utilities and regulatory agencies;
- Speed at which the policy could be expected to operate to reduce greenhouse gas ("GHG") emissions;
- Extent to which the policy could be expected to operate to reduce GHG emissions;
- Any effects the policy may have on the utility's business model;
- Any limitations on when the policy may be effective (e.g., utility must also be decoupled, will work more effectively in a northern climate, etc.); and
- Any other potential implications from the perspective of the gas utility or regulators.

Organization of This Report

The remainder of this report is comprised of five primary sections. Section 2 provides relevant background to our study including the state of the gas distribution industry business model and regulatory framework and how it has been impacted by climate and emissions policies or goals; Section 3 details the identified barriers to introducing low-carbon gas resources as well as the enabling activities and mechanisms that could spur the deployment of low-carbon gases into the distribution system; Section 4 reviews policies that have enabled the electric industry to transition to low-carbon renewable resources and identifies where similar approaches could be used by the gas sector to advance low carbon gas resources; Section 5 provides illustrative case studies of regulatory pathways; and Section 6 provides conclusions of the study. In addition, Appendix A provides sample interview questions, Appendix B provides a brief description of low-carbon gaseous fuels, and Appendix C provides supporting jurisdictional research examples of activities that have addressed barriers.

Background

Gas Industry Business Model and Regulatory Framework

The U.S. gas industry business model has remained relatively consistent for many decades. U.S. natural gas distribution companies' costs of providing utility services typically include capital investments, operating expenses, administrative expenses, and gas costs. In return for providing utility service, utilities may charge rates that allow them the opportunity to recover their yearly cost of service, which includes a return on their invested capital. Capital investments are recovered over time, with the undepreciated net plant referred to as the utility "rate base" for ratemaking purposes, upon which the utility is allowed to earn a return. Utility expenses are reflected in the yearly cost of service and do not earn a return. The cost of the natural gas commodity is typically a pass-through, meaning the gas utility does not mark-up or earn a profit on the sale of the natural gas commodity. Instead, utilities generally are reimbursed for the costs of gas procured through a Purchased Gas Adjustment ("PGA") rate mechanism, where rates are approved periodically by state regulatory commissions. Gas utility rates are transitioning from a volumetric-based framework, where the more gas sold the greater the revenue, to a decoupled framework, where the link between volume and revenue is reduced. Approximately two-thirds of gas utilities today have some form of decoupling,[13] which lessens the utility's reliance on volumetric sales to recover its cost of service.

The gas utility business model is primarily focused on deploying and maintaining infrastructure that distributes gas supply to consumers. Gas utilities are generally required to plan, build, and maintain their respective systems to meet specific reliability standards, typically based on an indicative historic peak day over a period of 10 to 30 years.

Gas utilities are required to demonstrate prudence in securing gas supplies for their customers, oftentimes using a "least-cost planning" principle, which may be based exclusively on the financial cost to the customer of procuring gas supplies. For gas utilities looking to advance low-carbon gas resources, a "least-cost" regulatory framework for supply procurement may present a regulatory challenge on the basis of cost to the extent that low-carbon gas resources are more expensive than natural gas.

13 According to S&P Global Market Intelligence in the supporting tables to RRA Regulatory Focus, *Adjustment Clauses* (November 12, 2019), approximately 65% of gas utilities have a decoupling mechanism and approximately 27% of gas utilities have a "full decoupling" mechanism, which enables utilities to offset the effect on revenues of fluctuations in sales caused by customer participation in energy efficiency programs, deviations from "normal" temperature patterns, or economic conditions.

Policy Response to Climate Change

Though efforts to advance low-carbon resources have been underway in the U.S. for decades, the Intergovernmental Panel on Climate Change ("IPCC")[14] issued a 2018 *Special Report on Global Warming* that found that in order to keep global temperature rise below 1.5°C, we would have to reduce carbon dioxide emissions by approximately 45% from 2010 levels by 2030, reaching net-zero around 2050.[15] Efforts to reduce greenhouse gas emissions have accelerated since the release of the IPCC's 2018 report. The U.S. has made a formal commitment to achieve net-zero emissions by 2050.[16] As the U.S. continues to discuss possible solutions for addressing the impact of climate change, several states have set targets to reduce or eliminate carbon emissions by mid-century. According to the Clean Energy States Alliance, there are 21 states, as well as Puerto Rico and Washington D.C., for a total of 23 U.S. jurisdictions that are targeting net-zero at time frames ranging from between 2030 and 2070, with the vast majority of states targeting carbon neutrality by 2050.[17]

The conversation around the zero-carbon energy sector is also occurring globally. Other countries, particularly across Europe, have focused on eliminating carbon emissions. Thirteen countries around the globe have codified the national intent for net-zero emissions targets into law.[18]

Impact of Low-Carbon Mandates for Gas Utilities

Though natural gas is the cleanest burning fossil fuel, its production, processing, transportation, and use through combustion can result in greenhouse gas emissions. Historically, natural gas has supplanted more carbon-intensive fuels used in electric generation and thermal applications. The combination of lower emissions and attractive costs has led to greater reliance on combined-cycle gas in many Independent System Operator ("ISO") footprints. However, more recently, natural gas is increasingly targeted for elimination by electrification[19] proponents that advocate

14 The Intergovernmental Panel on Climate Change ("IPCC") is the U.S.'s foremost governmental authority on climate change. According to a recent report by the IPCC, Climate Change 2021, The Physical Science Basis (August 2021), at SPM-5. "each of the last four decades has been successively warmer than any decade that preceded it since 1850." And, in its analyses in its IPCC Special Report, Global warming of 1.5°C (2018), at 11, IPCC references two primary thresholds for global warming, 1.5°C increase and 2°C increase over pre-industrialized levels (1850-1900), reporting diminishing adaptability and increased severity of impacts for global temperature increases in excess of 1.5°C. According to the IPCC, climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming of 1.5°C and increase further with 2°C.

15 IPCC Special Report, Global warming of 1.5°C (2018), at 12,

16 Ferek, Katy S., December 8, 2021 "Biden Commits U.S. Government to Net-Zero Emissions by 2050", Wall Street Journal, https://www.wsj.com/articles/biden-signs-order-committing-u-s-to-net-zero-emissions-by-2050-11638994931

17 Clean Energy States Alliance, Table of 100% Clean Energy States at https://www.cesa.org/projects/100-clean-energy-collaborative/guide/table-of-100-clean-energy-states/

18 According to the Energy & Climate Intelligence Unit Net Zero Scorecard, the following countries have codified net-zero emissions targets into law: Germany (2045), Sweden (2045), Portugal (2045), Japan (2050), France (2050), United Kingdom (2050), South Korea (2050), Canada (2050), Spain (2050), Ireland (2050), Denmark (2050), Hungary (2050), and New Zealand (2050). https://eciu.net/netzerotracker

19 Environmental and Energy Study Institute (EESI) "Beneficial Electrification" https://www.eesi.org/electrification/be

for replacing direct fossil fuel use with renewable electricity and full electrification of homes and buildings.

Jurisdictions such as Washington and California have placed restrictions on gas use in buildings and made commitments to phase out natural gas for space heating altogether, while New York, Massachusetts, Vermont, and Colorado are in the process of adopting similar restrictions.

> "The better option may be to decarbonize natural gas." *[Regulator]*
>
> "[In my jurisdiction] they would need to more than double electric to get rid of gas." *[Regulator]*

Though full electrification promises significant emissions reductions, during our interviews - regulators questioned the prospects of full carbon-free electrification and expressed concern around the potential costs. One regulator referred to full electrification as "silliness" and added, "we are decades away."

Many affirmed that they expect the natural gas distribution system to have a role in serving future energy requirements. We heard from Énergir that the cost of satisfying gas peaking load during the winter with cheap and plentiful hydroelectricity in Quebec would be more expensive than what it would cost for the electric utility to offer a combined gas and electric service (retaining the gas utility as an alternative and peaking fuel source) and reimbursing the gas utility for a significant portion of its lost revenues. Though definitive cost estimates are situation dependent and largely unavailable, there are several studies to suggest that the costs of decarbonizing through full renewable electrification would be substantial if not staggering.[20] Even studies that analyze full electrification scenarios still retain some gas system use for processes that cannot be or are difficult to electrify and for peaking purposes.[21]

Given the cost and logistical challenges of full electrification, recent industry studies have advocated for an approach that combines the relative strength of the gas and electric systems. According to the 2022 AGA study Net-Zero Emissions Opportunities for Gas Utilities, "[p]athways that leverage decarbonization strategies across both the gas and electric system may have potential to better maintain low energy costs, improve system reliability, create opportunities for emerging technologies (such as power-to-gas and hydrogen) to support the needs of both systems, accelerate carbon reductions, and improve overall energy system resiliency. Planning for a net-zero future should not necessitate a choice between one energy system or another energy system (gas, electricity, or other forms). Leveraging the gas and electricity systems for their relative strengths should allow for a lower risk pathway to reducing emissions."[22] The gas sector can play an important role in economy-wide emissions reductions, and we are increasingly

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20 *See* for example, Washington Gas Light's Climate Business Plan, which compares the cumulative and annual cost impact of a policy-driven electrification scenario with a fuel neutral decarbonization scenario. https://sustainability.wglholdings.com/wp-content/uploads/Climate-Business-Plan-March-16-2020.pdf

21 https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/Carbon-Neutral-NYC.pdf; See also, See, Independent Consultant Report dated March 18, 2022 (Part 1: Decarbonization Pathways) in the Massachusetts Future of Gas proceeding MDPU 20-80, https://thefutureofgas.com/sep

22 ICF, AGA Study, Net-Zero Emissions Opportunities for Gas utilities, (February 2022) at 12.

seeing a combined gas and electric system approach to such reductions with compelling findings.[23]

How Gas Utilities Can Participate in Low Carbon Efforts

Gas distribution companies transport gas to end-use customer locations through vast interstate and local distribution systems. The methane transported has been refined at processing gathering plants to achieve "dry, commercial grade, or pipeline quality"[24] gas, which typically has a methane content of 98% or more.

Gas utility approaches for reducing emissions has four primary pillars: 1) expanded energy efficiency and demand side management, 2) introducing low-carbon and zero-carbon resources into the gas distribution system; 3) addressing methane emissions in the gas distribution system and upstream pipelines; and 4) the use of offsets and negative emissions technologies, such as carbon capture and sequestration, to counter carbon emissions. This study focuses on the second pillar, "introducing low-carbon and zero-carbon resources into the gas distribution system."

Introducing low- and zero- carbon resources into the distribution system could take several alternative paths, including developing and transporting RNG, capturing and sequestering carbon, blending hydrogen into gas supplies, responsible sourcing or developing dedicated hydrogen systems. Please refer to Appendix B for a detailed discussion of low-carbon gaseous fuels that may be deployed for use in the gas distribution system.

Overview of Low-Carbon Gas Activity in the Gas Distribution Sector

In the U.S., according to the AGA, there are currently 30-plus states that have begun promoting RNG in the residential or commercial sector through either legislative, regulatory, or utility-led action.[25] Concentric's research focused on 23 states with recent and significant regulatory activity (Alaska, Arkansas, California, Colorado, Connecticut, Florida, Hawaii, Illinois, Maine, Maryland, Minnesota, Missouri, Nevada, New Hampshire, New Jersey, New York, North Carolina, Oklahoma, Oregon, Pennsylvania, Utah, Vermont and Washington); 3 Canadian provinces (British Columbia, Ontario and Québec); and 3 jurisdictions abroad (Australia, New Zealand and the United Kingdom).

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23 See NYC Study ICF et al., Pathways to Carbon-Neutral NYC: Modernize, Reimagine, Reach (April 2021) which examined electrification and a hybrid gas approach and found "the remaining gas system can transition to deliver low-carbon gas (e.g., such as hydrogen or renewable natural gas) for end uses too costly and complex to fully electrify, helping mitigate increases in winter peak electricity demand." at v. See also E3 and Scott Madden Study, The Role of Gas Distribution Companies in Achieving the Commonwealth's Climate Goals, Technical Analysis of Decarbonization Pathways (March 18, 2022) at 11, which found "Strategies that use both the gas and electric systems to deliver low-carbon heat to a portion of the buildings in Massachusetts show lower levels of challenge across a range of evaluation criteria." See also, See Shreve, Dan and Schauer, Wade, Wood Mackenzie, Deep decarbonization requires deep pockets – trillions required to make the transition (June 2019), See Williams, J. H., Jones, R. A., Haley, B., Kwok, G., Hargreaves, J., Farbes, J., &Torn, M. S., Carbon-neutral pathways for the United States. AGU Advances (2021),

24 Natural gas explained - U.S. Energy Information Administration (EIA), https://www.eia.gov/energyexplained/natural-gas/

25 See https://www.aga.org/natural-gas/environment/innovating-today-for-a-more-resilient-future

Utilities and regulators will need to find the right balance between the cost of introducing low-carbon gas resources into the gas system and the potential customer rate impact. Furthermore, regulators expressed interest in the economic benefits of locally produced low-carbon fuels,[26] but many jurisdictions currently lack cost-effective local RNG or hydrogen options. Currently, the ability to purchase and trade environmental attributes of RNG or hydrogen is largely absent from the national energy landscape but is necessary to achieve scale. In this report, we have sought to identify the most relevant regulatory actions that could support a utility's ability to advance low-carbon resources on a commercial scale.

[26] Utilities like Vermont Gas Systems have added a locally sourced option to its RNG tariff available to customers to further support in-state bio-methane project development under its program.

Regulatory Barriers and Pathways to Advancing Low-Carbon Gas Resources into Gas Distribution Systems

This section identifies the primary regulatory barriers to introducing low-carbon gas resources in the gas distribution system and the enabling activities and mechanisms that have been tried to overcome those barriers. We discuss each of the enabling activities in the context of the barrier they most directly address with examples drawn from our research. Through our research, we have identified the following regulatory barriers to the sizeable advancement of low-carbon gas resources into the gas distribution system: 1) Ambiguous Authority; 2) Cost; 3) Environmental Concerns and Uncertainty; 4) Aligning Utility Incentives with Social Policy Objectives; 5) Cost Causation and Who Should Pay; and 6) Technical Considerations. The barriers are ranked in order of importance based upon the information gathered through our interviews. In Appendix C, we have added jurisdictional examples of enabling activities that jurisdictions have employed to address these barriers.

Ambiguous Authority

Perceived limits to regulatory authority can be a significant barrier, particularly in states with a clear "least-cost mandate" requiring regulators to deem the least-cost resource as the prudent resource acquisition deserving of rate recovery by the utility. Most states currently lack clear enabling legislative language. In such states, regulatory commissions perceive that they do not have clear authority to approve more expensive low-carbon fuels as part of the utility's mainstream procurement activities. That is not to say that regulators do not participate in the legislative process. Legislators often seek their opinions and knowledge in drafting new legislation. According to regulators interviewed for this study, it is not uncommon for regulators to participate in crafting new legislation or to advocate on behalf of certain pieces of legislation.

> In interviews conducted for our Study, regulators overwhelmingly cited the need for clear regulatory authority, and specifically legislative support, as one of the largest barriers to widespread development of low-carbon gas resources.

Even without an explicit least-cost mandate, regulators also struggle with their role in approving long-term utility investments are scrutinized in the context of introducing low-carbon gas resources into gas distribution systems. Regulators must make decisions today on gas utility investments that will impact customers for decades to come.

Lack of certainty, even when legislation exists, inhibits the ability of a regulator to promote alternative low- or zero-carbon fuels' economics and technologies.

Enabling Activities and Mechanisms

Explicit Legislative Guidance

We identified several instances in our research where gas utilities or renewable developers took the initiative to develop legislative guidance. In Minnesota, CenterPoint led the initiative that culminated in the passage of the Natural Gas Innovation Act.[27] Similarly, in Oregon, Northwest Natural Gas ("NW Natural") was instrumental in the development and passage of Senate Bill 98 in 2019 that enabled procurement of RNG and investments in RNG infrastructure.[28] SoCal Gas was instrumental in passing the country's first renewable gas standard in California's SB 1440, which enabled the CPUC to set biomethane procurement targets for utilities in February of 2022.[29] Further, in the U.K. we find an example where legislation is crafted in coordination with Ofgem, the utility regulator, which is both flexible and responsive to the uncertainties surrounding the future of the gas system but at the same time offers legislative clarity to regulators and gas utilities. More detailed discussion of these examples may be found in Appendix C.

Climate Goals and Targets

Articulated policies such as emissions reduction targets and goals provide clear guidance to regulators and eliminate some of the uncertainties in the regulatory process. Established targets provide direction for utility regulators to approve utility procurement requests. However, these targets must be considered in the context of traditional regulatory practice where the public interest continues to be served by ensuring safe, reliable, and affordable utility service, and the consumer can be assured that whatever resource is employed will represent the "highest and best use" of that resource for the designated purpose.

In Oregon, SB 98 encouraged the development and investment in renewable natural gas resources to support a smooth transition to a low-carbon economy by allowing large utilities cost recovery for the progressive procurement of RNG within targets that ratcheted upwards from 5% in 2019 to 30% in 2045. The legislation also ensured cost recovery to the utility for the qualified investment in the production of renewable natural gas, including a return on investment. Annual RNG procurements were capped at 5% of the natural gas utility's revenue requirement. For more information, please refer to Appendix C.

Gas Renewable Portfolio Standards

The electric sector has widely employed RPS programs for advancing the proliferation of renewable energy to scale. There are a small number of cases where gas RPS have been proposed and become policy. Because RPS establish mandatory requirements to hold a minimum percentage of eligible renewable resources in the energy portfolio, it removes ambiguity with respect to regulatory authority or the environmental benefits of the underlying resource. Mandatory programs are often accompanied by the ability to trade the environmental benefits with RECs. The mandated program target(s) directly incentivizes adding low carbon gases into the traditional gas supply. Through our research, we have identified one jurisdiction that has introduced a renewable gas RPS, California, and Oregon (discussed above) has established renewable gas targets. A

[27] 216B.2427 Natural Gas Utility Innovation Plans, https://www.revisor.mn.gov/statutes/cite/216B.2427

[28] SB 896: Renewable Energy, https://olis.oregonlegislature.gov/liz/2019R1/Downloads/MeasureDocument/SB98/Enrolled

[29] SB-1440 Energy: biomethane: biomethane procurement. (2017-2018), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB1440; See also, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M454/K335/454335009.PDF

renewable gas RPS was proposed in Hawaii but was stalled due to COVID and has not been enacted. Please see Appendix C for more detailed information on these jurisdictions.

Regulatory Authority to Consider Environmental Impacts in Regulatory Decisions

There are several states where environmental considerations must be factored into regulatory decisions on prudent utility investment, allowing regulators some leeway to make other than "least-cost" decisions. According to a recent National Association of Regulatory Utility Commissioners ("NARUC") paper, twelve regulatory jurisdictions have included environment/climate goals in their mission statements. A commission's mission statement is a non-legally binding statement that documents its perception of its role in serving the public interest and the primary considerations for its decision-making. Most commissions indicate their duty to ensure just and reasonable rates and adequate, affordable, reliable, and safe utility service. However, the following states have indicated that environment/climate goals are important considerations for their decision making: Colorado, District of Columbia, Hawaii, Indiana, Iowa, Maryland, New Jersey, New York, North Carolina, Oklahoma, Pennsylvania, and Wisconsin.[30]

As an example of broad regulatory authority conferred by statute, the Maryland Public Service Commission's authority is designated in the following excerpt from the Maryland Code:

> *The Commission shall consider the public safety, the economy of the State, the* conservation of natural resources, and the preservation of environmental quality.[31]

Similarly, the Vermont state legislature has granted broad authority to the Vermont Public Utility Commission:

> *To ensure to the greatest extent practicable that Vermont can meet its energy service needs in a* manner that is adequate, reliable, secure, and sustainable; that ensures affordability and encourages *the State's economic vitality, the efficient use of energy resources, and cost-effective demand-side management; and that is environmentally sound*.[32]

Even as public utility commissions prioritize a long-term sustainable energy future, without explicit legislation and guidance, most public utility commissions are reticent to overstep their authority or potentially become subject to legal challenges seeking to overturn their decisions. As the NARUC paper states, "[t]he majority of PUC statutes instruct the PUC to act as an economic regulator and uphold the public interest. Beyond the common foundation, there is substantial diversity in the authority granted to each PUC by statute and how the PUC interprets its authority to act in the public interest."[33] Acts that confer

30 K. Zitelman and J. McAdams, NARUC, The Role of State Utility Regulators in a Just and Reasonable Energy Transition, Examining Regulatory Approaches to the Economic Impacts of Coal Retirements (September 2021) at 13-14. [NARUC 2021]

31 Md. Code, Pub. Util. § 2-113, as cited in "NARUC 2021"

32 Vt. Stat. Ann. tit. 30 § 218c, as cited in "NARUC 2021"

33 Id., at 5.

broad and loosely defined regulatory authority will be subject to each regulator's interpretation. Although some regulatory commissions may interpret their role as having the authority to make decisions based on environmental and climate impacts, absent specific a statutory or judicial requirement to act, they are not likely to stray far from their incontrovertible role of focusing on the rate impacts on current customers.

Cost

One of the most significant barriers to introducing low-carbon gas resources into gas distribution systems is the economic cost of procuring low-carbon gas resources versus natural gas. As indicated above, many states regulate gas procurements through a least-cost mandate. This policy requires gas utilities to procure the least-cost resources, ensuring that customers pay as little as possible for gas procurement. In jurisdictions where no official least-cost mandates exist, gas distribution companies still have to justify why investments or procurements are just and reasonable.

Natural gas exploration, production and gathering methods are efficient, with new technologies and operational scale having resulted in prices averaging under $4 MMBtu in recent years.[34] RNG production, however, is still a relatively nascent industry. A 2019 ICF study for the American Gas Foundation estimated that by 2040, a majority of the RNG resource potential could be produced at between $7-$20 per MMBtu.[35] Factoring in recent increases, the price of conventional natural gas exceeds RNG at the lower end of this range, but RNG supplies may still be priced at a premium over conventional sources today.

Producing green hydrogen from electrolysis is estimated to cost approximately $28 MMBtu, based on an electricity cost of 5 cents/kWh. The cost of gray hydrogen is $12 MMBtu if the cost of natural gas is $4 MMBtu.[36] The cost of dedicated hydrogen systems is still in the feasibility stage, as new systems may require substantial upgrades to safely distribute hydrogen gas, as well as the required retrofitting of consumer appliances. However, studies have shown that hydrogen may be blended at between 5 to 20 percent[37] with natural gas or RNG with little system disruption.

The wide range of RNG and hydrogen pricing hinges on the costs of feedstocks, upgrading gas equipment, operations, the initial investment in dedicated facilities, financing, and the expected throughput of the facilities. The price differential between natural gas and low- or zero-carbon gases makes it nearly impossible for utilities to promote low-carbon gas resources in jurisdictions where regulators are bound by a least-cost mandate that focuses exclusively on economic cost and challenging in jurisdictions where no such mandate exists. As RNG and Hydrogen achieve commercial scale, we expect the low-carbon resource costs to decline and become more competitive with natural gas.

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34 https://tradingeconomics.com/commodity/natural-gas

35 ICF, an American Gas Foundation Study, Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment, calculated by adding the low resource potential scenario of 1,660 trillion Btu (tBtu) of RNG and the high resource potential scenario including the potential for non-biogenic fraction of MSW of 4,510 tBtu, divided by the estimated technical resource potential of 13,960 tBtu.

36 http://www.fsec.ucf.edu/en/consumer/hydrogen/basics/production.htm

37 HyDeploy, Demonstrating non-disruptive carbon savings through hydrogen blending (August 2021) at 6.

Regulators will also factor the benefits of a given resource in conjunction with cost into its overall value assessment. Such benefits might include economic development, fuel diversity, contributing towards policy goals, enhancing fuel choice, among others. Benefits are not easily quantified but are afforded weight in regulatory resource decisions.

Enabling Activities and Mechanisms

Relaxing the Least-Cost Mandate

Through our research we have identified several examples of regulatory bodies that are not required to make "least cost" regulatory decisions. Most often, this flexibility is supported by clear legislation. For example, legislation in California has mandated RNG acquisition and supply in SB 1440.[38] In Florida, SB 896, specifically relaxed the least-cost mandate for RNG procurement, allowing cost recovery for RNG purchases that exceed natural gas prices but otherwise was deemed prudent[39] by the Commission.[40] Similarly, Oregon legislation SB 98 provided for recovery of prudently incurred costs in meeting the requirements of the RNG legislation. Prudence is an objective test, which in this case, would require the utility applicant to demonstrate that its procurement of RNG, irrespective of cost, displays the same level of care and skill as one would expect it to take in the conduct of its own affairs that were known or knowable at the time, i.e., that which a typical person with ordinary prudence and intelligence would undertake.

> [There needs to be] a transparent and rising price on carbon – and then the regulator can go about decision making using its traditional tools – how costs would be factored in. Absent that, utilities can put forward another rationale, i.e., probability of the price on carbon. Utilities are well served by coming at it from the perspective of the regulator and what they will be concerned with. How is risk distributed? [Regulator]

Importantly, in Minnesota, we see that the economic analysis the Commission is asked by legislation to perform is a comparison of the low-carbon resource "compared to other innovative resources that could be deployed to reduce or avoid the same greenhouse gas emissions targeted for reduction by the utility's proposed innovative resource" and not to

38 SB-1440 Energy: biomethane: biomethane procurement. (2017-2018) https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB1440.

39 The regulatory standard of "reasonable and prudent" would generally involve consideration of what level of care a typical person with ordinary prudence would undertake in the same situation. The concept of prudence in public utility law is a regulatory oversight standard that attempts to serve as a legal basis for judging whether utilities meet their public interest obligations. The test infers a fiduciary responsibility of care to manage affairs with a level of skill and care as a person of ordinary prudence and intelligence would use in managing his or her own affairs or investments. In Duquesne Light Company et al. vs. David M. Barasch et al., prudent investment was defined as "capital reasonably expended to meet the utility's legal obligation to assure adequate service." There is also a proscription against hindsight, such that a determination on the reasonableness of a utility decision, must be based on what was known or could have been known at the time the decision was made.

40 https://flsenate.gov/Session/Bill/2021/896/BillText/er/HTML

the cost of gas.[41] This type of analysis takes into account the carbon intensity of the particular resource when making cost comparisons.

The above examples (further detailed in Appendix C) provide important assurance of cost recovery to the utility so that they can procure low-carbon fuels that are currently more expensive than natural gas.

Carbon Pricing

Carbon pricing seeks to internalize the environmental, economic, and social costs of carbon emissions. Carbon pricing places a charge on the quantity of greenhouse gas emissions, effectively raising the price of carbon-emitting fuel products relative to alternative forms of energy. Carbon pricing assigns a cost to greenhouse gas emissions, lessening or eliminating the cost differential between carbon-emitting and zero-carbon resources, particularly as technologies advance and low- or zero-carbon gas supplies reach commercial scale. Currently, carbon pricing is employed in Canada and the U.K and regions of the United States. In British Columbia, residential gas customers receive a charge for the carbon tax on their invoices of 2.3053 per gigajoule, which translates to approximately $2.4524 per MMBtu. The U.K. carbon pricing scheme does not extend to the gas distribution sector. The U.S. does not currently have federal carbon pricing, but programs have been implemented through regional cooperation (e.g., the Regional Greenhouse Gas Initiative in the eastern United States).

A price on carbon has been used to close the gap between the cost of carbon-emitting and low-carbon resources. This construct could be extended to include the gas distribution sector to aid in the assessment of just and reasonable low-carbon gas costs. Absent a price on carbon, the cost effectiveness of low-carbon fuels can be determined through comparisons to alternative ow-carbon resources with the same or similar emissions reduction benefits, as described in the Minnesota case study in Section 5.

Environmental Concerns and Uncertainty

A few jurisdictions have called into question the long-term role of natural gas or gas utility infrastructure, given local objectives or mandates to reduce greenhouse gas emissions. For example, the State of Massachusetts Office of the Attorney General ("AGO") filed a petition with the Massachusetts Department of Public Utilities ("MDPU") to initiate an investigation to assess the future of LDC operations and planning in light of the Commonwealth's legally binding statewide limit of net-zero greenhouse gas emissions by 2050.[42] In its Petition, the AGO states:

> *The Department has both the authority and expertise to initiate this urgent public discussion by promptly opening an investigation that will (1) examine the gas distribution industry, regulatory, and policy changes needed to support the*

[41] 216B.2427 Natural Gas Utility Innovation Plans. Subd. 2(a)(6)

[42] Commonwealth of Massachusetts Department of Public Utilities, "Petition of the Office of the Attorney General, pursuant to G.L. c. 12, §§ 11E, 10; and its common law authority to act in the public interest, Requesting an Investigation, pursuant to the Department of Public Utilities' authority under G.L c. 164, §§ 76, 105A into the impact on the continuing business operations of local gas distribution companies as the Commonwealth achieves its target 2050 climate goals", D.P.U. 20-80, AGO Petition dated June 6, 2020, p. 3.

> *achievement of the Commonwealth's mandated GHG emission limits; and (2) determine what near- and long-term adjustments are necessary to maintain a safe and reliable gas distribution system and protect consumer interests as the Commonwealth transitions from fossil fuels to a clean, increasingly electrified, and decarbonized energy future by 2050.*

The MDPU responded to the AGO's petition by directing LDCs under their jurisdiction to review additional pathways not examined in the Executive Office of Energy and Environmental Affairs' 2050 Decarbonization Roadmaps, and to perform a detailed study that analyzes the feasibility of all pathways.[43] The Independent Consultant report found that ***"coordinated gas and electric decarbonization strategy, utilizing a diverse set of technologies and strategies, is likely to be better able to manage the costs and feasibility risks of decarbonization than scenarios that rely more heavily on single technologies or strategies."*** The Report evaluated a number of pathways including energy efficiency, hybrid electrification, biomethane, renewable hydrogen, renewable electricity, networked geothermal, and targeted electrification.[44] This Massachusetts example is evidence of the uncertainty some regulators may have around the long-term viability of gas distribution systems in certain U.S. jurisdictions.

In another example, consultants for the Attorney General of Rhode Island, in recommending that the State of Rhode Island Division of Public Utilities and Carriers condition the sale of Narragansett Electric (the largest electric and gas LDC in Rhode Island) by limiting capital expenditures for LDC gas mains to public safety projects or for projects already under construction, summarized the "going concern" issue as follows:

> *[L]egal and societal pressures are building to substantially reduce fossil fuel consumption. Moreover, policymakers are becoming increasingly concerned about methane emission in both gas production and distribution activities. In addition, the costs associated with replacing obsolescent natural gas distribution systems have increased substantially over the past decade, as many distribution utilities have accelerated their system replacement efforts. Finally, electric alternatives to natural gas heating (e.g., "mini-splits") are becoming more efficient and cost competitive. The economic risks to gas distribution service are both environmental and economic. Having a monopoly on natural gas distribution service does not insulate the utility from competition with alternative energy sources. In that context, it is not clear that natural gas distribution systems serving residential and smaller commercial customers have a long-term future.*[45]

It is against this backdrop of uncertainty that regulators in some U.S. jurisdictions must make decisions on long-term investments to introduce low-carbon gas into natural gas distribution systems. In this context, without the benefit of clear legislative guidance, regulators in these jurisdictions must wrestle with significant cost implications for the utility, customers, or both, depending on the path taken to achieve a net-zero or carbon-neutral environment.

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43 See, September 1, 2021, LDC update in Docket D.P.U. 20-80.

44 Independent Consultant Report dated March 18, 2022 (Part 1: Decarbonization Pathways, p. 15 in the Massachusetts Future of Gas proceeding MDPU 20-80, https://thefutureofgas.com/sep

45 Direct Testimony and Exhibits of Mark Ewen and Robert Knecht, Docket No. 21-09, November 8, 2021, at 23.

Enabling Activities and Mechanisms

Education and Outreach

Regulators and customers will need to be educated on the benefits of acquiring low-carbon resources (e.g., RNG and hydrogen). Gas utilities have an important role in educating their legislators, regulators, and the public on how low-carbon gas resources can contribute to meet economy-wide emission reduction goals (i.e., participating in the drafting of legislation, proposing regulatory programs, public education, etc.). Regulators that we interviewed expressed their perceptions that gas companies lack in these education and outreach efforts.

> "Utility education should focus on demystifying some of it – hydrogen and natural gas – getting regulators comfortable with the concept – make sure that people understand it has a positive role to play in addressing climate change. Utilities have a big role in that. When they come forward [with a proposal], they need to have an idea of how it should work. They need to be in on the conversation – they need to participate in the drafting of the bill and legislation – not just whether to vote on it. There is a need for more advocacy on gas business. Apart from pipeline replacement, there hasn't really been a change in how to handle business. – they need to be a bigger part of the conversation." *[Regulator]*

There are several examples from our research where the utility was driving the effort to introduce legislation to provide for low-carbon fuel resources in gas distribution systems. In Minnesota, CenterPoint worked to find common ground with stakeholders that had opposed its previous RNG initiatives which resulted in a coordinated effort and alliance with previous opponents to enact legislation. In Oregon, NW Natural Gas was the main proponent behind the passing of SB 98. The bill passed unanimously with bipartisan support with one side seeing it as an economic stimulus bill while the other side viewed the bill as an environmental protection bill. In Oregon, NW Natural has built up significant goodwill and has a high level of credibility and the bill passed with very little pushback. More recently, in California, SoCal Gas, with the support of labor organizations, was instrumental in passing SB 1440 to address short-lived climate pollutants ("SLCP") by diverting organic and dairy emissions to RNG production and mandatory gas portfolio standards.

On the topic of outreach, we heard from several regulators that the gas industry could benefit by expanding and enhancing its education and outreach efforts on the gas utility approaches to reducing emissions of the sector. Specifically, the important benefits of RNG and the potential for Hydrogen in gas distribution systems should be increasingly highlighted. The majority of regulators we interviewed expressed similar sentiments on the need for LDCs in their jurisdictions to engage in more education and outreach on these potential alternatives.

Aligning Utility Incentives with Policy Objectives

Utilities are subject to complex regulation when meeting their public service obligations or investing capital. Commissions review utility capital expenditures for prudency, which typically involves demonstrating a justifiable need for an activity, i.e., that it is in the public interest and that the utility manager acted reasonably in carrying out such activity. Utility managers must also balance the interests of their customers and the associated trade-offs, such as reliability, quality of service and cost. While this standard can be effective in discouraging the gold-plating of utility infrastructure at a high cost to consumers, it also tends to constrain creative approaches to advancing new and emerging technologies.

Performance-based regulation ("PBR"), or incentive regulation, applies a targeted approach to achieving desired outcomes. PBR is used in several US states to reward or penalize public utilities for performance in meeting specific operational performance targets, customer service metrics, reliability standards, demand reduction targets, or carbon reduction goals. PBR regulatory frameworks vary by jurisdiction, with some utility commissions examining a move away from traditional cost-of-service regulation in favor of the performance-based model. However, utility commissions have long used performance incentives within the traditional cost-of-service regulation framework for administering energy efficiency programs in the gas and electric utility sectors. Through either approach (cost-of-service or PBR), gas utilities can be incentivized to develop aggressive energy efficiency programs, implement waste reduction measures, leverage new and emerging technologies, and introduce renewable natural gas, certified gas, and green hydrogen into their supply mix.

Supportive regulatory frameworks are critical to enabling the innovation necessary to introduce lower-carbon gas resources into the gas sector. Much of the necessary supportive regulatory mechanisms already exist for traditional utility rate setting for natural gas systems and could be repurposed to provide for the integration of low-cost carbon resources with very little disruption to the existing regulatory framework. Such frameworks might include rate base treatment for investment and incentives that could be provided through a variety of mechanisms. Facilitating effective marketplaces for low-carbon fuels and their renewable attributes could drive down costs through competition and spur additional investment.

Enabling Activities and Mechanisms

Rate Base Investment

Allowing utilities to capitalize long-term investments in low- or zero-carbon projects and infrastructure in rate base provides an important incentive for utility investment. Capitalizing costs in rate base typically provides long-term certainty of cost recovery through depreciation expense and an ongoing return on net invested capital at the authorized rate for each year the investment is in service. The utility also recovers the associated ongoing operating and maintenance expenses ("O&M") as they are incurred for projects that have been capitalized in rate base.

The capitalization of interconnection costs could help spur development enabling the sale of low-carbon fuel products to end-use customers. Absent the ability to capitalize interconnection costs, utilities may ascribe these costs to the interconnecting producer, which could impact the economics and viability of the project from a development standpoint. Accordingly, producers/developers may need to consider in any supply arrangements not only the costs for the production of supply and processing facilities but also the interconnection facilities when considering a project. Utility interconnection expenses could render a project uneconomic. Some jurisdictions have policies in place to allow for recovery of as well as a return on these investments.

Currently, Ohio, Oregon and Minnesota and other states have allowed utilities to capitalize facilities and interconnections related to RNG in rate base and the utility may earn a return on this investment. More detail on these jurisdictional policies may be found in Appendix C. Rate base treatment has been granted for utility investments in biogas production projects, pipeline replacements, and for infrastructure investments needed to interconnect low-carbon resources into the gas system.

Pilot Programs

Pilot programs are a necessary tool for utilities to assess the readiness of their systems and customers to accept low-carbon gas resources. It is common for utilities to receive cost recovery to engage in capital-intensive research and development. Pilot programs are an important preliminary step towards advancing low-carbon gas resources in gas systems. While Pilot Programs are important for developing new, innovative resources and development models, pilot projects do not in themselves achieve scale because they tend to be limited in nature. They may, however, provide proof of concept for a scalable business model that could give policymakers and regulators the assurance of viability that they require to move forward with expanded programs. Detailed examples of rate frameworks that allow cost recovery for utility pilot programs are found in Appendix C.

Innovation Funding Programs

In recognition of the challenges regulation may have on encouraging innovation, policymakers worldwide have adopted innovation frameworks or regulatory sandboxes to support investments in emerging energy technologies. These programs help to assess the value proposition of an emerging technology that are typically in the proof of concept or demonstration phases. Regulatory sandboxes, can provide an arena for goods, process and service innovations and business models, based on interventions in regulatory frameworks. The need for regulatory sandboxes is often related to solutions which were not thought of or were not necessary before, but which are related to new challenges for the energy system. The main innovation goals addressed with a sandbox program are new products, new services, platform solutions, new tariff models and new business models. These innovation initiatives can then be scaled if they are demonstrated to be useful and cost-beneficial in meeting the stated program objectives.

States such as Vermont and Minnesota have regulatory sandboxes that support new technology development. The U.K. and British Columbia have also approved significant innovation funding to further low-carbon gas systems.[46] Further, some venture capital firms are offering innovation funding programs, such as the Natural Gas Innovation Fund in Canada. This program offers grant and equity financing for environmental startups and other challenges facing the natural gas sector.[47] Specific examples of utility innovation funds are identified In Appendix C.

Incentives

Electric and gas utilities are highly responsive to financial and reputational incentives for aligning outcomes with social objectives. The U.S. regulatory framework has employed the use of various types of incentives to expedite social outcomes. For example, the U.S. energy regulator, FERC, has employed incentives for the development of critical electric transmission and technological transmission enhancements in the way of an ROE adder in certain FERC transmission proceedings since 2005. Further, utility commissions have long incorporated incentives for conservation and energy efficiency programs into the traditional cost-of-service framework. Incentive regulation is gaining momentum in the U.S., but the U.K. regulatory framework (RIIO) is built on incentivizing the achievement of targeted outputs. Those targeted output metrics may be tied to any measurable outcome, e.g., heat pump conversions, emissions reductions, customer satisfaction, etc. Appendix C includes an example of output incentives in the U.K.

Purchased Gas Adjustment (“PGA”) Mechanisms

PGA mechanisms have historically allowed LDCs to minimize the risk of gas cost commodity recovery by allowing the utility to pass through its gas costs to customers on an interim basis, i.e., between rate cases. PGA mechanisms have been, and continue to be, the predominant regulatory treatment for gas procurement. Regulatory authority to include RNG purchases as “mainstream” purchases and recovery through the PGA will help enable higher volumes of RNG purchases, which will help to drive future prices downward. States such as Oregon, Vermont, and California have begun to allow RNG purchased gas to be recovered in its PGA.

Decoupling or Lost Revenue Adjustment Mechanisms (“LRAM”)

Robust participation and funding of electric and gas conservation and load management programs provide a cost-effective means of cost-effective means of reducing energy emissions. The implementation of revenue decoupling for both gas and electric utilities has effectively removed the disincentive for utilities to promote conservation.

Decoupling mechanisms or LRAMs are regulatory rate mechanisms that compensate the utility for lost revenues between base rate cases. A decoupling mechanism allows the utility to offset the effect on revenues of fluctuations in sales caused by customer

46 https://www.ofgem.gov.uk/sites/default/files/docs/2019/02/riio-2_innovation_workshop_slides_-_5_february_2019.pdf; See also, https://www.nrcan.gc.ca/science-and-data/funding-partnerships/funding-opportunities/current-investments/21146

47 https://www.ngif.ca/

participation in energy efficiency or due to deviations from normal temperature patterns. An LRAM is typically used in conjunction with energy conservation and demand-side management programs, where the utility is compensated for the "lost" units of gas that would have otherwise been sold absent the conservation program. LRAM can take on a few different forms, ranging from a simple LRAM calculated based on utility distribution unit margins and avoided gas sales, up to "full" decoupling, which completely severs the relationship between a utility's unit sales and revenues.

These types of mechanisms are prevalent in the gas distribution industry and the majority of gas utilities have either a full decoupling mechanism or a partial decoupling mechanism (which could also be referred to as an LRAM).[48] Gas utilities have been experiencing declining use per customer for decades related to technological advances in producing more energy efficient furnaces and water heaters, as well as due to conservation efforts that have been underway for some time. They can be considered keep-whole mechanisms for loss of revenues caused by factors identified in the specific mechanism. Accordingly, revenues earned in excess of what the mechanism would allow are returned to customers and deficiencies are recovered from customers.

Procurement Strategies

A policy approach that seeks to procure the least-cost resources through a competitive process can significantly reduce the costs of low carbon gas supplies. Utilities have used power and/or gas purchase agreements to meet renewable energy targets in a cost-effective and reliable manner. Long-term purchase agreements help to provide a steady, predictable revenue stream to developers of clean energy suppliers[49], which decreases risk and drives down the projected costs of adding new sources of supply. Delivery requirements and other terms can be specified up front in a long-term contract, helping to provide buyers assurance regarding the availability of such supplies and the price terms.

Competitive long-term contracting with the ability to trade environmental attributes through renewable energy certificates ("RECs") or similar market constructs has been a successful model in the electric industry for enabling the development of large-scale wind and solar projects needed to meet forecasted RPS requirements. This strategy has also enabled development of many RNG projects to date, principally through off-take agreements with end users that are seeking the renewable attributes to offset GHG emissions or meet renewable energy goals. Specific examples of procurement strategies we identified in our research can be found in Appendix C.

Natural gas is a product that can be verified to show environmental responsibility across the value chain, from wells to processing facilities, to transmission and distribution systems to industry and consumers. Responsibly sourced gas (or certified natural gas) is

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48 According to S&P Global Market Intelligence in the supporting tables to RRA Regulatory Focus, Adjustment Clauses (November 12, 2019), approximately 65% of gas utilities have a decoupling mechanism and approximately 27% of gas utilities have a "full decoupling" mechanism, which enables utilities to offset the effect on revenues of fluctuations in sales caused by customer participation in energy efficiency programs, deviations from "normal" temperature patterns, or economic conditions.

49 Because of the long-term nature of energy purchase agreements relative to standard energy procurement practices, utilities typically require a regulatory approval at the time of entering into such agreements.

conventional gas that an independent third party has verified as meeting specified standards and practices to minimize the environmental footprint.[50] Policies which require gas utilities to replace all or a portion of its conventional gas supply with responsibility sourced gas could provide substantial upstream methane emissions savings.

Development of Long-term Integrated Resource Plan ("IRP")

Long-term IRPs provide visibility to the regulator as to a given utility's assessment of future resource requirements, policy goals, physical and operational constraints, and the utility's plan to meet those future needs. The Plan is integrated as it also factors in customer-side resources such as energy efficiency and conservation into the assessment. IRPs have been employed by electric utilities for decades, but generally have not been standard practice for gas distribution utilities. However, now that gas utilities are targeting RNG goals as well as carbon reduction goals it is becoming increasingly useful for gas utilities to use long-term IRPs to chart their course and gain necessary regulatory feedback.

Further, there are indications that we may be entering an era of jointly filed IRPs by combined gas and electric utilities such that each resource can be used for its "highest and best use." A coordinated IRP in the midst of increasing electrification will help to eliminate overlapping plans by both the gas and electric utility to serve the same customer loads. And the joint IRP will provide a plan that assumes customers will be served with the energy product that best addresses the need and is most beneficial for the customer at the time, based on the availability of resources.

Utilities and regulators are increasingly focused on energy system resilience and assessing the climate risks such as extreme temperature variability or increased damage from storms or wildfires, cybersecurity threats and an evolving electric grid and gas system.[51] In capacity constrained areas such as New England, localized sources of RNG or hydrogen can provide important resilience benefits across multiple sectors. Through careful and coordinated planning across sectors, utilities can assess dependencies and optimize planning.

Examples of Gas IRPs identified through our research are included in Appendix C.

Voluntary Green Tariffs (VGT)

VGT offerings are another way utilities can connect sellers of low-carbon gas products to customers. VGT programs allow households and businesses to purchase RNG (or other renewable resource) attributes from utilities at a price premium. Customers who opt into such a program receive an adder or surcharge on their bills. The utility offering the program will then purchase the clean energy attributes from a seller on the participating customers' behalf.

Utilities in many U.S. jurisdictions have approved voluntary green tariffs for RNG, including Vermont (Vermont Gas System), Maine (Summit Natural Gas), Michigan (DTE Energy), California (Southern California Gas Company and San Diego Gas & Electric Company),

50 https://www.williams.com/energy-insights/what-is-responsibly-sourced-gas/

51 Guidehouse, AGF Study, Building a Resilient Energy Future: How the Gas System Contributes to US Energy System Resilience (January 2021) at p. 5-6.

Illinois (Nicor), Oregon, Washington (Puget Sound Energy and Avista Corporation), and Utah (Dominion Energy). Additional utilities are in the process of seeking approval of new programs, including Liberty in New Hampshire and Dominion Energy in North Carolina. Missouri (House Bill "HB" 734) and Washington (HB 1257) have passed requirements mandating their state commissions to adopt rules for gas companies to offer voluntary RNG programs.

While program specifics vary by utility, voluntary RNG tariffs typically allow for a customer to elect to offset a fixed portion (10, 25, 50 or 100%) of their monthly usage with RNG renewable attributes at the tariff price. Some green tariff programs, such as those in Vermont, provide an option to purchase locally sourced RNG. Detailed examples of green tariffs identified through our research are included in Appendix C.

Cost Causation and Who Should Pay

Policymakers must also consider the question of who should pay for lower carbon energy as there is a clear societal benefit that extends beyond that realized by the gas customer alone. Traditionally, the principle of "cost causation" is applied to shape utility ratemaking.[52] In its simplest terms, "cost causation" analysis assigns the revenue requirements of the utility based on the class of customers that cause that cost to be incurred. In the case of the cost of emission reductions, allocating the full costs to just LDC customers may at first seem logical based on the cost causation premise that gas customers used the fuel that caused GHG emissions, but can appear myopic when realizing that the "causation" happened over generations of people using many different carbon-emitting fuels. Further, whether the cost is transferred to customers through a volumetric charge or on a per meter basis, will also be an important question to consider. The former could disproportionately impact large consumers, while the latter could be construed as disproportionately impacting small consumers. Cost causation principles could also logically suggest that the cost should be spread to those who receive the benefit, namely all citizens. Policymakers and regulators must also be careful to craft policies that do not disproportionately impact low-income and vulnerable populations. Policy makers will be focusing on cost allocation policies that strike the right balance between utility customers, a broad consumer base and/or taxpayers.

Enabling Activities and Mechanisms

Utility Rates and Rate Riders

Utility rates and riders are common cost recovery mechanisms for utility investment. These initiatives or costs are funded by customers and are derived from fundamental cost allocation and equity considerations to minimize subsidization from one rate class to another or one generation of customers to another. Certain service classifications will have specific Utility cost recovery can take many forms for charges that ultimately end up in utility rates. In a typical cost of service ratemaking framework, utilities recover their cost of service through the basic utility rate. Further, there are many notable instances, where a program cost is passed on to customers through a special rider or charge on the utility bill. Riders are often specific to the initiatives that they fund and may be used to pass on

52 Bonbright, James C. (1961). Principles of Public Utility Rates, New York: Columbia University Press.

charges to customers to provide funding for clean energy initiatives under a clean energy rider. Riders are often used for conservation programs, such as energy efficiency, gas utility infrastructure costs, and other economic development or policy initiatives that are separate from rates and are equally applicable to all customers. These types of funding form the basis of utility rates, where a utility's programs are funded by its customers.

Public Private Partnerships

Utilities may look outside utility rates as a means to develop projects. This practice of securing funding outside of utility rates is prevalent in the UK where companies are incented to partner with other entities to access available forms of grant for other private funding. Public private partnerships promote collaboration around technologies, pilots, and programs to quickly fund and develop gas technologies and programs. There are many instances in the U.S. where significant initiatives were funded through collaboratives for energy technologies and infrastructure.

Business Alliances

Business alliances involve cooperation among entities for the purpose of achieving common business objectives, sharing risk, and providing opportunities for synergies and complementary services. The ability to pool resources and expertise with other partners also enhances innovation development. Utilities are increasingly forming joint ventures with other firms, or working with universities, technical laboratories, and industry/trade associations to develop and bring forward innovative marketplace solutions to energy and climate challenges. Capital investment firms are supporting a new generation of companies focused on the development of low-carbon gas resources.[53]

Industry/Trade Associations play an important role in promoting innovation by providing funding support and by connecting gas utilities to the emerging technology start-ups that utilities typically don't have good visibility on. The American Gas Association (AGA)[54] and GTI Energy[55] offer financial outreach and supports Research & Development ("R&D") in key areas such as natural gas infrastructure, operations, end-use technologies, security issues and low-carbon gas resource development.

The Natural Gas Innovation Fund[56] ("NGIF") is an industry-led, industry-funded, granting organization launched by the Canadian Gas Association ("CGA"), formed to accelerate cleantech innovation in the production, pipeline transmission, and end-use of natural gas. NGIF Industry Grants has strong connections to every part of the gas value chain, offering startups a means to test and develop clean technologies through field trials and pilots.

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53 See for example: SJI Renewable Energy Ventures and REV LNG, LLC, https://www.sjindustries.com/sji/media/ir/SJI-Investor-Fact-Sheet-REV-LNG-02-25-21.pdf; Green Impact Partners, https://www.greenipi.com/portfolio/; Energy Impact Partners, https://www.energyimpactpartners.com/our-partners; Energy Capital Ventures, https://www.businesswire.com/news/home/20221004005086/en/Energy-Capital-Ventures-Closes-61-Million-Fund-I-to-Accelerate-the-Natural-Gas-Industry%E2%80%99s-ESG-Transformation

54 https://www.aga.org/about

55 https://www.gti.energy/services-capabilities/research-and-development/

56 https://www.ngif.ca

Green Bonds and Sustainability Bonds

Green bonds and sustainability bonds provide novel financial tools to access relatively low-cost debt capital to finance the development of environmentally sound and sustainable projects that foster a net-zero emissions economy and protect the environment. Sustainability bonds typically have a social benefit component along with a green project component. According to S&P Global, supply of green bonds reached a record high in 2021, with companies globally issuing more than $200 billion worth of such debt in the first half of the year. The Climate Bonds Initiative, or CBI, found that the premium on green bonds, also referred to as the "greenium", is evident globally and is particularly strong for U.S. dollar debt. Savings for borrowers' range between 1 basis point and 10 basis points on a global basis, according to ING.[57] There have been notable issuances where the greenium has been as much as 50 bps. However, borrowers are accountable for their green projects and may be penalized if they access green funding without using the funds to develop a net-zero or carbon-neutral project. Some examples of green bonds in the gas sector are listed below. Specific examples of where green bonds have been employed are included in Appendix C.

Technical Considerations

Significant research has been conducted to understand the similarities and differences between the composition of raw biogas and conventional natural gas. Additionally, significant technological advances have occurred in treating and processing raw biogas to make it of pipeline quality.

The processes, requirements, and agreements used to interconnect these supplies have not historically been uniform. Inconsistencies in these processes have resulted in commercial and technical uncertainties for RNG suppliers, who may be unfamiliar with gas operations and navigating complex interconnection processes. More recently, however, the gas industry has worked to develop interconnection standards and gas quality standards that are surfacing and being adopted in various regions of the country.[58] It is an important prerequisite for RNG production and use that gas utilities and regulators have sufficient assurance that alternative resources under consideration will not compromise the safety or reliability of the gas system.

Hydrogen ("H_2") is a naturally occurring element and is used in several industrial applications. Its use as a mass-market fuel is being considered given the fact that it releases zero carbon when combusted. Hydrogen, unlike methane or RNG, requires unique technical, safety and operational considerations to use as a consumer fuel. These technical considerations are beyond the scope

57 https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/green-bond-premium-justified-by-strong-secondary-market-performance-flexibility-66696509

58 For example, the Gas Technology Institute (GTI) assisted the Northeast Gas Association and member utilities in developing an interconnection guide, which provides a technical framework and guidance to assist gas utilities and other stakeholders as they consider the introduction of RNG into the gas network. The guide establishes composition equivalency and interchangeability with RNG and pipeline supplies, and effectively bridges policy and technical concerns of project developers and pipeline operators. Additionally, the guide provides a structured approach that parties can use to begin the technical collaboration processes necessary to develop a potential project, including conducting the preliminary evaluation, the interconnection feasibility analysis, and developing a gas interconnection agreement.

of this report; however, it should be noted that it may be blended with methane in existing systems and its viability as a long-term component of a low-carbon future is being evaluated. Hydrogen's natural characteristics include a substantially higher range of combustion compared to methane, and its comparable smaller and simpler molecule makes it susceptible to pipeline leakage.[59] Further complicating the hydrogen option is its chemical interaction with certain metals used in older pipeline systems (e.g., iron, steel, and aluminum) which can result in embrittlement.[60]

Enabling Activities and Mechanisms

Infrastructure Replacement Programs

Gas utilities have been engaging in significant infrastructure replacement programs for decades replacing known leak-prone pipe with more modern materials and construction techniques. Significant pipeline replacement of cast iron and steel pipes have been underway in most U.S. jurisdictions which has reduced methane leakage. However, with the potential introduction of Hydrogen to gas transmission and distribution systems, it is increasingly important that known leak-prone pipes are replaced in those systems. In addition to minimizing the likelihood of leaks, modern pipe materials may allow for additional hydrogen to be injected within the LDCs' gas distribution systems. Many gas utilities have special recovery riders to help facilitate timely cost recovery of pipe replacement programs. Such programs have been identified by states, such as New Jersey, as supportive of progress toward emissions reduction targets.

Rate Base Treatment of Interconnection Costs

Interconnecting RNG production with gas distribution systems has presented new challenges for gas companies. Recently, interconnection/development incentives for Biogas producers, facilitated through or in conjunction with LDCs have begun to surface to address the regulatory challenge of how gas distribution utilities can access RNG supplies if not through their normal gas transmission network. LDCs and biogas producers are both faced with understanding how to leverage available incentives for interconnection and renewable energy projects, and with determining which costs should be borne by LDC customers, as the LDC's gas system is used transport and deliver RNG. Examples of regulatory tools that have been created to facilitate RNG interconnection and supply are detailed in Appendix C.

Interconnection and Gas Standards

Gas utilities and regulators want sufficient assurance that alternative energy resources being transported through pipeline and LDC infrastructure will not compromise the safety and reliability of the gas system. To this end, industry technical frameworks and guidance may assist gas utilities and other stakeholders as they consider the introduction of RNG into the gas network. Such frameworks establish composition equivalency and interchangeability requirements for RNG to facilitate integration within the LDC's gas system. Such frameworks may assist parties in beginning the technical collaboration

[59] https://h2tools.org/bestpractices/hydrogen-compared-other-fuels

[60] National Center for Biotechnology Information (2021). PubChem Compound Summary for CID 783, Hydrogen. Retrieved December 21, 2021, from https://pubchem.ncbi.nlm.nih.gov/compound/Hydrogen.

processes necessary to develop a potential project, including conducting the preliminary evaluation, the interconnection feasibility analysis, and developing a gas interconnection agreement.

Several states have interconnection guidelines or interconnection tariffs in place, including Minnesota, Georgia, Arizona, Connecticut, Florida, Illinois, New York, North Carolina, and Nevada.

Lessons Learned from the Electric Industry

The electric utility industry provides an excellent example of how regulators and policymakers have created a framework to align utility and societal goals. This framework included, among other things, lucrative U.S. federal tax incentives, state-level RPS/REC programs, IRPs that strategically plan for clean energy investments, and other state-level incentives and investment dollars for climate initiatives and innovation. State-level regulatory mechanisms have been enacted that promote conservation through energy efficiency programs and load management while decoupling rates to ensure that the utility's distribution revenues would be kept whole. When electric utilities were forced to retire coal generation assets, many received special cost treatment for stranded assets such as regulatory assets and securitization or the ability to swap out a coal asset with an investment in a renewable asset. REC markets have evolved in allowing market participants to trade renewable energy attributes and support investment in renewable energy resources. Carbon markets and carbon taxes have been created to internalize the social and economic cost of carbon, provide a funding mechanism for clean energy initiatives, and to close the economic price gap between clean renewable resources and legacy carbon-emitting fuels.

U.S. Federal Tax Incentives

The U.S. Federal Business Energy ITC has been amended a number of times, most recently in August 2022 as part of the *Inflation Reduction Act of 2022* ("IRA"). The IRA extends the ITC under section 48 of the Code at the 30 percent rate for energy property for which construction begins before 2025 (other than geothermal property, for which construction must begin before 2035). This extension generally applies to the same categories of energy property for which the ITC was available before the Act, including solar, wind, geothermal, and fuel cell property, and is available for energy property that is placed in service during or after 2022.

The IRA creates a new, standalone ITC for energy storage technology, qualified biogas property, and microgrid controllers. The Act also creates an ITC for qualified interconnection property in connection with the installment of energy property that otherwise is eligible for the ITC. The new ITC applies to these projects and assets that are placed in service during or after 2023.

The IRA also extends the PTC under section 45 of the Code at a rate of 1.5 cents per kWh (as adjusted for inflation, currently 2.6 cents per kWh) for qualified facilities, including wind, biomass, landfill gas, and hydropower facilities, for which construction begins before 2025. The PTC continues to be available for electricity produced by the taxpayer and sold to unrelated parties in each of the ten years beginning in the year the qualified facility is placed in service. The extension is available for qualified facilities that are placed in service during or after 2022. Additionally, the IRA revives the solar PTC, available at the full rate described above, for qualified facilities that begin construction before 2025. The previous solar PTC expired in 2006.

The IRA eliminates the 50 percent reduction in the applicable PTC rate for qualified hydropower facilities and marine and hydrokinetic renewable energy facilities. The 50 percent reduction continues to be applicable to, among other qualified facilities, open-loop biomass facilities, and landfill gas facilities. [61]

Qualified biogas property is defined as (1) property that converts or concentrates biomass into a gas that consists of not less than 52 percent methane by volume, and offers the gas for sale or productive use, and not for disposal via combustion, and (2) any property which is part of such system which cleans or conditions such gas.[62]

This credit is also referred to as an ITC for RNG since it precludes projects that produce electricity and requires the renewable biogas be used for "productive" use.

Renewable Portfolio Standards (RPS)

RPS programs are widely used by U.S. states for increasing the use of renewable energy sources for electricity generation. These policies require electricity suppliers to provide their customers with a minimum percentage of electricity or energy from eligible renewable resources. State RPS programs vary in portfolio requirements and structure, types of renewable resources allowed, and compliance enforcement. Some RPS programs have carve-outs or technology minimums within their overall standard to facilitate certain types of resources.

Renewable Thermal RPS Carveout

While RPS programs have historically focused on electricity generation, some states have incorporated renewable thermal power technologies into their RPS as a way to support the development and market growth of solar thermal, biomass thermal, geothermal, and other renewable thermal technologies. Renewable thermal energy has many of the same benefits as other renewable technologies, such as improved air quality, economic development, and job creation. At least nine states have thermal RPS programs which include biomass for electricity generation.[63] Renewable thermal power programs may contain restrictions on the use and eligibility of biogas. For example, Massachusetts has provisions in its Alternative Energy Portfolio Standard ("APS") that requires that all qualified renewable thermal generation units must provide a 50% reduction in lifecycle GHG emissions. While thermal RPS carveouts allow for a broader array of solutions to meet the stated program target(s), a gas utility specific RPS would more directly incentivize lower emissions of traditional gas end use.

REC Programs

REC programs in the electric industry have propelled the advancement of renewable electricity and are essentially seen as the currency of the renewable electric power markets. RECs are transferable certificates that represent the environmental attributes of renewable energy and may be used to demonstrate compliance with renewable portfolio standards. RECs may also be used in the voluntary market to demonstrate one's commitment to clean energy goals. The environmental attribute may be separated from

61 The National Law Review, Volume XII, Number 276. "General Overview of the Inflation Reduction Act of 2022" dated August 18, 2022.

62 Sec. 13102. Extension and Modification of Energy Credit (RNG Investment Tax Credit) of the IRA.

63 Clean Energy States Alliance, Renewable Thermal in State Renewable Portfolio Standards, July 2018.

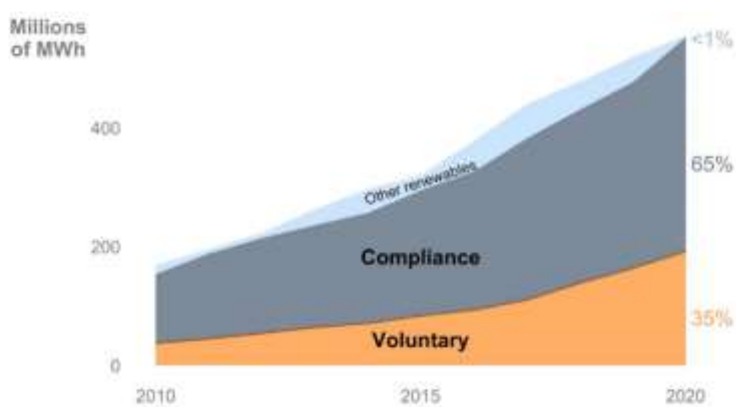
the commodity itself, such that you essentially have two commodities, the REC and the electricity produced. RECs are measured at the point where electricity enters the electric grid. They provide a means of tracking and trading each MWh of renewable energy sold and provide information about the generation resource (wind, solar, etc.), when the electricity was generated and the location of the generator. RECs provide the ability to fulfill clean energy goals and targets with renewable generation, where this generation is economical to build and where renewable resources are accessible.

The combination of RPS standards and RECs in the renewable electric industry has in large part contributed to the ability of renewable power to achieve scale. As RPS are developed in the gas distribution industry, we would expect an associated REC market to develop to allow the trading of environmental attributes so that utilities with no access to low-carbon fuel supplies may demonstrate compliance with the RPS standard by purchasing RECs. The authors expect that as the number of jurisdictions that employ a gas RPS grow, a national REC market for environmental attributes of RNG and Hydrogen should more fully evolve.

Voluntary Market

Some of the early experience with voluntary tariff programs in the electric sector is that, while beneficial, the programs struggle with providing the scale needed to offset greenhouse gas emissions from the gas sector in the manner and timeframes that many jurisdictions are targeting. **Figure 4** below illustrates that the experience with utility green pricing in the electric industry represents a small fraction of voluntary sales. The dominant driver of renewable energy procurements in the U.S. over the last decade is the compliance market.

Figure 4: The Voluntary Market in Context[64]



64 NREL, Status and Trends in the Voluntary Market (2020 Data) (nrel.gov).

Figure 5 below illustrates the Voluntary Green Tariff ("VGT") program experience in the electric industry and that utility green pricing represents a small fraction of voluntary sales as illustrated below.

Figure 5: Green Power Sales and Customers by Mechanism

Based on this experience in the electric sector, the case for the advancement of an RPS for gas utilities accompanied by RECs to demonstrate compliance provide a compelling case for advancing the scale of carbon-neutral gases for use in gas systems. Voluntary programs alone would likely be insufficient to enable gas utilities to achieve robust aspirational targets.

Shared Energy Programs

Programs that allow energy resources to service multiple consumers rather than a single consumer, such as shared solar and virtual net metering, have been successful in encouraging the development of renewable electric generation technologies where customer-sited generation is not feasible or practical while simultaneously providing affordability benefits to low-income customers and other program participants. Because this model typically includes bill credits for participating customers, it can provide climate and affordability benefits from renewable resources. Similar constructs could by adopted in the gas sector to enable more development of low-carbon energy resources while providing bill relief to customers struggling with energy affordability.

The electric utility industry provides important lessons on aligning utility and societal goals that have propelled renewable electricity to achieve scale quickly. The most influential programs to promote scale have been lucrative U.S. federal tax incentives, state-level RPS/REC programs, IRPs that strategically plan for energy investments, and other incentives and investment dollars for initiatives and innovation. Based on the experience of electric utilities, voluntary programs alone are not sufficient to achieve the required scale to derive the greatest benefits from low-carbon gas resource

Case Studies

Minnesota - CenterPoint forges Alliances with Diverse Stakeholder groups to Promote Innovations Act Passage

Minnesota utilities now have a multitude of potential options to introduce lower-carbon resources into their gas operations cost-effectively through a new, technology-agnostic innovations program. The Innovation Act framework provides a robust market opportunity for gas utilities to develop and use low-carbon energy for its existing services and expand into new, innovative business models and technologies. The scale and duration of this program (5 years or longer) presents a sizeable business development opportunity for the gas companies and potential business partners along the supply chain.

Once fully implemented, the Innovation Act provides a pathway for gas utilities to obtain regulatory approval of Innovation Plans and to seek recovery of eligible costs under the plan. The cost-recovery provisions are balanced with consumer protections such as an annual cost caps, achievement of commission-established cost-effectiveness objectives and normal prudency reviews. The cost-effectiveness of Innovative Resources is calculated from the perspective of the utility, society, non-participating customers, and the participating customers compared to other innovative resources that could be deployed to reduce or avoid the same greenhouse gas emissions.

Background

Minnesota has long been a national leader in bioenergy development, and its industries have made significant progress toward increased energy productivity over the years. Minnesota is well-positioned for continued bioenergy development, as Minnesota's industrial and agricultural sectors contribute significantly to the state's economy, and account for 34 percent of the state's energy use.[65] The industrial sector includes energy-intensive businesses such as construction, food processing, chemical products manufacturing, petroleum refining, agriculture, mining, and paper manufacturing industries, accounting for one-third of Minnesota's total energy end-use.[66] In 2020, Minnesota's CenterPoint Energy proposed RNG tariffs in response to demand from RNG producers regarding interconnection, and CenterPoint Energy customers wanted the Company to develop solutions for carbon emissions from natural gas. For example, members of the City of Minneapolis Council were looking to CenterPoint Energy to move more quickly toward alternative energy sources for buildings.[67]

Minnesota's 2025 Energy Action Plan acknowledged the continued role of biobased gas in transportation, in particular, long range and/or heavier duty vehicles, where EV options may not be suitable or cost-effective. With refueling infrastructure already in place (Minnesota has 13 existing CNG fueling stations as of December 2021[68]), heavy-duty vehicles have reliable access to CNG/LNG refueling stations without an excessive burden.

While most RNG developed to date has been in response to policies to encourage the vehicle fuels market, natural gas utilities and large natural gas users have begun to purchase RNG, and these purchasers represent an emerging market for RNG.

Minnesota's Natural Gas Innovations Framework

65 Minnesota's 2025 Energy Action Plan. https://mn.gov/commerce-stat/pdfs/mn-e2025-finalreport.pdf

66 Minnesota - State Energy Profile Analysis - U.S. Energy Information Administration (EIA)

67 CenterPoint RNG Application_20204-162405-01.pdf (sharepoint.com)https://afdc.energy.gov/stations/

68 Alternative Fuels Data Center: Alternative Fueling Station Locator (energy.gov) https://afdc.energy.gov/stations/.

In June of 2021, Minnesota lawmakers passed legislation (H.F. No. 164) containing a new policy framework that encourages gas companies to develop and pursue innovative resources that support a low-carbon future. This new regulatory framework, better known as the Natural Gas Innovation Act ("Innovation Act"), uniquely positions Minnesota's natural gas utilities with a substantial opportunity to pursue innovative climate solutions and partnerships to make cost-effective investments in advancing low-carbon gas resources and transitioning their gas systems using multiple technologies. Innovative resources that may be pursued in such plans include biogas, renewable natural gas, power-to-hydrogen, power-to-ammonia, carbon capture, strategic electrification, district energy and energy efficiency ("Innovative Resources").

The Innovations Act provides a robust and sustainable market opportunity for furthering Minnesota's clean energy economy and will provide meaningful insight into the scalability of these emerging technologies.

1. Role of utility in drafting legislation

Leading up to the passage of the Innovation Act, CenterPoint Energy, with natural gas utility operations in central and southern Minnesota, including Minneapolis, began developing natural gas programs in reaction to growing climate concerns. The Company encountered unexpected challenges in its first attempt at gaining regulatory approval to initiate low-carbon gas programs. In August 2018, CenterPoint proposed, before the Minnesota Public Utilities Commission ("MPUC"), a five-year RNG pilot through which CenterPoint Energy customers could subscribe to purchase all or a portion of their natural gas from renewable natural gas sources for an additional fee.[69] The Company also proposed to add a small amount of renewable natural gas to its general gas portfolio in support of the pilot offering. The company sought to defer its incremental administrative costs and initially requested a modest shareholder incentive through the program charge for facilitating the pilot offering, but later withdrew that request in response to concerns about the program. The program would have been among the first such programs offered by an American gas utility.

A number of parties were supportive of CenterPoint's Petition, including the City of Minneapolis and RNG industry groups. However, Environmental organizations, the Office of the Attorney General and the Department of Commerce opposed the petition due to program costs, a lack of well-developed program tracking and verification for non-transportation use of RNG, reliance on RNG supply resources outside of Minnesota, and questions about the scalability of RNG resources to meaningfully reduce emissions from end-uses currently served by natural gas. In light of the questions raised by pilot opponents, the Commission denied the petition without prejudice. In that ruling, the Commission left the door open for the Company to work with stakeholders to develop tracking and verification systems and, in any future pilot programs, address local environmental benefits and scalability[70] CenterPoint later won approval of an interconnection tariff petition and was tasked with proposing a framework for evaluating and verifying the carbon intensity of various RNG sources.[71]

Alongside the Interconnection proceeding, CenterPoint continued to work with stakeholders to explore RNG opportunities in Minnesota and took a central role in drafting the initial version of the Innovations Act, proposed during the 2020 regular session of the Minnesota Legislature. As they were drafting the initial bill, CenterPoint worked to find common ground with those previously opposed to the earlier programs, and other stakeholders. Two pivotal organizations helped provide momentum for advancing this initiative: The first were moderate environmental stakeholders, including the Great Plains Institute and Center for Energy and Environment, who co-convened a broad set of individuals and organizations to explore pathways and develop potential solutions to drastically reduce or eliminate GHG emissions from natural gas end uses in Minnesota.[72] Second, Minnesota unions provided strong support behind the proposals in the Innovation Act. While passage of the bill did

[69] See August 23, 2018 Petition of CenterPoint to introduce a Renewable Natural Gas Pilot Program, Docket No. G-008/M-18-547.

[70] Minnesota Public Utilities Commission, August 29, 2019 Order in Docket No. G-008/M-18-547.

[71] Minnesota Public Utilities Commission, January 26, 2021 Order in Docket No. G-008/M-20-434.

[72] *See* https://e21initiative.org/natural-gas/

not materialize in 2020 due in part to the COVID-19 public health emergency, the combined efforts of CenterPoint and stakeholders eventually did lead to the successful passage of the Innovation Act in 2021 with bipartisan support in an omnibus energy and commerce bill.

2. Natural Gas Utility Innovation Plans

Under the Innovation Act framework, a natural gas utility may file an innovation plan with the MPUC. Innovation plans must include, among other things:

- the Innovative Resource(s) the utility plans to implement to contribute to meeting the state's greenhouse gas and renewable energy goals,
- the research and development investments planned for the development of Innovative Resource(s),
- avoided lifecycle greenhouse gas reductions and a comparison to 2020 emissions from natural gas use,
- the incremental costs to implement each element of the plan, and
- the cost-effectiveness of innovative resources

The Innovation Act framework also requires action by its larger gas utilities (defined so as to include only CenterPoint Energy at this time). The First innovation plans filed by these companies must include pilot programs aimed at the following initiatives:

- delivering thermal energy audits,
- providing Innovative Resources for certain industrial processes,
- providing deep energy retrofits and installation of cold-climate electric air-source heat pumps to existing natural gas customers, and
- facilitating the development of district energy systems.

Gas utilities must also file utility system reports and forecasts with the MPUC, who will evaluate a utility's Innovation Plan in the context of the planned investments related to conventional natural gas. Outside of an Innovation Plan, a natural gas utility may still propose Innovative Resources to satisfy an approved green tariff program and may procure alternative supplies for its general gas supply portfolio if it is available at a specified small premium to conventional gas.

3. Program Details

Incremental costs eligible for recovery under an Innovation Plan include the return of and on capital investments for production, processing, pipeline interconnection, storage, and distribution of innovative resources, incremental operating costs associated with program capital investments; incremental costs to procure innovative resources from third parties; incremental costs to develop and administer programs; and incremental costs for research and development related to innovative resources of up to ten percent of the proposed total incremental costs.

These costs are offset by the value received by the utility upon the resale of innovative resources or innovative resource by-products, cost savings achieved through avoidance of purchases of natural gas produced from conventional geologic sources, including avoided commodity or capacity purchases, and other revenues directly attributable to the Innovation Plan.

Cost Recovery

Prudently incurred costs under an approved Innovation Plan are recoverable by a utility either through the purchased gas adjustment, a general rate case filing, or via annual adjustments after proper notice and review. Where annual adjustments are used, the Innovation Act specifies that a full revenue requirement may be recoverable at the current authorized rate of return, unless the MPUC determines that a different rate of return is in the public interest.

Program Limitations

The Innovation Act places limitations on the total incremental costs of the program that may be authorized over each successive plan. Additional funding may be allowed in select instances. The cost caps are shown in the table on the following page[73].

[73] Certain very large customers are exempt from paying and may not participate in Innovation Act programs.

Innovation Act Limitations on Utility Customer Costs			
Description	**First**	**Second**	**Third and Subsequent**
Base Limit Percentage of Gross Operating Revenues	1.75%	2.75%	4.00%
Annual Base Limit per Non-Exempt Customer ($)	$20	$35	$50
Additional Annual Incremental Costs (for eligible waste diversion technologies)	0.25% / $5 per customer	.75% / $10 per customer	1.5% / $20 per customer

Reporting Requirements

A utility operating under an approved Innovation plan must file annual reports to the commission on the progress toward achieving the plan, costs incurred, lifecycle greenhouse gas emission reductions, tracking and verification of Innovative Resources and retirement of associated environmental attributes, the economic impact of the plan, and any proposed modifications. A subsequent innovation plan must be filed at least a year prior to the expiration of the previous plan. Each successive Innovation Plan must demonstrate incremental cost-effectiveness over the previously approved plan.

Subsequent Innovation Activity

Development of hydrogen technologies is also beginning to take a firmer hold in Minnesota, due in part to energy policies such as the Innovation Act. The president and CEO of Xcel, in Minnesota, said in an October 2021 interview that the company is now exploring the addition of five to eight greenfield and brownfield hydrogen projects, in addition to the hydrogen demonstration project located at the Prairie Island nuclear plant in Minnesota.[74] The CEO commented that the "favorable state backdrops in Minnesota and in Colorado, which have passed clean fuel legislation as well as a potential for a federal hydrogen production tax credit. . . [represent] favorable renewable generation conditions to help push beyond pilots and into green hydrogen production resources".

74 Xcel CEO: Capital required for green hydrogen production 'could be material' over balance of the decade | Utility Dive

Florida Gas Utilities and RNG Developers Partner on RNG Legislation - FPL Receives Rate Base Treatment for Hydrogen Pilot

Recent RNG legislation, SB 896, was the product of outreach by RNG producers to Florida's LDCs, that was precipitated by the producers' need for the LDC to provide upgrading and cleaning services so that RNG production would be pipeline and gas distribution system compatible. Together, the RNG developers and gas utilities worked to drive legislation that ultimately enabled the production of scalable quantities of RNG and provided for cost recovery of RNG procurement by a gas utility. This legislation has paved the way for scalable low-carbon fuel development in Florida. In the past two years Florida State Legislatures have enabled cost recovery for RNG by gas utilities and outlawed municipal prohibitions against natural gas service. Florida's access to some of the country's largest biomass supply puts the state in a unique opportunity to leverage those supplies and introduce RNG into gas systems and for electric generation.

Further in Florida, FPL was granted rate base treatment for its investment in the Okeechobee Clean Energy Center Hydrogen pilot.

Background

Florida is the fourth largest energy consumer among the states and the second-largest producer of electricity in the nation. Florida produces nearly 8% of the nation's biomass-fuel for electricity generation. Biomass fuels almost all of the non-solar renewable generation in Florida. Only California and Georgia produce more biomass-fueled electricity.[75] The largest share of the state's almost 1,200 MWs of biomass-fueled generating capacity is at plants that process municipal solid waste, followed by those fueled by wood and wood waste. Landfill gas facilities in Florida account for 6% of the state's biomass generating capacity.

Florida is one of 13 states that does not have a renewable portfolio standard ("RPS"), despite having some of the largest access to renewable resources (wind, solar, and biogas) in the United States. NextEra Energy and Duke Energy are the two largest electric utilities in Florida. People's Gas System, Florida Public Utilities Company, and Florida City Gas are the three largest investor-owned gas distribution utilities in Florida.

Foundational Legislation – Energy & Climate Change Action Plan

In 2008, the Governor's Action Team on Energy & Climate Change released *Florida's Energy & Climate Change Action Plan* laid the foundation for recent RNG legislation. The plan contains 50 separate policy recommendations to reduce GHG emissions. The report estimates that if all of the policy recommendations were implemented, it could lead to net cost savings of over $28 billion from 2009 to 2025, meet emissions reductions targets, and improve energy security.[76]

The plan identified expanding the use of agriculture, forestry, and waste management ("AFW") biomass feedstocks for electricity, heat, and steam production as a policy solution to displace the use of fossil energy sources. Below are the relevant policy recommendations and associated goals for each recommendation:

1. Create a concurrent reduction of CO2 due to displacement of fossil fuels, considering life cycle GHG emissions associated with viable collection, hauling, energy conservation, and energy distribution systems,
2. Develop a long-term sustainable supply of reasonable cost biomass for generating electricity, heat, and steam,
3. Promote enhanced growth of long rotation, short rotation, and dedicated energy crops, as well as collection of biomass residues,
4. Provide incentives that would result in an increase in the use of waste-to-energy ("WTE") and other waste-based energy technologies, and the recovery of landfill gas.

The goals of the policy recommendation were to:

1. Increase the use of renewable energy from biomass feedstocks by 500 percent by 2025,
2. By 2025, energy crops should increase by 10 percent. The acres of land producing ecologically sustainable energy crops are to increase up to an additional 300,000 acres by 2025, increase the current generation of

75 https://www.eia.gov/state/analysis.php?sid=FL

76 https://www.c2es.org/wp-content/uploads/2018/11/FL_2008_Action_Plan.pdf

renewable energy from WTE facilities by 20 percent by 2025, and increase the number of uncontrolled MSW landfills recovering CH4 as an energy source, such that 50 percent of the landfill gas generated is controlled by 2020. Much of Florida's recent low-carbonization development has been led by the gas and electric utility industries.

Another policy recommendation was to increase the amount of in-state liquid/gaseous biofuels production to displace the use of fossil fuel. This recommendation:

1. Promoted the development of technologies and production systems that use MSW biomass to produce liquid or gaseous biofuels,
2. Provided Market incentives to develop biofuels technologies from the multiple feedstocks.

Goals included:

1. Maximizing production of liquid and gaseous biofuels in Florida,
2. Producing enough in-state biofuel to offset 25 percent of Florida's consumption of liquid fuels that are fossil-fuel based by 2025.

Another policy recommendation included Commercialization of Biomass to Energy Conversion and Bio-Products Technologies. The Action Team addressed four main elements including:

1. Manure digestion and other waste energy utilization,
2. Wastewater treatment plant biosolids energy production,
3. Other biomass conversion technologies, and
4. Bio-products technologies and use.

The higher costs of RNG are cited by the Action Team as a potential barrier to low-carbon fuel development in Florida. Objectives of the policy included:

1. Development of methods for wastewater treatment plant biosolids to be used as fuel for combustion units,
2. Improving the rate of technology development and market growth of biomass and MSW conversion technologies.

Goals included:

1. Utilizing 20 percent of available methane from livestock manure for energy production by 2025,
2. Maintaining the current level of available WWTP solids used for soil application, and
3. Annually produce and utilize 150,000 tons of bio-based products by 2025.

SB 896: Renewable Energy

SB 896 was approved by the Governor on June 29th, 2021. The law expands the term "renewable energy" and adds the terms "bio gas" and "renewable natural gas." The definition of renewable energy is expanded to mean electrical energy that is produced from a method that uses one or more of the following fuels as energy sources: green hydrogen, biomass, solar energy, geothermal energy, wind energy, ocean energy, and hydroelectric power. "Biogas," is defined as a mixture of gases, largely comprised of carbon dioxide, hydrocarbons, and methane gas, which is produced by the biological decomposition of organic materials. "Renewable natural gas" is defined as anaerobically generated biogas, landfill gas, or wastewater treatment gas, which is refined to a methane content of 90 percent or more, that may be used as transportation fuel, for electric generation, or is of a quality capable of being injected into a natural gas pipeline.

The law permits the PSC to approve cost recovery by a gas utility for renewable natural gas procurement in which the pricing provisions exceed the current market price of natural gas, but which are otherwise deemed reasonable and prudent by the commission. Prior to the passing of SB 896, it would have been more challenging for gas utilities to provide renewable natural gas to their customers, due to its higher cost and the risk associated with the utility's ability to recover those costs.

SB 896 aims to grow RNG as a renewable resource for electricity and gas utilities in Florida.

SB 919: Preemption Over Restriction of Utility Services

SB 919 was approved by the Governor on June 21st, 2021.[77] The law prohibits municipalities, counties, special districts, or other political subdivisions from restricting or prohibiting the types of fuel sources of energy production used, delivered, converted, or supplied by certain entities to serve customers. Florida is 1 of 20 states that have outlawed or prohibited municipalities from banning natural gas service to customers.

SB 919 and SB 896 faced opposition from environmentalist and interest groups, such as the Sierra Club.[78] Florida's LDCs are developing tariffs that incorporate RNG into their operations and provide for the direct contracting of upgrade and cleaning services outside of regulated rates and between the LDC and the RNG producer.

Utility RNG Tariff Activity

1. Florida City Gas

In January of 2021, the Florida PSC approved a new RNG Service tariff for Florida City Gas ("FCG").[79] FCG had been approached by municipalities and private businesses to construct facilities to convert biogas into pipeline quality RNG. Under FCG's program, the company would enter contracts with biogas-producing customers to build and operate the RNG facilities. This RNG would be used onsite or injected into the company's distribution system to offset the conventional natural gas supplies. The biogas producers would pay a monthly service charge for the facilities to compensate for the provision of upgrade and cleaning services, which is designed to recover the costs of constructing and operating the facilities.

In the event that a customer produces more RNG than is needed on sight, the tariff enables them to sell the RNG to another producing customer at a different location, sell the gas to a third party that is interconnected to FCG's distribution network, or inject the gas into FCG's system for delivery to the interstate gas market. The tariff also permits FCG to purchase the gas as part of the supply portfolio to serve its own customers. FCG states that it would seek cost recovery for RNG costs through the annual Purchased Gas Adjustment proceeding. The proximity of the biogas production could mitigate pipeline capacity costs and lower RNG procurement costs.

2. TECO Peoples Gas

In June of 2021, Peoples Gas, the largest gas utility in Florida, reached an agreement with Alliance Dairies to construct an RNG facility on the farm to produce 105,000 MMBtu of RNG annually. The facility will provide enough RNG to support nearly 4,400 homes annually.

In 2017, the Commission approved a new RNG waste-to-energy service. These services included biogas gathering, biogas cleaning and conditioning, RNG transportation, and interconnection to Peoples' Gas pipelines. This program was first offered only to RNG producers.

Also in 2017, the Commission approved People Gas' tariff modification to accommodate the receipt and transport of RNG. This was the first tariff filing by a Florida LDC that would give biogas producers the option of delivering RNG into the utility's distribution system. Peoples Gas had been approached by potential customers, landfill operators and wastewater treatment plant owners, who wanted to deliver RNG into the distribution system. The company received project proposals, from many local governments, which would reuse waste gas that would normally escape into the atmosphere as methane or would be flared.

Biogas producers (landfill operators or wastewater treatment plant owners) could use the RNG onsite or inject into the distribution system. Primary customers would include compressed natural gas filling stations, industrial customers, or Peoples Gas, to displace a portion of its natural gas resources with renewable gas.

The Commission approved the modifications to existing tariffs to accommodate the transportation of RNG and Rate Schedule RNGS. The tariff modification would allow Peoples to provide compensation for injecting gas into the distribution system. Rate Schedule RNGS allows Peoples to recover from biogas producers the cost to upgrade, clean, and process the biogas. Since each of the biogas projects throughout Florida are different, Peoples Gas upgrades the

[77] Originally introduced as SB 1128, the bill was substituted to CS/CS/HB 919 on April 22, 2021.

[78] House bill preempting local energy regs clears Commerce Committee

[79] http://www.psc.state.fl.us/Home/NewsLink?id=11904

gas into RNG that is pipeline quality. The monthly service charge would equal Peoples' gross investment in the facilities necessary to provide biogas upgrade services multiplied by a percentage (predetermined by Peoples and the producer to represent the producers share of the facility). The investment that Peoples Gas would need to make to support RNG processing would include blowers, chillers, condensate removal equipment, and quality monitoring equipment and would be outside of utility rate base.

Okeechobee Clean Energy Center – Green Hydrogen Pilot Project

NextEra Energy and subsidiary Florida Power Light ("FPL") are amongst the first in the U.S. to make investments in hydrogen technology. In July 2020 FPL announced that they were investing in a green hydrogen pilot project. The Okeechobee Clean Energy Center ("OCEC") is a 1,750 MW advanced combined cycle power plant. NextEra Energy Inc. plans to invest $65 million in a 20MW hydrogen electrolysis system on sight of the OCEC. The company will use curtailed wind and solar to produce green hydrogen. This hydrogen will be blended with natural gas to be burned at the OCEC. The pilot project is expected to be in operation by 2023.

Specific blending percentages are uncertain at the moment, but President and CEO of NextEra believes that producing hydrogen from renewables has the potential to displace 10% of the carbon emissions from the electric sector within the next five to 10 years.[80]

NextEra's investment in hydrogen electrolysis is not driven by a state mandate. Rather the company has voluntarily decided to invest in the project. The estimated project cost was allowed in FPL's rate base subject to challenge at a later date.[81]

[80] https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/nextera-plans-foray-into-hydrogen-to-drive-more-green-energy-spending-59577677

[81] FPSC Order, In re.: Petition for rate increase by Florida Power & Light Company, Docket No. 20210015-EI, Order No. PSC-2021-0446-S-EI (December 2, 2021) at 19.

Washington Gas Light publishes Study on Natural Gas and its Contribution to a Low Carbon Future, Climate Business Plan

In June of 2021, the Public Service Commission of the District of Columbia ("DC") opened Formal Case No. 1167 to commence a climate policy proceeding to consider whether and to what extent utility or energy companies under their purview are meeting and advancing the DC's energy and climate goals. Potomac Electric Power Company ("Pepco") and Washington Gas Light Company ("WGL") were directed to file a proposed timeline for filing proposals that seek to implement the Climate Solutions Plan and the Climate Business Plan, respectively.

WGL's Climate Business plan proposes a fuel neutral decarbonization strategy to achieve the district's 2050 carbon neutrality goals. WGL maintains that this strategy not only achieves the desired GHG goals at a fraction (59%) of the cost of full electrification, it maintains energy resilience and reliability and preserves customer choice. WGL's climate business plan calls for decarbonization actions across three key areas of its business – end use, transmission and distribution, and sourcing and supply, as illustrated in **Figure 6** below.

Figure 6: WGL Climate Business Plan – Building Block of Decarbonization[82]

End Use	Transmission and Distribution	Sourcing and Supply
Energy Efficiency ▪ Expand DCSEU programs ▪ Develop Washington Gas programs that support – Behavioral demand reductions – High-efficiency appliances – Building envelope upgrades – Gas heat pumps – Demand response internet of things automation – CHP deployments ▪ Electric/Gas Hybrid Heating – Explore approaches, such as Energy-As-A-Service, to ease financial burden – Reduce economic disincentives through decoupling/revenue normalization adjustment adoption – Accelerate advanced technology development/adoption via partnerships and pilots with National Labs/original equipment manufacturers	▪ Prioritize Accelerated Pipeline Replacement Programs projects based on GHG emissions using data analytics ▪ Promote advanced leak detection and enhanced response solutions ▪ Recover gas during maintenance, repair and replacement projects using drawdown compressors ▪ Evaluate the efficacy of several promising airborne and vehicle-based methane detection systems	▪ Certified Gas – Low cost emissions reduction – Ready now strategy ~ 1–2% reduction – Pending study with Rocky Mountain Institute to validate emissions reductions ▪ RNG – Facilitate development of and access to non-fossil supply (13% by 2032; 58% by 2050) – Purchase/distribute RNG and other zero carbon fuels including biogas, power-to-gas, and green hydrogen ▪ Seek regulatory cost recovery – Socialize cost across customer base – Encourage marketers to provide additional opt-in RNG offering

Conclusions

Overall Assessment

Figure 7 provides a linkage between observed enabling activities and mechanisms and the barriers identified in Section 3. For each identified regulatory policy, mechanism or framework, we have assessed the policy with the following criteria: 1) whether it creates opportunities for utility investment; 2) how it affects end-user costs; 3) implications for customer fuel choice, 4) impact on recording and regulatory burden; 5) speed at which the policy could be expected to reduce GHG; 6) extent to which the policy could be expected to reduce GHG; 7) impact on utility business model; and 8) whether there are limitations on when the policy is effective. For each of these criteria, a "yes" answer to the above criteria would result in a check mark on the table in **Figure 7**. If the attribute creates a negative impact on the criteria, it is denoted with an "x." If the criteria are not significantly affected or could be either positively or negatively affected, the field is left blank. Generally, a check mark is a positive attribute, i.e., is good, and an "x" is a negative attribute or is bad. With respect to the "impact on the utility business model," significant or disruptive impacts on the utility business model are denoted with an "x."

Figure 7: Enabling Activities/ Mechanisms

Barriers	Enabling Activities/Mechanisms	Creates Opportunities for Utility Investment	Effects on End User Costs	Implications for Customer Fuel Choice	Reporting and Regulatory Burden	Speed at Which Policy Could be Expected to Reduce GHG	Extent to Which Policy Could be Expected to Reduce GHG	Impact on Utility Business Model	Limitations on When Policy is Effective
Ambiguous Authority	Explicit Legislative Guidance	✓				✓	✓	×	
	Climate Goals and Targets	✓				✓	✓	×	
	Development of Renewable Portfolio Standards for Gas	✓		✓		✓	✓	×	
	REC Programs for Gas	✓	✓	✓	×	✓	✓	×	
	Regulatory Authority to Consider Environmental Impacts in Regulatory Decisions	✓		✓	×	✓			
Cost	Relaxing the Least Cost Mandate	✓	×	✓		✓			
	Carbon Tax and Carbon Pricing Schemes	✓	×	✓		✓	✓	×	
Environmental Concerns and Uncertainty	Education and Outreach	✓		✓					
Aligning Utility Incentives with Social Policy Objectives	Rate Base Investment	✓	×	✓		✓	✓	×	
	Recovery of Low Carbon Gas Program Cost	✓	×	✓				×	×
	Pilot Programs	✓		✓	×	✓			×
	Innovation Funding Programs	✓	×	✓	×	✓	✓	×	
	Output Incentives	✓		✓	×	✓	✓	×	
	Purchased Gas Adjustment Mechanism	✓	×	✓		✓	✓		
	Lost Revenue Adjustment Mechanisms	✓	×	✓				×	
	Competitive Procurement Strategies	✓	✓	✓					
	Development of Long Term Integrated Resource Plans	✓		✓	×			×	
	Green Tariffs	✓	×	✓	×	✓			
Cost Causation and Who Will Pay	Carbon Tax and Cap-and-Trade Carbon Pricing	✓	×	✓			✓	×	×
	Utility Rates and Rate Riders	✓	×	✓		✓			
	Public Private Partnerships	✓	✓			✓			
	Business Alliances	✓	✓		×	✓	✓	×	×
	Green Tariffs	✓	×	✓	×	✓			
	Green Bonds and Sustainability Bonds	✓	✓	✓					×
Technical Considerations	Infrastructure Replacement Programs	✓	×	✓			✓		
	Rate Base Treatment of Interconnection Costs	✓	×	✓		✓			
	Interconnection and Gas Quality Standards	✓		✓		✓	✓		

Legend
✓ Positive
× Negative
Blank Neutral

Examples of Potential Pathway(s) to Introducing Low-Carbon Gas Resources into Utility Delivery Systems

Figure 8 provides potential tools and activities available to gas utilities to overcome barriers to successful low-carbon gas usage at scale. Any combination of these activities may result in a successful "pathway" – the path taken to achieve meaningful introduction of low-carbon gas resources into the system that results in the attainment of the goals of the state policymakers, regulators, and the utility. Concentric has provided two examples of how regulatory barriers may be navigated.

Figure 8: Scenario 1

In the first example, Scenario 1, we assume no clear legislative mandate regarding climate goals. Rather, interested parties continue to aggressively intervene in utility cases seeking commitments to voluntarily reduce greenhouse gas emissions. Further, the state regulations include a least-cost mandate, which requires the utility to justify why one resource was chosen over another to meet the basic service requirements of the utility.

Primary Barriers Encountered:

Absence of a Clear Environmental Mandate. Our interviews with regulatory commissioners uniformly confirm that regulators generally do not find it within the scope of their authority to fill gaps in public policy, particularly large policy matters such as environmental goals. Rather, regulators believe it is their responsibility to implement rules and regulations and, where appropriate, directing utility investments toward achieving public policy goals while maintaining their core regulatory functions of ensuring utilities provide safe and reliable service at just and reasonable rates.

Least-Cost Gas Procurement Mandate. In jurisdictions with existing least-cost mandates, regulators may lack the authority to change it, and may require legislative changes.

Potential Pathway:

The stakeholders may choose a number of enabling activities and rate approaches to overcome these two primary barriers:

Absence of a Clear Environmental Mandate. The stakeholders could:

- Work collaboratively to propose enabling legislation. This strategy assumes that all stakeholders are "on board" with formalizing climate goals. This approach may also seek legislative changes to existing law that more clearly define the roles and responsibility of the regulatory commission. Utilities should play an active role in these discussions, as the result of legislative changes could either eliminate barriers, or potentially exacerbate existing barriers or create new ones.

Least-Cost Gas Procurement Mandate. The stakeholders could:

- If bound by existing legislation, the stakeholders could collaboratively seek changes to or elimination of the mandate. This may require two steps. First, changes to the existing law, and second, changes to commission rules and regulations.

Once these two legislative impediments are cleared, other barriers are likely to move to the forefront. For example, even without a least-cost mandate regulators will still be bound to setting just and reasonable rates and must evaluate the prudence and cost effectiveness of the resources procured by the LDC. Further, the stakeholders will likely have different proposals to achieve their goals, which may result in a protracted set of regulatory proceedings. Other stakeholders focused on social equity issues may also intervene. However, once the two major barriers of a clear mandate and authority to procure low-carbon resources not solely based on cost are resolved, utilities and the remaining stakeholders (likely regulatory proceeding intervenors) could advocate for their proposed solutions and begin crafting a collaborative solution (e.g., as was done in the Minnesota case study).

Figure 9: Scenario 2

In the second example, Figure 9 Scenario 2, we assume the subject gas LDC is exploring potential pathways to introduce RNG into the gas system at scale and to contribute to the jurisdiction's environmental policy goals. In this scenario, there is a clear mandate to achieve low carbon emissions across all utilities combined. Regulators have the authority to approve utility proposals to achieve the mandate and are not constrained by a "least-cost mandate."

Barriers:

Affordability. The stakeholders are concerned regarding overall cost of utility service to the residents in the jurisdiction. Despite the absence of a least-cost mandate, affordability is a clear regulatory objective.

Aligning Utility Incentives with Social Policy Objectives. The regulator anticipates the utility may propose a suite of options and incentives that are aligned with achieving the environmental goals while maintaining affordable utility service. Intervenors representing a potential wide spectrum of interests (e.g., low-income, retired persons, social justice advocates) are participating in regulatory proceedings.

Local Sourcing. Although not specifically mandated, many interested parties have expressed a desire to have RNG produced locally and contribute to the economic vitality of the region.

Potential Pathway:

The stakeholders may choose a number of enabling activities and rate approaches to overcome these three primary barriers that have been identified:

Affordability. The utility could:

- Ensure there is a mechanism by which the utility could interconnect with RNG projects. If no mechanism is available, the utility could make a proposal for the recovery of interconnection costs as well as a return on those costs to its regulator.
- Once a means for interconnection is available, issue Request for Proposals ("RFPs") for locally sourced RNG. RFPs ensure fair bidding practices and can include terms and conditions that favor local project development. Further, RFPs are non-binding solicitations, which allows the utility to evaluate prices and determine whether the cost for incremental RNG supply could have an adverse impact on customer rates.
- Petition the regulator for RNG costs to be included in the PGA with other gas purchases. With this approval the utility can gradually increase its RNG procurement and evaluate the impact on overall cost of gas rates and customer bills.
- The utility should propose that the prudency of low-carbon resources procured be evaluated on the basis of how the cost of those resources compare to the cost of alternative resources with the same emissions reduction benefits, which may enable the utility to enter into longer-term gas supply agreements with RNG producers.
- Consider the need for special rates for firming, ramping and balancing services for electric generation by the gas utility that would need to be supplied with low-carbon gas resources resulting in a greater allocation of costs to electric generators.
- Propose a green tariff. This proposal will stream RNG prices to customers on a subscription basis. This enables direct cost attribution and insulates other customers from what may be a higher-cost for the purchase of a low-carbon gas resource. This proposal can be complementary to PGA treatment, as enrolling customers can elect a significantly higher percentage of their supply from RNG than what would otherwise flow through the PGA.
- Propose a green tariff rebate for low-income and vulnerable customers such that those customers' energy costs relative to their total income are in line with those of the average customer.
- Perform regular quantification and reporting on the economic impact of the RNG procurement and rebate program on low-income and vulnerable customers and develop a plan for how the program will be adjusted if it is determined to disproportionally impact low-income customers.

Aligning Utility Incentives. The regulator could:

- Require the utility to propose a suite of incentives aligned with measurable environmental performance metrics. For example, the utility could propose a greenhouse gas reduction performance metric that includes a symmetrical financial incentive. Such a metric could be structured so that the utility earns an incentive if they can show that they have met GHG emissions reduction targets, and the incentive dollar amount could be based on a pre-determined cost of carbon. This incentive may also include a penalty for missing the target.

- Consider allowing the utility to directly participate in RNG capital investment. Utilities earn their financial returns on invested capital, and as a result, are interested in new opportunities to invest in their utility systems. In the case of RNG, utility investment can range from "make ready" investments (pipes and apertures constructed to a pre-determined interconnection site) to a turnkey full RNG project (methane capture, processing, and introduction into the utility system).

Local Sourcing. All stakeholders could:

- Encourage local investment in new RNG facilities. This may include local tax incentives, long-term purchase agreements with the utility, and incentives for local biogas sources to participate in an identified and structured economic development program.
- Fund education and outreach programs. Electric utilities that encourage rooftop solar have crafted powerful education and outreach programs, such as town-wide focus events that include solar PV retailers, utility representatives, and energy efficiency experts that are funded through utility energy efficiency charges on customer bills. RNG production can be viewed as a similar opportunity with targeted education, outreach, and incentives to participate.
- Include local-sourcing option in voluntary green tariff.

In our assessment, the most effective regulatory policies to achieve rapid and extensive reduction of greenhouse gases in the gas distribution sector are those which have the greatest impact on the "Speed at Which Policy Could be Expected to Reduce GHG" and the "Extent to Which Policy Could be Expected to Reduce GHG." The policies and initiatives that we have identified that satisfied both criteria included: explicit regulatory authority through legislation, climate goals and targets, renewable portfolio standards for gas, REC programs for gas, rate base investment, innovation funding programs, output incentives, recovery of renewable fuel costs through the purchased gas adjustment mechanism, certain business alliances, and the setting of interconnection and gas quality standards. Though as indicated above, each regulatory pathway will be unique to the utility and its regulatory jurisdiction, our research suggests that the policies listed above are the most influential in achieving scale in the distribution of low-carbon fuels.

Appendix A: Interview Questions

1. What barriers/obstacles exist in the current regulatory landscape at the state level for natural gas utilities to advance low-carbon resources, namely low-carbon gas supplies such as RNG and Hydrogen? What do you consider to be the greatest barrier to adoption and implementation of low-carbon gas resources?
2. In your view, what are best practices that are available to give utilities a reasonable opportunity to advance low-carbon gas resources? Is there a regulatory jurisdiction in the U.S. and abroad where you consider those best practices are being employed?
3. What rate design characteristics would allow utilities to recover costs and earn an adequate return in the low-carbon gas environment. What has been tried and failed? What has been most successful?
4. What sort of policy and regulatory changes are necessary to allow utilities to introduce higher-priced gases like RNG and hydrogen into the distribution system for system-wide adoption?
5. How do regulators effectively address more expensive low-carbon gas procurement in the context of a least-cost mandate?
6. How do you balance the social mandate of zero carbon with ratepayers' economic interests?
7. What lessons learned from electric system modernization efforts can be applied to accelerate the decarbonization of other sectors (in the case of natural gas systems) or promote new sectors such as hydrogen?
8. What is your experience with low-carbon gas programs? How is it working to date? Are there concerns?
9. What have been the greatest areas of resistance in advancing low-carbon gas programs in your jurisdiction? How were you able to overcome that resistance, or other pitfalls, false starts, etc.?

Appendix B: Low-Carbon Gaseous Fuels

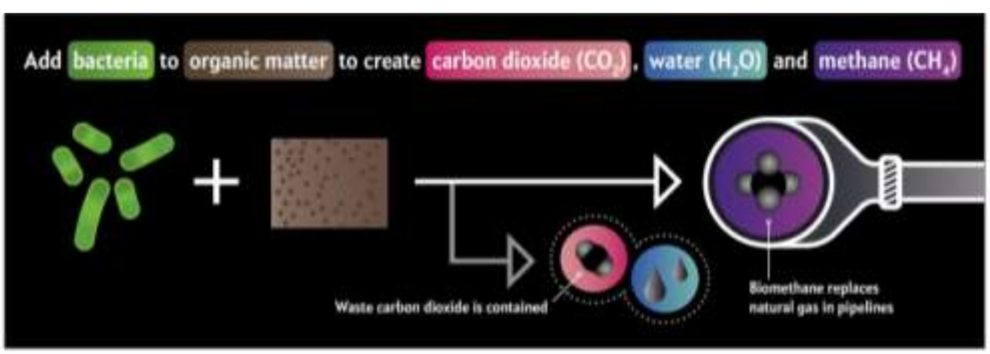
Renewable Natural Gas (RNG)

The American Gas Association ("AGA") defines RNG as "any pipeline compatible gaseous fuel derived from biogenic or other renewable sources that has lower lifecycle CO_2 emissions than natural gas." Most RNG today is simply methane captured at a variety of naturally occurring sources and refined to become commercially equivalent to natural gas stock. The RNG refinement process removes moisture and particulates and other contaminants[83], and is typically treated at or near the source. For example, methane captured at a landfill can be treated and compressed on site, and eventually utilized for end-uses such as electric generation, vehicle fuel, or heating. This output of pipeline-quality gas can also be introduced into a utility's distribution system if an interconnection facility (flange, meter, and other appurtenances) are "made ready" at the site. Like natural gas, RNG injected into a natural gas pipeline commonly has a methane content of between 96 and 98 percent.[84]

RNG can be safely used in any end-use application that is typically fueled by natural gas, including: heating, cooling, water heating, cooking, industrial applications, transportation fuel, and electricity generation. The primary source of RNG is from capturing emissions from existing waste streams. In recent years, RNG has become increasingly available with approximately 50 trillion Btu per year of RNG injected into gas transportation and distribution systems from landfills, dairy digesters, and water resource recovery facilities ("WRRFs").[85]

A simplistic view of how RNG is produced via anerobic digestion is shown in **Figure 10**:

Figure 10: How RNG is Produced[86]



83 U.S. Environmental Protection Agency report EPA 456-R-20-001, "An Overview of Renewable Natural Gas from Biogas", July 2020.

84 https://www.epa.gov/lmop/renewable-natural-gas

85 Mintz, M. and P. Voss. Database of Renewable Natural Gas (RNG) Projects, 2020 Update, Argonne National Laboratory, October 2020, https://www.anl.gov/es/reference/renewable-natural-gas-database.

86 Diagram from "What to do About Natural Gas" by Michael E. Webber. Scientific American, April 2021 Volume 324, number 4.

The captured fugitive methane emissions that are used to produce RNG are 25 to 28 times more potent than CO2 as a greenhouse gas.[87] Burning methane emits roughly 2.75 grams of CO2 for every one gram of methane that is completely consumed.[88] Simple math indicates that we are roughly 9 to 10 times better off by burning RNG than doing nothing and allowing the methane to escape into the atmosphere. To the extent that there are opportunities to capture the carbon from burning methane, e.g., from the flue of an industrial process or through direct air capture, there is an opportunity to further reduce carbon in the atmosphere.

Hydrogen

Hydrogen is a naturally occurring element produced when water interacts with minerals and the water vapor escapes into the atmosphere. It can also be produced using man-made processes. Hydrogen production is often characterized with colors, **Figure 11**, ranging from green to gray in accordance with the CO_2 balance of its production.[89] Green Hydrogen 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. Turquoise Hydrogen 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. Blue Hydrogen is also generated from fossil fuels, where CO_2 is separated and stored or reused such that Hydrogen production is carbon-neutral. Grey Hydrogen is obtained from fossil fuels, where for example natural gas may be converted to Hydrogen, but the CO_2 byproduct is not captured and stored.[90] The definition for Grey Hydrogen is provided for purposes of inclusivity, but we note that its carbon emitting properties would preclude it from consideration as a low-carbon gas alternative.

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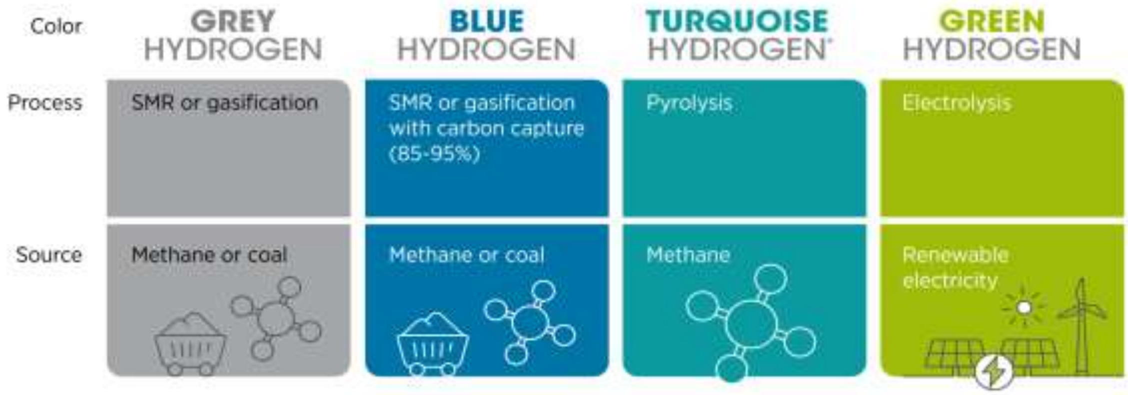
87 https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf

88 R. Muller, Fugitive Methane and Greenhouse Warming; https://static.berkeleyearth.org/memos/fugitive-methane-and-greenhouse-warming.pdf

89 The Department of Energy ("DOE") has recently shifted language to "clean hydrogen" to be inclusive of all decarbonized pathways and does not characterize hydrogen production processes by color.

90 Schnettler, Heunemann, and von dem Bussche, *Hydrogen infrastructure – the pillar of energy transition, The practical conversion of long-distance gas networks to hydrogen operation* (2020) at 6.

Figure 11: Colors of Hydrogen[91]

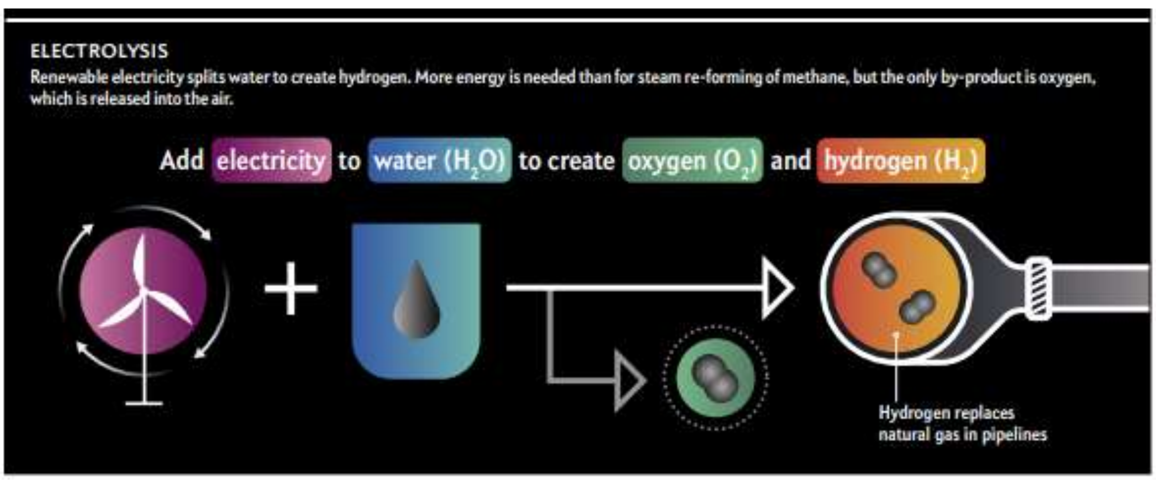


Note: SMR = steam methane reforming.
** Turquoise hydrogen is an emerging decarbonisation option.*

Hydrogen may either be blended with natural gas or may be substituted for natural gas in a dedicated hydrogen system. Though hydrogen production is still in the demonstration phases in the U.S., the United Kingdom has begun to test and develop hydrogen networks. A 2019 report by *The Fuel Cells and Hydrogen Joint Undertaking ("FCH JU")* states that hydrogen could account for 24 percent of final energy demand and 5.4 million jobs by 2050.[92]

An example of how "Green Hydrogen" is produced through electrolysis is shown in **Figure 12** below[93]:

Figure 12: Green Hydrogen Production



91 IRENA (2020), Green Hydrogen: A guide to policy making, International Renewable Energy Agency, Abu Dhabi.

92 "Hydrogen Roadmap Europe: A Sustainable Pathway For The European Energy Transition", Fuel Cells and Hydrogen Joint Undertaking, 11/02/2019.

93 Scientific American, April 2021 Volume 324, number 4.

Appendix C: Jurisdictional Research Examples of Activities that have Addressed Barriers

Ambiguous Authority

Explicit Legislative Guidance

Minnesota

As we discuss in our case studies, in Minnesota, CenterPoint Energy, with gas utility operations in southern and central Minnesota, including Minneapolis, led the drive towards enacted legislation, which culminated in the June 2021 passage of the Natural Gas Innovation Act. This Act gives Minnesota's gas utilities a substantial opportunity to pursue innovative climate solutions and partnerships to make cost-effective investments in low-carbon gas resources.

United Kingdom

In April 2021, the UK committed to net-zero by 2050 and a 78% reduction in carbon emissions from 1990 levels by 2035. The UK Government's 10-point Green Plan sets a path for accomplishing the net-zero commitments. The Plan targets 5 GW of low-carbon hydrogen capacity by 2030 and commits to maximize electrolyzer resources and Carbon Capture, Usage and Storage ("CC&S") technologies. It provides for permitting hydrogen heating trials - starting with a hydrogen neighborhood and then a hydrogen town before 2030, which is supported by a £240 million Net Zero Hydrogen Fund and will establish business models and revenue mechanisms to bring through private investment in 2022. The Plan develops revenue mechanisms for CC&S in the North Sea and commits to raising R&D investment to 2.4% of GDP by 2027. It also provides funding for various innovation projects and commits to use green Bonds to finance sustainable infrastructure.

While it is not known exactly how the UK will reach the Net-Zero target, researchers and policy makers are exploring potential pathways, including electrification, local low-carbon heat networks, and hydrogen networks. Each possible pathway or combination of interventions would result in a very different future use of the gas distribution networks.

Great Britain's energy regulator, Ofgem, set out its goals and priorities in its Decarbonization Program Action Plan (February 3, 2020) to deliver many of the government's environmental and social support schemes, which are key to enabling low-carbon heat and power. Ofgem recognizes that there will be additional costs in the short-term as energy decarbonizes and intends to ensure that these costs are as low and fair as possible. Ofgem has asserted that investing in the short term will save money in the medium and long term; and that not acting today will result in much higher costs in the future as there would be even tougher challenges to reduce carbon emissions. The dramatic reduction in offshore wind costs serves as an example of how in the long term, low-carbon energy can be cheaper than traditional fossil fuels.

Ofgem has stated,

> …the best way forward is not yet clear, but it could include the development of hydrogen networks and the electrification of heating. We will work with government and harness our expertise, including in running energy support schemes and through innovation funding, to inform and develop the wider evidence base for the different options;[94]
>
> ...The future of heating is less certain, with a range of possible different pathways to decarbonise. In 2017, just 4.5% of the energy used for heating the UK's 29 million homes and other non-residential buildings was from a low carbon source. This number needs to rise significantly by 2050; CCC analysis proposes that 90% of homes, and 100% of non-residential buildings, should be heated from a low carbon source. Electric heat pumps (including hybrid variations) and replacing natural gas with hydrogen are two of the alternative low carbon technologies to heat our buildings in the future, but there is uncertainty as to their relative roles. Heat networks equally have a role to play, where heat is provided by heat pumps, hydrogen, biomass, waste heat or other low carbon fuels…[95]
>
> …The route that is taken to decarbonise will depend on government policy, technological developments, and consumer behaviour as well as regulatory policy choices. The CCC has advised that government must make some key decisions, in particular on the future of heat, in the mid-2020s. We must also act together with others, including local and regional governments.[96]

This U.K. experience provides an excellent example of a coordinated effort between government and the regulator, and how clear legislation and regulatory policy can provide a clear path forward, even when significant uncertainties remain.

Climate Goals and Targets

Oregon

In Oregon, the largest gas utility, Northwest Natural Gas ("NW Natural"), was instrumental in the development and passage of Senate Bill 98 in 2019. SB-98 declared that: a) Natural gas utilities can reduce emissions from the direct use of natural gas by procuring renewable natural gas and investing in renewable natural gas infrastructure; b) Regulatory guidelines for the procurement of renewable natural gas and investments in renewable natural gas infrastructure should enable the procurements and investments while also protecting Oregon consumers; and (c) Renewable natural gas should be included in the broader set of low-carbon resources that may leverage the natural gas system to reduce greenhouse gas emissions.

Specific targets were identified for RNG procurement from 5% in 2019 to 30% in 2045 of the large gas utility's (NW Natural's) gas portfolio; and the utility was ensured that it would receive cost recovery for its procurement of RNG as detailed below.

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94 Ofgem decarbonization programme action plan (February 2020) at 6.

95 Id., at 11.

96 Id., at 16.

Aside from the progressive RNG targets, the program included the use of thermal certificates to track the use of RNG in the program as detailed below:

- use of M-RETS as the approved system used to track the chain of custody of the Renewable Thermal Certificates ("RTCs") that represent one dekatherm of RNG in the program.
- A "book and claim" framework for the RTCs (separation of the environmental attribute from the physical gas) and broad eligibility for RNG supply.
- Lifecycle accounting to demonstrate the bundled carbon intensity of various forms of RNG and the derived greenhouse gas benefits that are fully aligned with the framework used in Oregon's Clean Fuels program.[97]

Oregon provides an excellent example of clear legislation and RPS targets that were the result of a coordinated effort involving the gas utilities, the regulator, the legislature, and numerous engaged stakeholders.

Gas Renewable Portfolio Standards

California

In February 2022, California adopted a renewable gas standard. Under the new standard adopted by the California Public Utilities Commission ("CPUC"), California's four large gas utilities will be required to source biomethane equal to approximately 12.2% of the conventional natural gas used in 2020 by core customers (residences and small businesses) by 2030. The new standard also includes meeting an interim target of 3% renewable gas by 2025. Senate Bill 1440, passed in 2018, and authorized the CPUC to adopt the biomethane procurement program targets for the gas utilities it regulates.

The interim target alone is 17.6 billion cubic feet of biomethane, corresponding to 8 million tons of organic waste diverted annually from landfills. This along with the 2030 target will help the state achieve its goal to reduce methane and other short-lived climate emissions by 40% by 2030.[98] The state targets are even somewhat less aggressive than SoCalGas's own strategy of achieving 20 percent RNG by 2030 and net zero GHG by 2045.[99]

The methodology adopted by the CPUC to determine cost effectiveness uses the social cost of methane[100] as the metric for procedural review such that procurement contracts must be scrutinized on a uniform basis to determine whether the biomethane procured provides the most GHG reduction benefit at the least cost. It would require analysis of factors such as the

97 PUCO Rulemaking Order, AR 632, Order No. 20-227 (July 16, 2020) at pp. 3, 8-9.

98 https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-sets-biomethane-targets-for-utilities

99 https://www.socalgas.com/sustainability/leading-through-sustainability

100 The $26/MMBtu value is based on the most recent 2021 federal Interagency Working Group estimate of the social cost of methane. "Social cost of methane" represents the monetary value of the net harm to society associated with adding a small amount of methane to the atmosphere in a year. In principle, it includes the value of all climate change impacts, including (but not limited to) changes in net agricultural productivity, human health effects, property damage from increased flood risk natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services.

price of natural gas, costs associated with transporting the gas, the cost of biomethane, the cost of emissions compliance, and the carbon intensity ("CI") of the biomethane.

In addition, the CPUC recognized the need to ensure that every biomethane contract entered into by the utilities is cost-effective and takes into consideration the various perspectives and factors that parties recommended in the proceeding, such as short-lived climate pollutant reductions, carbon intensity, and air quality improvement in disadvantaged communities. Thus, the utilities are required to take these factors into consideration when establishing the standardized cost-effectiveness test for individual contracts and biomethane procurement planning purposes. The issues of cost-effectiveness and environmental justice must be addressed in a public forum.[101]

To mitigate rate impacts to disadvantaged customers, the gas utilities offer the California Alternate Rates for Energy ("CARE") program, previously authorized by the CPUC. Under the CARE program, Low-income customers that are enrolled receive a 20 percent discount on their natural gas bill.[102]

Concerned that inflexible short-term procurement targets could adversely affect biomethane prices if the utilities were required to purchase limited biomethane supply at above market rates to adhere to a strict or inflexible target, the utilities requested and were granted a flexible compliance approach for meeting the 2025 short-term target, including the adoption of compliance methods such as banking and borrowing, possible trading excess supplies between the utilities, and other tools available to manage supply.[103]

Hawaii

Hawaii - HB 1242 proposed an RPS for gas utilities. The bill required the following renewable portfolio requirements: 25 percent of sales by 2025; 40 percent of sales by 2030; 70 percent of sales by 2040; and 100 percent of sales by 2050. The bill provided for cost recovery through an automatic rate adjustment clause. The bill has not been enacted and there has been no further activity since the hearing, scheduled for March 2020, was cancelled.

Cost

Relaxing the Least-Cost Mandate

Florida

In Florida, SB 896, passed in April 2021, allows the PSC to approve cost recovery by the utility for purchases of RNG where pricing exceeds the natural gas market price but is otherwise deemed reasonable and prudent. The Act defines renewable natural gas and provides guidance to regulators for cost recovery below:

> *(f) "Renewable natural gas" means anaerobically generated biogas, landfill gas, or wastewater treatment gas refined to a methane content of 90 percent or greater which may be used as a transportation fuel or for electric generation or is of a quality capable of being injected into a natural gas pipeline.*

101 https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-sets-biomethane-targets-for-utilities.

102 https://www.cpuc.ca.gov/lowincomerates/

103 https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-sets-biomethane-targets-for-utilities

> *(9) The commission may approve cost recovery by a gas public utility for contracts for the purchase of renewable natural gas in which the pricing provisions exceed the current market price of natural gas, but which are otherwise deemed reasonable and prudent by the commission.*[104]

Oregon

Bill SB-98 laid out a regulatory structure for both large and small gas utilities with large gas utilities subject to increasing annual RNG percentages; and provided for recovery of costs of RNG through the PGA. Further, it provided for recovery of prudently incurred costs in meeting the requirements of the legislation, including the company's allowed return on investment. Specifically, with respect to cost recovery, Bill SB-98 found that:

> *(2) The commission shall adopt ratemaking mechanisms that ensure the recovery of all prudently incurred costs that contribute to the large natural gas utility's meeting the targets set forth in subsection (1) of this section. Pursuant to the ratemaking mechanisms adopted under this subsection:*
>
> *(a) Qualified investments and operating costs associated with qualified investments that contribute to the large natural gas utility meeting the targets set forth in subsection (1) of this section may be recovered by means of an automatic adjustment clause, as defined in ORS 757.210.*
>
> *(b) Costs of procurement of renewable natural gas from third parties that contribute to the large natural gas utility meeting the targets set forth in subsection (1) of this section may be recovered by means of an automatic adjustment clause, as defined in ORS 757.210, or another recovery mechanism authorized by rule.*[105]

Minnesota

The Gas Innovation Act provides a pathway for gas utilities to obtain regulatory approval to seek recovery of eligible costs under an "innovative resource" plan filed by the utility and approved by the Minnesota Public Utilities Commission.

With respect to natural gas utility innovation plans, the Gas Innovation Act also requires the Commission to establish a framework for the procurement and development of "innovative resources," which are defined as follows:

> *(h) "Innovative resource" means biogas, renewable natural gas, power-to-hydrogen, power-to-ammonia, carbon capture, strategic electrification, district energy, and energy efficiency.*[106]

The cost-recovery provisions are balanced with consumer protections such as an annual cost caps, achievement of commission-established cost-effectiveness objectives and normal prudency reviews. Rather than impute a social cost of carbon into the calculation, the cost effectiveness test looks to the cost of alternative resources that provide the same level of emissions reductions. Specifically, in the Gas Innovation Act, the cost effectiveness test is defined as follows:

> *(6) the cost-effectiveness of innovative resources calculated from the perspective of the utility, society, the utility's nonparticipating customers, and the utility's participating customers compared to other innovative resources that could be deployed to reduce or avoid the same greenhouse gas*

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104 Florida 2021 Legislature, Enrolled. SB 896, 1st Engrossed. Section 2. Part (f) and Subsection (9) as added to section 366.91, Renewable Energy, Florida statutes.

105 Id., Section 5, part (2).

106 State of Minnesota, House of Representatives, H.F. No. 6, Article 8, Section 20, Subd. 1. Definitions (h).

> *emissions targeted for reduction by the utility's proposed innovative resource;*[107]

Aligning Utility Incentives with Social Policy Objectives

Rate Base Investment

Ohio

Ohio law (HB 166) allows gas utilities to treat infrastructure, facilities and interconnections related to biologically derived methane gas as “useful” facilities for distribution service, thus allowing utilities to recover a return on this investment as part of a normal rate case. Specifically, the law states,

> *Any property, equipment, or facilities installed or constructed by a natural gas company to enable interconnection with or receipt from any property, equipment, or facilities used to generate, collect, gather, or transport biologically derived methane gas, or to enable the supply of biologically derived methane gas to consumers within this state, may be treated as instrumentalities and facilities for distribution service if the public utilities commission determines that treatment is just and reasonable. If the commission makes that determination, the property, equipment, or facilities shall be considered used and useful in rendering public utility service for purposes of section 4909.15 of the Revised Code.*[108]

Oregon

Senate Bill 98 provides that qualified investments in renewable natural gas infrastructure by a natural gas utility for the purpose of providing gas service under an RNG program, may be capitalized in rate base and earn the authorized return on investment.[109] In rules adopted by The Public Utility Commission of Oregon to implement 2019 Senate Bill 98, the commission authorized utilities to invest in and own the cleaning and conditioning equipment to process raw biogas, the facilities needed to connect to the local gas distribution system, as well as upstream biogas investment. However, before making a qualified investment in biogas production that is upstream of conditioning equipment, pipeline interconnection or gas cleaning, a large natural gas utility must engage in a competitive bidding process under the commission rule.[110]

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107 State of Minnesota, House of Representatives, H.F. No. 6, Article 8, Section 20, Subd. 2. Innovation plans. (6)

108 HB 166, 133rd G.A. (2019), Sec. 4928.18 (B) at 1394.

109 Senate Bill 98, 80th Oregon Legislative Assembly –2019 Regular Session, Sections 5(3) and 6(4). Note that “Qualified Investments” in biogas infrastructure exclude certain investments in biogas production by a single livestock operation that produces more than 250 standard cubic feet of biogas per minute; or a single biogas source that produces more than 1,000 standard cubic feet of biogas per minute.

110 Public Utility Commission of Oregon, Order No. 20-227, Rulemaking Regarding the 2019 Senate Bill 98 Renewable Natural Gas Programs, Appendix A.

Minnesota

Incremental costs eligible for recovery under the recently enacted Innovation Plan include the return of and on capital investments for production, processing, pipeline interconnection, storage, and distribution of innovative resources.

Pilot Programs

California

Sempra Utilities received approval to pilot a voluntary RNG program for residential customers [Application 19-02-015]. As approved, residential customers will be able to select a fixed dollar amount per month ($10, $25, or $50) for the purchase of RNG. Commercial customers will be able to select a fixed dollar amount per month or select a percentage of their consumption for the purchase of RNG, up to 100%. The ALJ decision proposed a three-year pilot, whereby at least 50% of RNG must be procured from in-state. The plan was approved by the California Public Utilities Commission ("CPUC") on December 17, 2020.

New Jersey

New Jersey Natural Gas ("NJNG") is seeking full recovery of the Howell Power-to-Gas Injection Project, located in Howell, NJ. The project will utilize renewable power for the production of Hydrogen. The Hydrogen would be produced and stored on site for direct injection to the natural distribution system to create a blended mixture of Hydrogen and natural gas in the pipeline system. The project is estimated to cost $6.0 million in their recently filed rate case.[111] This case is pending a decision, but NJNG has moved forward with the project and the facility was placed into service in October 2021.[112]

Florida

In Florida, Florida Power and Light has proposed a 15 MW green hydrogen electrolyzer and storage facility at the Okeechobee Clean Energy Center (Case 20210015-EI Pilot). The project will use curtailed solar power to produce green hydrogen to be stored as fuel for turbines - a $65 million investment. In the Joint Motion for Approval of Settlement, the joint parties authorized the implementation of the green hydrogen pilot project. The parties agreed that FPL's decision to pursue the Green Hydrogen pilot program is prudent and Florida Power and Light was allowed to include the project in its rate base, subject to future challenge.[113]

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111 Direct Testimony of John B. Wyckoff, VP – Engineering, NJNG Co., BPU Docket No. GR21030679 (March 30, 2021), Exhibit P-2, at 19.

112 https://www.njrsustainability.com/environmental/NJR_HydrogenProject_Factsheet_01d1.pdf

113 FPSC Order, In re.: Petition for rate increase by Florida Power & Light Company, Docket No. 20210015-EI, Order No. PSC-2021-0446-S-EI (December 2, 2021) at 19.

Illinois

Nicor Gas' Renewable Gas Interconnection Pilot received approval July 8, 2021, from the Illinois Commerce Commission. The pilot aims to encourage the development of RNG production facilities within Nicor Gas' service territory and allows the company to determine how RNG can be efficiently integrated into its gas distribution system as a safe, reliable, and clean energy source for customers.

UK

In the UK, Ofgem allows funding to gas distribution networks ("GDNs") on an application basis for Hydrogen Consumer Trials (pilot programs) to support the Government in assessing feasibility, costs, and benefits of transitioning to hydrogen for heat – enabling a policy decision on whether or not gas networks will be converted at scale for use of hydrogen in occupied buildings using existing network infrastructure. The GDN's are expected to fund part of the pilot along with private sector investors. Most work would be funded by established regulatory mechanisms such as, the Net-Zero Funding Allowance Reopener and Network Innovation Allowances.

Innovation Funding Programs

Minnesota

In 2021, the Minnesota legislature adopted a first-of-its-kind innovation framework specifically targeted toward encouraging gas utilities to reduce emissions and diversify their business. This program encourages gas utilities to use RNG for their gas supply portfolio, develop hydrogen, carbon capture and district energy projects, and even propose electrification strategies. Section 5, of this report contains a case study on the history and program details of the Minnesota Innovations Act framework.

Vermont

Vermont Gas System ("VGS") has received authorization to include $2 Million in spending per year in base rates for Climate Action and Innovation, a portion of which shall be operating and maintenance costs of no more than $500,000 annually. Under the Climate Action and Innovations program, VGS will pursue and consider projects, programs, and services that support Vermont's statewide energy goals by advancing promising technologies to facilitate efficient, lower carbon energy choices for its customers (e.g., researching and seeking to pursue district energy, RNG, uses of waste heat to lower usage of natural gas, power-to-gas projects, more efficient or less carbon-intensive equipment for heating and industrial processes, etc.).[114]

British Columbia

The British Columbia Utilities Commission ("BCUC") approved a $25 million Clean Growth Innovation Plan and associated rider for FortisBC Energy Inc. ("FEI") to advance renewable gas targets as outlined in the CleanBC Plan. The Plan is to be funded with a fixed rider on

[114] See, Exhibit VGS-JMP-5 in Case No. 3529. The Commission approved VGS's Amended Alternative Regulation Plan pursuant to the statutory requirements of 30 V.S.A. § 218d on August 11, 2021.

customer bills of $0.40/month. The Plan also includes a true-up deferral account that will be allowed to earn a return on capital at the allowed weighted average cost of capital. This funding was incremental to previously approved and ongoing funding for natural gas value chain innovation, DSM innovative technologies, and innovation funding for Natural Gas for Transportation ("NGT") and RNG programs.

UK

The UK provides Innovation Funding in its regulatory framework through Network Innovation Allowances ("NIA") and Strategic Innovation Funds ("SIF"), collectively, allowing £30 billion of upfront investment across network sectors with a further £10 billion that could be available during the 5-year price control. The SIF supports funding of high value projects to address innovation challenges set by Ofgem. £209 Million of NIA allowance funding will support the energy system transition across all sectors in the price control. Specific to gas distribution networks, Ofgem has provided £18 Million specifically funded for Cadent in developing a first-of-a-kind hydrogen project in an industrial cluster; £40 Million across the GDNs for Net Zero use-it-or-lose-it allowances to enable companies to fund early design and pre-construction work to facilitate small Net Zero projects; and £450 Million of Strategic Innovation Funding across the price control for high value innovation projects of £5 Million or more to address innovation challenges set by Ofgem, and to coordinate with public sector funding initiatives to support Net Zero.

Canada

NGIF Industry Grants is a first-of-kind, industry-led grant organization to fund early-stage startups developing solutions to environmental and other challenges facing Canada's natural gas sector. NGIF Industry Grants is operated by a Canadian venture capital firm NGIF Capital Corporation and offers grant and equity financing for startups that deliver solutions to the challenges (environmental and other) facing the natural gas sector. NGIF Cleantech Ventures, also operated by NGIF Capital Corporation, makes equity investments in early-stage startups. The Fund's investments include climate solutions in existing natural gas production, transmission, distribution, storage, and end-use applications, as well as leading to the expanded production of renewable natural gas and hydrogen.[115]

Incentives

UK

In its most recent regulatory framework for gas network operators (gas distributors), Ofgem has established a series of output incentives that are tied to socially desired outcomes such as customer safety, reliability, emissions reductions, etc. One example of an incentive mechanism is the "Shrinkage and Environmental Emissions" incentive. This serves as both a reward and a penalty for excess performance or deficient performance relative to an established benchmark for pipe leakage. The incentive is calculated by the variance above or below the benchmark in GWh multiplied by the associated greenhouse gas emissions cost

[115] https://www.ngif.ca/about-ngif-capital-corporation/

plus the cost of the gas, subject to an asymmetrical deadband and a cap/collar equal to plus or minus 0.25% of base revenue.[116]

Procurement Strategies

New Hampshire

In New Hampshire Liberty Utilities filed a petition for approval of a 17-year RNG supply and transportation contract for the purchase of all pipeline quality RNG produced from a Bethlehem, NH landfill. Liberty's proposal includes plans to compress the RNG and deliver it into Liberty's distribution system and (or) transport to other locations, to be used in place of natural gas by distribution customers and by designated users under special contract. The proposed RNG agreement calls for Liberty to pay set prices for the gas supply and to pay a lower price if Liberty purchases the RNG facility. The Company states that approximately 65 percent of the RNG would be served to Special Contract customers, with the remaining 35 percent to be injected into the general distribution systems. Until the RNG contract volumes are fully allocated, the Company proposes to include the balance of unsold RNG in the Company's overall cost of gas, subject to a cap of 5 percent of the Company's overall annual send out. The Company states it is investigating an "opt-in" tariff for customers to purchase RNG at its contract price. Liberty claims that special contract customers' facilities are eligible for thermal renewable energy certificates ("TRECs") generated by the use of RNG, and that distribution customers whose boilers or furnaces use RNG to heat their homes or businesses are similarly eligible for TRECs. Liberty anticipates "monetizing" the value of TRECs not otherwise owned by special contract customers, to reduce the Company's cost of gas.[117]

Connecticut

Recent legislation proposed in Connecticut (SB 337 & HB 6409) would have established a procurement process for gas utilities to cost-effectively meet a portion of its annual supply with RNG. The procurement process outlined in that legislation is similar to what Connecticut has previously used for contracting grid-scale renewable electricity resources.

Vermont

Vermont Gas Systems' ("VGS") recently approved rate plan provides for an RNG procurement process that gradually increases RNG as a percentage of its retail sales and ensures that VGS remains a competitive heating services company as it reduces its greenhouse gas emissions. VGS offers a voluntary RNG tariff to its customers and is gradually increasing its RNG as part of its overall supply over time. The Amended Alternative Regulation Plan allows for an increase in RNG supply equivalent to 2% of VGS's retail sales on an annual basis.[118] Over the term of its Amended Plan, VGS may incrementally increase the amount of RNG under the PGA by up to 2% of VGS's overall retail gas sales.

[116] RIIO-2 Final Determinations – GD Sector Annex (Feb 2021) at 69.

[117] New Hampshire Public Utilities Commission Docket No. DG 21-036, 6/25/2021.

[118] Vermont Public Utility Commission Case No. 19-3529-PET, August 11, 2021.

Oregon

Oregon is laying the groundwork for a low-carbon gas system with supporting policies that will bring low-carbon gas resources to scale. SB 98 provides for renewable gas portfolio allotments allowed during each 5-year period, with an annual cap of 5% of its revenue requirement. This is bolstered in a subsequent Order providing for the receipt of a Renewable Thermal Certificate ("RTC") for the environmental attributes procured or produced for RNG delivered to retail gas customers. The utilities are entitled to recovery of RNG costs through the PGA or a separately approved automatic adjustment clause. The Order also specified an IRP framework where the gas utility would lay out its strategy for meeting its annual RNG targets.[119] Utilities have begun procuring long-term supplies. NW Natural entered into a 21-year deal to buy up to 1 million MMBtu of RNG per year starting in 2022 to sell to its customers in Oregon.[120] This is the third such agreement to procure RNG by NW Natural. To date, the agreements provide NW Natural options to buy or develop renewable gas totaling about 3% of its annual sales volume in Oregon.

Development of Long-term Integrated Resource Plan ("IRP")

Colorado

In Colorado, recently enacted legislation (SB 21-264) requires gas utilities to file a "clean heat plan" with the Colorado Public Utilities Commission ("CPUC"). The targets are a four percent reduction below 2015 GHG emission levels by 2025 and 22 percent by 2030. Within the overall targets, RNG may only account for one percent of the 2025 target and five percent of the 2030 target. The CPUC will establish a cost cap for each Gas Distribution Utility's ("GDU's") compliance with its plan. The cost cap is 2.5% of annual gas bills for all of a GDU's full-service customers. The CPUC is directed to approve a plan if it finds that doing so is in the public interest.

Washington, District of Columbia

Clean Energy DC is the District of Columbia's ("DC") proposal to reduce greenhouse gas (GHG) emissions at least 50% below 2006 levels by 2032 while increasing renewable energy and reducing energy consumption, as directed by the landmark Sustainable DC plan; and its long-term goal to achieve carbon neutrality by 2050. In the DC government's plan, the utilities are directed to explore "energy as a service" for electric/gas hybrid heating.

[119] Oregon PUC, Order No. 20-227, AR 632, entered July 16, 2020.

[120] S&P Capital IQ, NW Natural inks 21-year renewable natural gas deal with Archaea Energy unit (November 15, 2021).

Oregon

In developing the regulatory rules for the implementation of SB 98 which provides for an RNG RPS directed to retail gas customers, the Oregon PUC specified an IRP framework where the gas utility would lay out its strategy for meeting its annual RNG targets. The RNG Planning framework requires the gas utility to file information on RNG in accordance with existing IRP requirements in Oregon. The additional RNG information would include information about opportunities, challenges, and the natural gas utility's strategy for meeting annual RNG targets during the period of the IRP action plan, and the cost-effectiveness calculation that the utility will use to evaluate RNG investments.[121]

Green Tariffs

Vermont

VGS offers customers a variety of pricing options under its program. Customers first have the option of purchasing blended RNG or locally sourced RNG (i.e., from projects located in Vermont). Under either option, customers can elect to offset a fixed portion (10, 25, 50 or 100%) of their monthly usage or a fixed charge based on the amount of ccf chosen by the customer (regardless of how many are used).[122] This structure is one of the most flexible VGT by a U.S. Utility and provides multiple options to fit customer preferences and budgets, including spreading the additional cost over the course of the year, rather than the higher usage winter months.

VGS has several tools within its VGT program to match the purchase of RNG supply with demand. If demand for RNG exceeds available supplies during the program year, the company may source additional RNG supply the subsequent year, purchase equivalent carbon offsets, or contribute equivalent revenue to the Clean Energy Development Fund established by the Vermont General Assembly through Act 74 (30 V.S.A. § 8015) to avoid suspending the program. If supply for RNG exceeds demand, VGS would first seek to market the RNG and environmental attributes and if necessary, recover any residual costs through the purchased gas adjustment or through a rate case.

Utah

In 2019, Dominion Energy Utah received approval to create a voluntary RNG program called "GreenTherm". While the program generated $52,589 in contributions from 1,269 participants in 2020, its first full year of implementation, the 5,295 dekatherms of natural gas offset by clean resources under the program was de minimis compared to the scale of the company's approximate 115 million dekatherms of annual gas sales. The company is evaluating ways to include more RNG in its gas portfolio and is also exploring a hydrogen initiative called "ThermH2", intended to confirm that a 5% hydrogen-blended gas stream would not adversely impact system or customer safety.[123] [124] Lastly, the Company announced the launch of its

[121] Oregon PUC, Order No. 20-227, AR 632, entered July 16, 2020.

[122] Renewable Natural Gas – VGS (vgsvt.com)

[123] https://cdn-dominionenergy-prd-001.azureedge.net/-/media/pdfs/utah/greentherm/2020-annual-greentherm-program-report-6-30-2021.pdf?la=en&rev=cecbe954c6174f6791313e8ee96daeee

[124] See for example, Dominion Energy Utah Integrated Resource Plan for June 1, 2021, to May 31, 2022. https://pscdocs.utah.gov/gas/21docs/2105701/319082DEUIRPJune12021May3120226-14-2021.pdf

CarbonRight program in January 2022, that allows customers to offset their carbon footprint with the purchase of offsets on their energy bill.[125]

Public Private Partnerships

UK

To access Strategic Innovation Funding in the UK, gas distribution companies are expected to fund part of the initiative along with private sector investors, though most of the work would be funded through utility rates via Net-Zero funding allowances and Network Innovation Allowances. The UK has also established a Strategic Innovation Challenge that provides funding opportunities for projects that meet the challenge criteria upon successful application by the utility. The framework for the challenge is specifically intended to improve coordination between networks and other system participants as well as improve coordination of emerging innovations across networks, generators, market participants, investors, local & national policy makers, consumers, and other key stakeholders, among other challenge criteria. The 2021 Strategic Innovation Fund Challenge includes decarbonization of heat.

Business Alliances

UK

In the UK, companies are partnering to provide heat-as-a-service where customers are billed for hours of warmth of their homes and not for units of energy used to perform the service. The homes are fitted with smart heating systems that provide room-by-room temperature control and data on consumer behavior and the thermal performance of the home. Consumers select heat plans based on budget and the customer experience they seek. Once the service provider understands a consumer, the service provider can help them pick the best low-carbon system for their situation.

HyDeploy partners (Keele University and Northern Gas Networks, Progressive Energy, HSE - Science Division and ITM Power) teamed together to successfully demonstrate that 20% volume of hydrogen blended with natural gas is safe and creates no disruption to how customers currently use gas service.

The Department of Business, Energy, & Industrial Strategy ("BEIS") is currently supporting a consortium led by ITM Power along with Orsted, Phillips 66, and Element Energy through its Low-Carbon Hydrogen Supply Program. The ITM Power Gigastack Project explored the potential to scale up electrolyzer size and integrate those units with offshore wind facilities.

Oregon

In Oregon, NW Natural Holding Company will partner with a customer-owned utility and a clean energy program provider to explore the development of what would be one of the largest renewable hydrogen production facilities in North America in Eugene, Oregon. A memorandum of understanding was signed with the Oregon-based natural gas and water utility operator with the Eugene Water & Electric Board and the Bonneville Environmental

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123 https://www.dominionenergy.com/CarbonRight

Foundation to advance the initiative. Plans for the plant aim to build a 2 MW - 10 MW green hydrogen facility.

Énergir/Hydro Québec

The Énergir / Hydro Québec initiative provides an excellent example of how the traditional gas utility business model may be transformed to participate in its highest and best use and at the same time be kept essentially whole by savings realized on the electric side and conferred to the gas utility. In the proposed partnership that is currently before the Régie in Québec, Hydro Québec and Énergir would partner together to provide a dual energy service focused on electrification of space heating, except when it is too costly to do so, and joint customers will instead consume carbon-neutral gas. It should be noted that the particular circumstances in the Quebec service territory with relatively cheap and abundant hydroelectricity that is competitive with natural gas in the province, makes this partnership economically possible providing a savings opportunity for customers and beneficial to both the gas and electric utility as well as their respective customers. The partnership focuses on value over volume.

The partnership determines where and when a given fuel source will provide the most environmental and economic value, i.e., the right energy at the right time and at the right price. In their research, each company found that the goal of 100% electrification, even with Hydro Québec's cheap and abundant renewable energy sources, would increase all electric bills by 3% and gas bills by 5%, for a combined cost of approximately $2.5 billion by 2030.

Both companies went to the Canadian government together to explain the cost and proposed a new plan to pursue 70% electrification of gas customers in target markets, while the remaining 30% of existing gas customers would continue to be served with RNG. Over time, the gas system is expected to be powered entirely by RNG and Hydrogen. Because Hydro Québec would realize significant savings from the proposed dual service approach versus the full electrification approach, Hydro Quebec will remit 80% of Énergir's lost revenues out of its savings from the avoided cost of full electrification. The program is voluntary but provides a sufficient economic incentive for customers to participate and any necessary equipment retrofits are provided by the gas utility. When a customer signs on to the plan it is for a term of 15 years. However, the utilities will revisit the plan with the Regie (assuming it is approved) every 5 years.

Cost Causation and Who Should Pay

Green Bonds and Sustainability Bonds

Ontario

In February 2021, Enbridge entered a three-year syndicated Sustainability Linked Credit Facility for $1.0 billion, which allowed Enbridge to reduce its borrowing costs if it were to achieve certain ESG goals.[126] Enbridge was also among the first companies in North America to issue a Sustainability-Linked Bond ("SLB") with a $1.0 billion, 12-year term 2.50%

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126 Enbridge Inc., "Enbridge Reports Strong 2020 Financial Results," February 12, 2021, https://www.enbridge.com/media-center/news/details?id=123663.

issuance in June 2021.[127] The Company estimated that this bond issuance received a 5-basis point "greenium" (i.e., discount relative to the estimated interest rate of a regular debt issuance from the Company at that time) because the interest rate was linked to the Company's ability to achieve certain emissions and inclusion targets.[128] However, this SLB issuance included asymmetrical risks and rewards. While Enbridge benefitted from the estimated 5 basis point "greenium," the SLB issuance also includes a 50-basis point penalty if Enbridge were to fail to meet the GHG emission reduction milestones.[129]

Enbridge issued a second SLB in September 2021 and estimated that the greenium doubled to 10-basis points.[130]

UK

Ofgem's Decarbonization Action Plan indicates that green bonds will be used to finance investments in sustainable infrastructure.

Technical Considerations

Rate Base Treatment of Interconnection Costs

California

CPUC Decision 15-06-029 adopted the biomethane interconnector monetary incentive program which uses customer funds to support up to 50% of interconnection costs, capped at $1.5M/project, statewide total cap of $40M.

Act No. 2021-234 (Enacted 9/23/21) California Renewables Portfolio Standard Program authorized a community choice aggregator to submit eligible bioenergy projects for cost recovery pursuant to the BioMAT program, if open capacity exists within the 250-megawatt BioMAT program limit.

New York

Case 19-G-066: Con Ed approved to purchase RNG, with NYPSC recognizing that RNG may be more costly than conventional supplies and granted recovery of RNG interconnection costs through a consumer rate surcharge until rolled into base rates in the next rate case.

[127] S&P Capital IQ Pro, "Enbridge Closes $1B Sustainability-Linked Bond Financing," June 29, 2021.

[128] Bloomberg News, "Enbridge Doubles 'Greenium' with Canadian SLB Sale," September 17, 2021.

[129] Enbridge Inc., Form 424B5 Prospectus Supplement, June 24, 2021, at 2.

[130] Bloomberg News, "Enbridge Doubles 'Greenium' with Canadian SLB Sale," September 17, 2021.