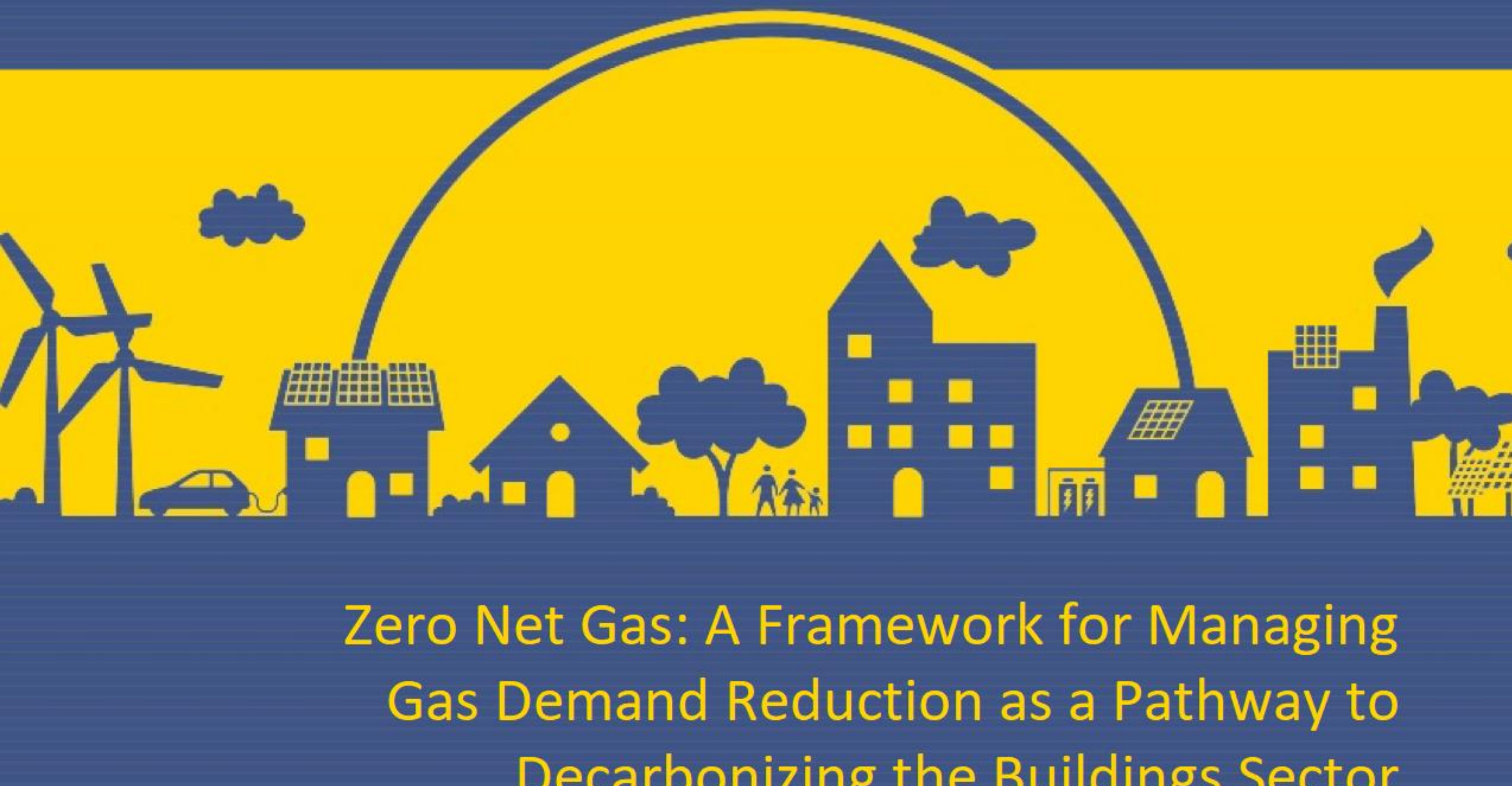

Zero Net Gas: A Framework for Managing Gas Demand Reduction as a Pathway to Decarbonizing the Buildings Sector

Radina Valova, Craig Hart, Tom Bourgeois, and Joseph O'Brien-Applegate

July 2020

Prepared for Rockefeller Brothers Fund by the Pace Energy and Climate Center

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Pace Energy and Climate Center

ELISABETH HAUB SCHOOL OF LAW

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The Pace Energy and Climate Center is a project of the Elisabeth Haub School of Law at Pace University. More than a think tank, the Pace Energy and Climate Center turns ideas into action. We believe thoughtful engagement of government and key stakeholders leads to better public policy. We conduct research and analysis on legal, regulatory and policy matters because thorough, objective analyses are essential to finding solutions to today's complex energy and climate change challenges. We are lawyers, economists, scientists, and energy analysts, committed to achieving real-world progress. For more information, visit energy.pace.edu or contact pecc@law.pace.edu.

Executive Summary

To meet Paris Agreement greenhouse gas reduction targets, gas distribution utilities and the buildings they serve—residential, small commercial, and large commercial and industrial buildings—must fully decarbonize. This paper proposes a Zero Net Gas demand reduction framework to achieve decarbonization of the buildings sector.

The Zero Net Gas Framework is a policy and regulatory pathway to start reversing gas dependence in buildings, towards deep decarbonization. The ZNG strategy posits that gas consumption must be capped in the near-term—and incrementally reduced where possible—by pairing new gas demand with reductions in existing inefficient gas use through demand-side measures, such as energy efficiency, heat pumps and renewable heating technologies such as solar thermal, non-pipe solutions, and demand response programs. The Framework focuses on reducing peak demand as a means of stopping gas infrastructure expansion, as well as reducing total gas usage in order to minimize greenhouse gas emissions.

The Zero Net Gas Framework is the first step toward deep decarbonization: by providing a mechanism for states to halt the growth of gas, regulators and stakeholders establish a pathway to achieving mid-century climate and energy mandates without further investment in gas infrastructure and dependence.

At its heart, the Zero Net Gas Framework requires that any proposed increase in gas demand is netted with a corresponding reduction in demand elsewhere within the system. Decarbonization of the gas system will require action across the gas system by various stakeholders. The Zero Net Gas Framework envisions the following elements as part of halting the growth of new net gas demand and infrastructure:

- Comprehensive integrated planning for gas infrastructure and consumption as the regulatory framework to establish the Zero Net Gas Framework;
- To implement the netting requirement, adopting a robust evaluation, monitoring, and verification process;
- Changing the gas service application process to require developers and consumers to adopt alternatives to gas wherever feasible;
- Where new gas is to be deployed, requiring it be as efficient as possible;
- Enabling large-scale deployment of non-gas, renewable resources and energy efficiency, including through cost-effective incentives to reduce financing barriers;
- Increasing access for low- and moderate-income communities to non-gas alternatives; and
- Changing the current business-as-usual approach favoring gas in the building trades for new construction and retrofits to embrace non-gas heating and cooking technologies.

This paper recommends both a process for public utility commissions to establish the Zero Net Gas Framework, as well as specific substantive and procedural considerations. Importantly, public utility commissions can rely upon their existing authority to regulate in the public interest to establish the Zero Net Gas Framework.

The paper specifically addresses gas as a fuel for building energy services, including heating, cooking, hot water, clothes drying, and on-site distributed generation. Although this paper provides an overview of the gas system as a whole, necessarily encompassing the power generation and petrochemical industrial processing sectors, it does not analyze demand-reduction measures for the electricity sector or industrial applications, given the Zero Net Gas framework's focus on gas end-use within the distribution utilities and buildings sectors.

As used herein, the term "gas" refers to any gas produced or purchased by distribution utilities to serve their customers. This can include fossil gas extracted through conventional drilling or hydraulic fracturing, as well as non-extracted gas produced from landfill waste, wastewater treatment facilities, or other biological processes (referred to as "biogas").

This paper focuses primarily on gas demand reduction challenges and opportunities in urban settings, due to the supply constraints that a number of gas utilities are currently facing in their more densely populated service territories. New York City, in particular, has faced recent moratoriums on new gas connections, impacting thousands of customers. As such, this paper examines the utility regulatory context, public service law, and distribution system issues through the lens of New York utilities. However, the findings and recommendations are broadly applicable to utility regulatory commissions and gas distribution utilities across the United States.

This paper is organized in six chapters. The first chapter presents the transition we face as a society in deciding the future of our reliance on natural gas if we are to act against climate change, and how state and municipal governments are leading this transition. Chapter two is a background chapter providing an overview of the natural gas production, transportation, and distribution infrastructure system, drivers of natural gas consumption, and the environmental and health impacts of our reliance on natural gas. The third chapter presents the economic, institutional, social, and technological barriers and challenges of transitioning away from natural gas. The institutional challenges include legal and policy issues related to jurisdiction, the prevailing approach to utility ratemaking, and the challenge of stranded assets. Chapter four explores the technology and policy options presently available to effectuate the transition from natural gas. Chapter five presents the Zero Net Gas Framework proposed in this paper as a first step to halting the growth of natural gas infrastructure, with the aim of ultimately phasing it out. The final chapter proposes next steps.

Acknowledgements

The Pace Energy and Climate Center is grateful to the Rockefellers Brothers Fund for supporting our work on zero net gas. This white paper serves as a starting point for our work on decarbonization, which is mandated in New York State by 2050. Other jurisdictions are increasingly following suit.

In preparing this paper, Karl Rábago proposed the topic and provided early guidance, and he and Sam Swanson reviewed earlier drafts of the work. Center interns and Pace Law School students Meghan Atallah (JD '21), Kylie Ayal (JD '21), Kaitlin Brockett (LL.M. '20), Sarena Malsin (JD '21), and Yuriy Korol (JD '20) supported our writing with research. We conducted several stakeholder discussions with individuals drawn from regulatory agencies, civil society, and industry who shared their insights.

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Note

Table of Contents

1. Natural Gas at a Crossroads

Natural gas and its supporting infrastructure jeopardize our planet. Expanding consumption of natural gas has replaced coal as the driving force behind global greenhouse gas emissions.[1] In the United States, gas's displacement of coal is driven by electric utilities phasing out coal-fired generation units, often replacing them with natural gas-fired units, or a combination of renewables and natural-gas fired units. Simultaneously, gas consumption by the buildings sector for heating and cooking is similarly increasing.

Climate science demands that global greenhouse emissions reduce to net zero by 2050 to prevent warming within 1.5°C above pre-industrial levels.[2] We cannot achieve this reduction without phasing out our reliance on natural gas.

States and municipalities across the United States are responding to the science by passing ambitious decarbonization mandates that aim to stop expanding gas consumption and ultimately reverse it. In New York, the setting for this study, the Climate Leadership and Community Protection Act requires the state to reduce greenhouse gas emissions 85 percent below 1990 emissions levels, and targets net-zero emissions economy-wide by 2050. In order to achieve this ambitious mandate, New York will have to significantly reduce gas-related emissions. Sixteen other states and Puerto Rico have greenhouse gas reduction mandates.[3]

Achieving these targets requires aggressive actions, challenging gas distribution utilities and the customers they serve—residents, small business, and larger commercial and industrial institutions—to transform not only their fuel choice, but also technologies, business models, and lifestyles in the process.

Gas was once promoted as the "bridge fuel" to climate mitigation. Decarbonization mandates now threaten to disrupt the entire gas value chain. Across the United States, mounting opposition to new pipeline construction has caused several utilities to impose moratoriums on new gas customers due to supply constraints. Legislation constraining distribution and transmission will likely impact gas exploration and production in the long run.

In this new environment, the natural gas value chain must either decarbonize, adapt, or perish.

Complicating this challenge, while a significant number of states have adopted gas decarbonization policies, the majority have yet to act, and among those that have acted there is broad variation in approach and ambition.[4] Gaps in regulation create potential for the natural gas industry to protect its toehold, shifting supply towards states and sectors that lack decarbonization requirements.

Gas transition also places civil society at a crossroads. Municipal leaders, the real estate development community, and public interest advocates have raised alarm over the economic and customer impact of gas moratoriums. Environmental advocates have called for robust policies and funding to ensure an equitable transition for environmental justice and

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[1] Gas is the fastest growing fossil fuel globally. *See* R B Jackson et al., *Persistent fossil fuel growth threatens the Paris Agreement and planetary health,* 14 ENVTL. RES. LETTERS (2019).
[2] JOERI ROGELJ ET AL., MITIGATION PATHWAYS COMPATIBLE WITH 1.5 °C IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT 95 (Masson-Delmotte et al., eds., 2018), *available at* https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf.
[3] Laura Shields, *Greenhouse Gas Emissions Reduction Targets and Market-based Policies*, NAT'L CONFERENCE OF ST. LEGIS. (Dec. 17, 2019), https://www.ncsl.org/research/energy/greenhouse-gas-emissions-reduction-targets-and-market-based-policies.aspx.
[4] *Id*.

disadvantaged communities while achieving climate goals.[5] Yet, even with policies and financial support, this transition will impose significant costs, which must be borne by utilities, industry, taxpayers, and ratepayers.

This transition must be both revolutionary and carefully planned. New York and other states mandating decarbonization must rethink how residential, commercial, and industrial customers are supplied with essential energy services that currently rely on gas. The transition away from gas requires avoiding major disruption to the economy and ensuring just and equitable treatment for all consumers.

The zero net gas ("ZNG" or "Zero Net Gas") policy framework presented in this paper is proposed as the first step of a staged approach to decarbonization. The framework aims to halt gas growth through a netting process that prioritizes demand-side resources and the most efficient, appropriately-sized, modular uses of gas. Halting gas demand and infrastructure expansion is essential and urgent; delay increases the stock of assets that will be "stranded"—investments that are lost due to changes in the market or regulatory environment—ultimately increasing the cost of transition and wasting societal resources.

By halting the growth of gas, the ZNG policy framework prepares New York and other states to develop longer-term mechanisms to decarbonize the gas system, addressing both environmental and consumer priorities in an equitable manner.

1.1 States and Cities Are Driving Gas Transition Through Decarbonizations Laws

In the absence of federal action to reduce greenhouse gas emissions from fossil fuels, states and municipalities are driving the nascent transition away from gas as an everyday fuel by adopting aggressive measures to curb carbon emission generally, and in some cases natural gas consumption specifically.

In January 2020, New York's ambitious Climate Leadership and Community Protection Act ("CLCPA") took effect, requiring an economy-wide emissions reduction of 40 percent from 1990 levels by 2030, and 85 percent reductions by 2050.[6] Additionally, 70 percent of electricity generation must be derived from renewable energy by 2030,[7] and 100 percent of the state's electricity must be emission free by 2040.[8] Although the CLCPA does not specifically limit the greenhouse emissions of the gas distribution utility and buildings sectors, the law's 85 percent economy-wide emissions reduction mandate applies to these sectors, making gas decarbonization essential to meet the economy-wide target.

Other states in the Northeast similarly have made robust climate commitments. New Jersey's 2019 Energy Master Pathway to 2050 aims to achieve 100 percent clean energy by 2050, and requires the New Jersey Board of Public Utilities to prepare a plan for decarbonizing the gas

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[5] In response to the moratoriums, the New York Public Service Commission approved hundreds of millions of dollars in funding support for clean energy technologies, efficiency, and other mechanisms to reduce gas demand and potentially allow new customer connections. Case 19-G-0678, Proceeding on Motion of the Commission to Investigate Denials of Service Requests by National Grid USA, The Brooklyn Union Gas Company d/b/a National Grid NY and KeySpan Gas East Corporation d/b/a National Grid, *Order Adopting and Approving Settlement* (November 26, 2019); Case 19-G-0080, In the Matter of Staff Investigation into a Moratorium on New Natural Gas Services in the Consolidated Edison Company of New York, Inc. Service Territory, *Press Release: New York State Announces $250 Million Westchester Clean Energy Action Plan* (Mar. 14, 2019).
[6] Climate Leadership and Community Protection Act, S. 6599, A. 8429, 2019-20 Reg. Sess. (N.Y. 2019), §1(12)(a).
[7] Climate Leadership and Community Protection Act, S. 6599, §1(12)(d).
[8] *Id*.

system.[9] Massachusetts enacted its Global Warming Solution Act in 2008, with initial goals of reducing emissions between 10 to 25 percent by 2020, and requires the Department of Environmental Protection to set interim reduction targets for 2030 and 2040 in order to achieve 80 percent emissions reductions by 2050.[10] Connecticut has passed several measures to mitigate climate change, culminating in reductions of greenhouse gas emissions by 80 percent of 2001 levels by 2050.[11] Additionally, the state must achieve 40 percent renewable energy by 2030 and procure two thousand megawatts of offshore wind power by 2030.[12]

Beyond the Northeast, Wisconsin's governor signed an executive order in 2019 mandating 100 percent zero-carbon electricity by 2050 toward the goals of the Paris Climate Accord.[13] California has taken an especially aggressive approach to climate change, mandating 40 percent greenhouse gas emissions from 1990 levels by 2030 and carbon neutrality by 2045.

Significantly, in January 2020, the California Public Utilities Commission initiated a rulemaking coordinating the electricity and gas utilities in developing a long-term planning strategy to manage the state's transition away from natural gas-fuel technologies and achieve the state's decarbonization goals.[14] As demand for natural gas declines in the state, gas utilities will be required to maintain safe and reliable gas systems at just and reasonable rates, with the goal of minimal or no stranded costs.[15]

Soon thereafter, New York's Public Service Commission initiated its own integrated gas planning proceeding in March 2020, explicitly recognizing that such a process is critical to ensuring that New York reaches its ambitious CLCPA goals.[16] Although the New York proceeding does not specifically commit to a transition away from gas technologies as does California, it opens the dialogue among regulators, utilities, and the public for such a transition, without which the state cannot achieve its climate goals.

In addition to state laws and public utility commission actions, several municipalities have directly or indirectly required that gas be phased out in buildings. Direct bans on expanding gas service to curb greenhouse gas emissions have been imposed by several cities, including Berkeley and San Jose in California. New York City pledged to develop legislation to phase out

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[9] 2019 New Jersey Energy Master Plan Pathway to 2050, St. of New Jersey, https://nj.gov/bpu/pdf/publicnotice/NJBPU_EMP.pdf.
[10] Shields, *supra* note 3.
[11] *Conn. Dep't of Energy and Env't Protection: Connecticut Legislation and Executive Orders on Climate* Ct.gov (Sept. 2019), https://www.ct.gov/deep/cwp/view.asp?a=4423&q=530290.
[12] 2019 Conn. Pub. Act No. 19-71.
[13] Wis. Exec. Order No. 38 (August 16, 2019), *available at* https://content.govdelivery.com/attachments/WIGOV/2019/08/16/file_attachments/1268023/EO%20038%20Clean%20Energy.pdf.
[14] Case R2001007, California Public Utility Commission, Order Instituting Rulemaking to Establish Policies, Processes, and Rules to Ensure Safe and Reliable Gas Systems in California and Perform Long-Term Gas System Planning (Jan. 16, 2020), *available at* http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M324/K792/324792510.PDF; *See also*, Cal. Exec. Order No. B-55-18, S.B. 100, 2017-18 Reg. Sess. (Cal. 2018).
[15] *Id.*
[16] NYPSC Case 20-G-0131, Proceeding on Motion of the Commission in Regard to Gas Planning Procedures, *Order Instituting Proceeding* (Mar. 19, 2020).

fossil fuel use by 2040.[17] Direct bans as a measure to achieve reduction are described further in Section 4.2.1 of this report.

Indirect municipal regulations will also drive the transition away from gas. A leading example is New York City's Local Law 97 of 2019, which requires covered buildings greater than 25,000 square feet to reduce their greenhouse gas emissions by 40 percent by 2030 and 80 percent by 2050.[18] Buildings must file compliance reports with the Department of Buildings, and will be fined if their volume of emissions exceeds their permitted carbon footprint, which is calculated based on carbon intensity per square foot of indoor space.[19] The law affects approximately 50,000 buildings.[20]

These state, municipal, and public utility commission actions are generating momentum towards the phase-out of natural gas in our everyday lives. They have placed the issue in the public discussion in the United States, and their progress in overcoming the challenges of the move away from gas will guide the broader transition for others that follow.

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[17] *State of the City 2020: Mayor de Blasio Unveils Blueprint to Save Our City,* CITY OF N.Y. (Feb. 6, 2020) https://www1.nyc.gov/office-of-the-mayor/news/064-20/state-the-city-2020-mayor-de-blasio-blueprint-save-our-city#/0.

[18] NYC Building Emissions Law Summary, URBAN GREEN COUNCIL, https://www.urbangreencouncil.org/sites/default/files/urban_green_emissions_law_summary_v3_0.pdf (Updated Jul. 9, 2019).

[19] *NYC Carbon Emissions Bill Passed into Law – "Local Law 97" – What it means for commercial building owners,* CODEGREEN (May 20, 2019) https://codegreensolutions.com/nyc-carbon-emissions-bill-passed-into-law-local-law-97-what-it-means-for-commercial-building-owners/.

[20] URBAN GREEN, *supra* note 18.

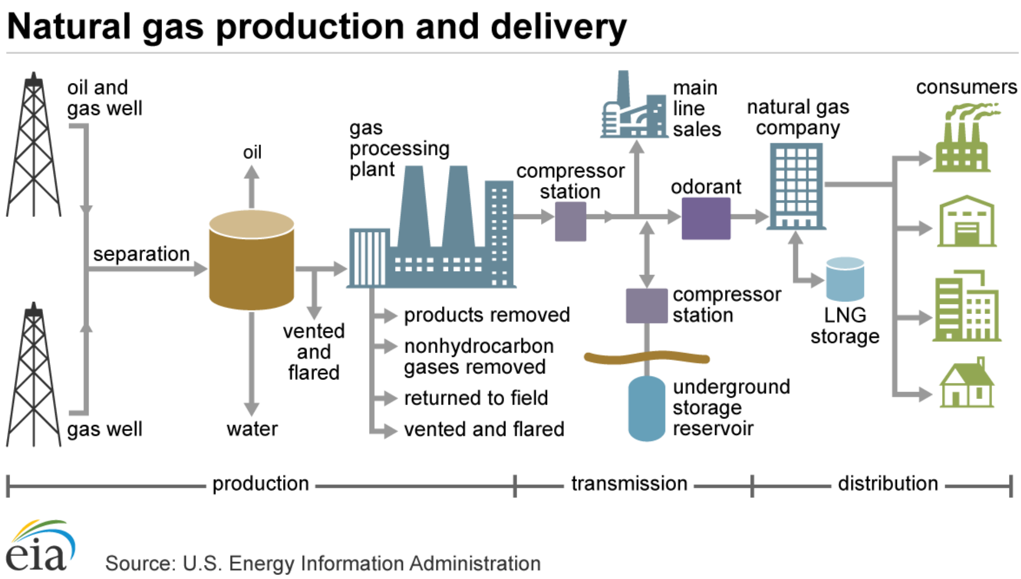
2. <u>Gas System: Infrastructure, Demand and Environmental Impacts</u>

2.1 Gas System Infrastructure

The gas system begins at the extraction well and ends at the "burner tip"—the burning of gas as an energy source. The natural gas value chain comprises three stages: production, transmission, and distribution. Through these stages, the custody of the natural gas transfers from wholesale sellers to utility distributers, ultimately reaching consumers.

The natural gas value chain is illustrated in Figure 1 below.

Figure 1.



At the production stage, gas is extracted by wells through either conventional drilling relying on the natural pressure of the geologic formation, or "unconventional" extraction through the use of injectants for hydraulic fracturing and horizontal drilling.[21] Once extracted, gathering lines transport the raw gas from the field wells to a central processing facility.[22] Wells, gathering lines, and processing facilities are regulated by the state in which they are located.[23]

The gas is processed to separate impurities, such as water, carbon dioxide, and other hydrocarbon gas liquids. The specific standards for gas purity are determined by law or regulation specific to the end use.[24]

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[21] *Natural Gas Explained,* U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/natural-gas/ (Updated Dec. 6, 2019).

[22] *Natural Gas Explained: Delivery and storage of natural gas*, U.S. ENERGY INFORMATION ADMIN. https://www.eia.gov/energyexplained/natural-gas/delivery-and-storage.php (Updated Jan. 21, 2020).

[23] E. Allison & B. Mandler, *U.S. Regulation of Oil and Gas Operations*, AMERICAN GEOSCIENCES INSTITUTE (2018), https://www.americangeosciences.org/sites/default/files/AGI_PE_Regulations_web_final.pdf.

[24] SAEID MOKHATAB ET. AL., HANDBOOK OF NATURAL GAS TRANSMISSION AND PROCESSING 123 (Saeid Mokhatab et. al. eds., 3rd ed. 2015).

After the natural gas is processed, it is transported to distribution utilities for sale to customers, or directly to large end users.[25] Compressor stations along transmission and distribution pipelines maintain gas pressure, which dissipates due to friction between the natural gas and the pipe.[26]

At the terminus of transmission, distribution utilities receive gas and take ownership at a "city gate" or "gate station." This delivery point serves three main purposes: to reduce pressure, to add an odorant to give gas its distinctive smell so that people can detect leaks, and to measure the volume of gas delivered to the distribution utility.[27]

Gas distribution utilities are responsible for monitoring and controlling the pressure and flow rate throughout the distribution system. Block valves are installed on transmission and distribution pipelines as a safety measure to isolate sections of pipeline in the case of rupture or other safety contingency. In addition to block valves, onshore pipelines must have blowdown valves to evacuate gas to the atmosphere safely. Excess flow valves are required on each service line to residences to shut down service to individual homes in the event of fire or rupture.[28]

Interstate pipelines are regulated by the U.S. Department of Transportation and the Federal Energy Regulatory Commission,[29] while states assume safety authority for intrastate pipelines.[30] Gas distribution utilities are regulated by state public service commissions, which set the rates utilities can charge their customers and establish service standards.

2.2 Growing Gas Demand for the Power, Petrochemicals, and Building Sectors

Gas is used across three broad economic sectors: as a fuel source for electric generation, as a chemical feedstock in industrial processes, and for direct energy services in the buildings sector.

The buildings sector includes residential, small commercial, and large commercial and industrial buildings, and uses gas for the provision of heating, hot water, cooking, clothes drying, and as a fuel source for on-site, distributed generation, and combined heat and power systems.

In 2018, electricity generation accounted for the largest use of gas in the United States (35 percent of total usage), followed closely by industrial consumption as a chemical feedstock and for energy services (33 percent). The buildings sector is the third largest consumer of gas at 29 percent, comprising residential (17 percent) and commercial (12 percent). The transportation sector presently accounts for 3 percent of gas consumption for direct use in cars and increasingly for electricity used to power electric vehicles.[31] Gas usage will increase if transportation electrification is not accompanied by decarbonization of the power sector.

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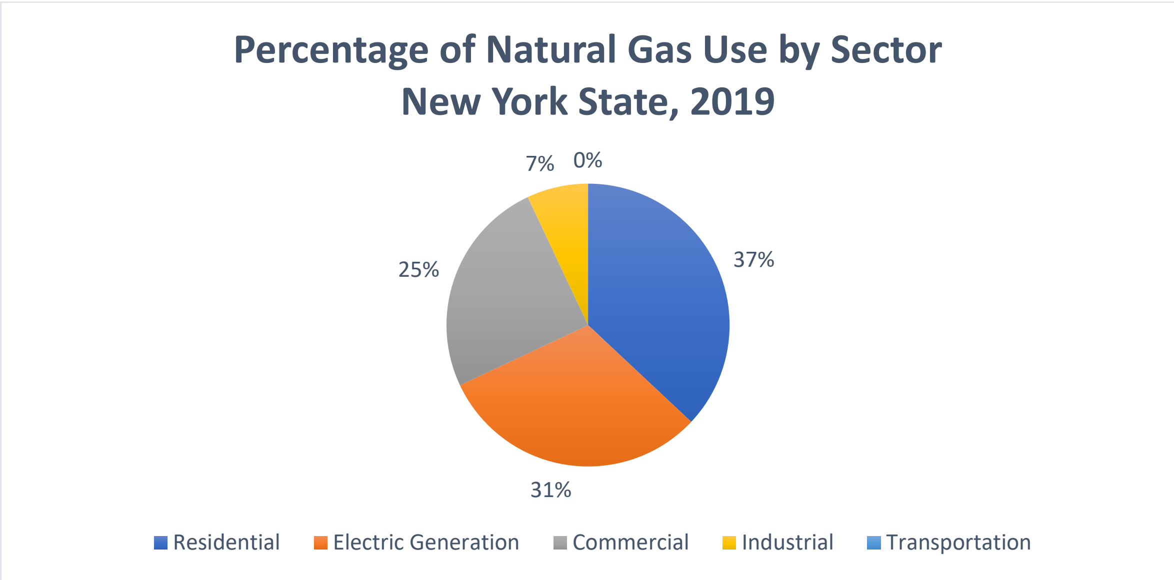
[25] The transmission system in the U.S. includes approximately 272,000 miles of pipelines. *How does the Natural Gas Delivery System Work?,* AMERICAN GAS ASSOCIATION (Accessed Apr. 7, 2020), https://www.aga.org/natural-gas/delivery/how-does-the-natural-gas-delivery-system-work-/.
[26] *Id*.
[27] *Id.*
[28] 49 C.F.R. §§ 192.5, 192.179, 192.81 (2019).
[29] Jacquelyn Pless, *Making State Gas Pipelines Safe and Reliable: An Assessment of State Policy,* NAT. CONF. OF STATE LEG. (Mar. 2011) https://www.ncsl.org/research/energy/state-gas-pipelines-federal-and-state-responsibili.aspx.
[30] *State Programs Overview,* U.S. DEPT. OF TRANS. (Accessed Apr. 7, 2020) https://www.phmsa.dot.gov/working-phmsa/state-programs/state-programs-overview.
[31] *Natural Gas Explained: Use of natural gas*, U.S. ENERGY INFORMATION ADMINISTRATION (Updated Dec. 18, 2019) https://www.eia.gov/energyexplained/natural-gas/use-of-natural-gas.php.

In New York, the building sector represents the largest consumer of natural gas.[32] New York residential consumers are the largest gas users (37 percent), followed by power generation (31 percent), commercial building customers (25 percent), industrial consumers (7 percent), and transportation (1.7 percent).[33]

Figure 2.



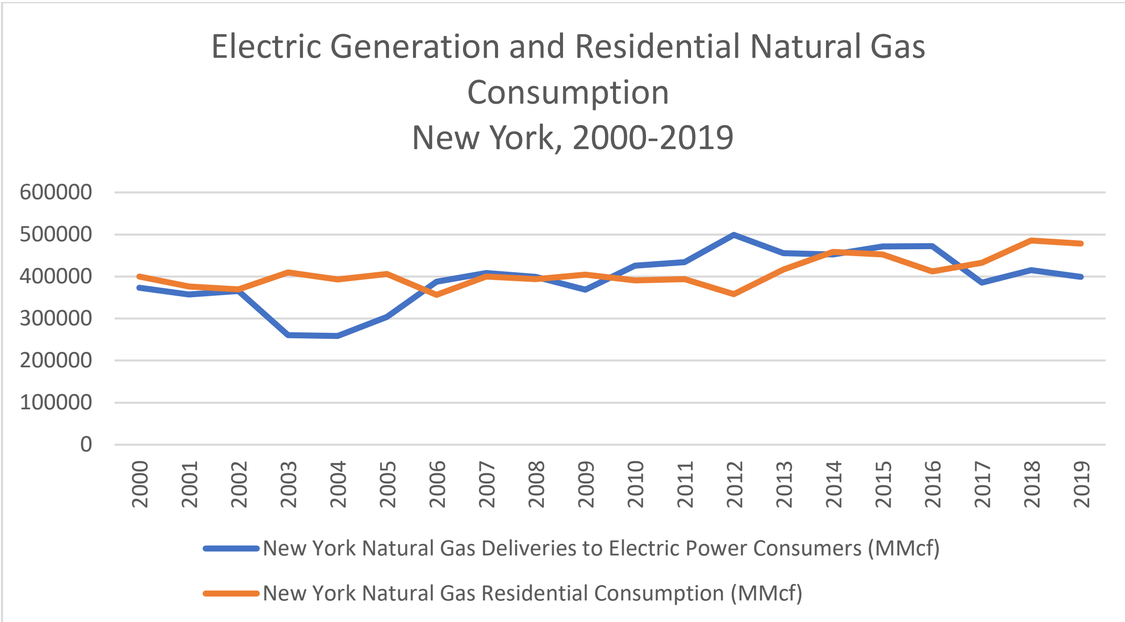
Source: U.S. Energy Information Administration.

Although New York residential gas consumption has fluctuated, it has increased steadily over the years.[34] The power sector could potentially overtake residential consumption as the largest user of gas in New York, however the data from the electricity sector demonstrates broad unpredictability.[35]

Figure 3 below represents the use of gas for electric generation and the residential sector in New York between the years 2000-2019.

[32] *Natural Gas Consumption by End Use,* U.S. ENERGY INFORMATION ADMINISTRATION (Accessed Apr. 7, 2020) https://www.eia.gov/dnav/ng/NG_CONS_SUM_DCU_SNY_A.htm.
[33] *Id.*
[34] *New York Natural Gas Residential Consumption,* U.S. ENERGY INFORMATION ADMINISTRATION (Accessed Apr. 7, 2020) https://www.eia.gov/dnav/ng/hist/n3010ny2a.htm.
[35] *New York Natural Gas Deliveries to Electric Power Consumers,* U.S. ENERGY INFORMATION ADMINISTRATION (Accessed Apr. 7, 2020) https://www.eia.gov/dnav/ng/hist/n3045ny2a.htm.

Figure 3.



Source: U.S. Energy Information Administration.

2.2.1 Gas Demand in the Electricity Generation Sector

Nationally, natural gas accounts for 29 percent of primary energy consumption for power generation.[36] In New York, gas accounts for roughly 40 percent of the state's central-station power generation.[37] Throughout the Northeast, natural gas has displaced coal as the leading energy source for fossil-fuel power generation, and is expected to further increase its market share in the immediate future due to the imminent closure of the region's aging nuclear power plants.[38]

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[36] U.S. ENERGY INFO. ADMIN., *supra* note 31.

[37] *New York State Energy Profile,* U.S. ENERGY INFORMATION ADMINISTRATION (Updated Aug. 15, 2019) https://www.eia.gov/state/print.php?sid=NY.

[38] Javier E. David, *US Northeast states are devouring natural gas for electricity, and that's a problem for coal*, CNBC (May 14, 2017), https://www.cnbc.com/2017/05/14/natural-gas-pushes-deeper-into-us-energy-mix-a-problem-for-coal.html.

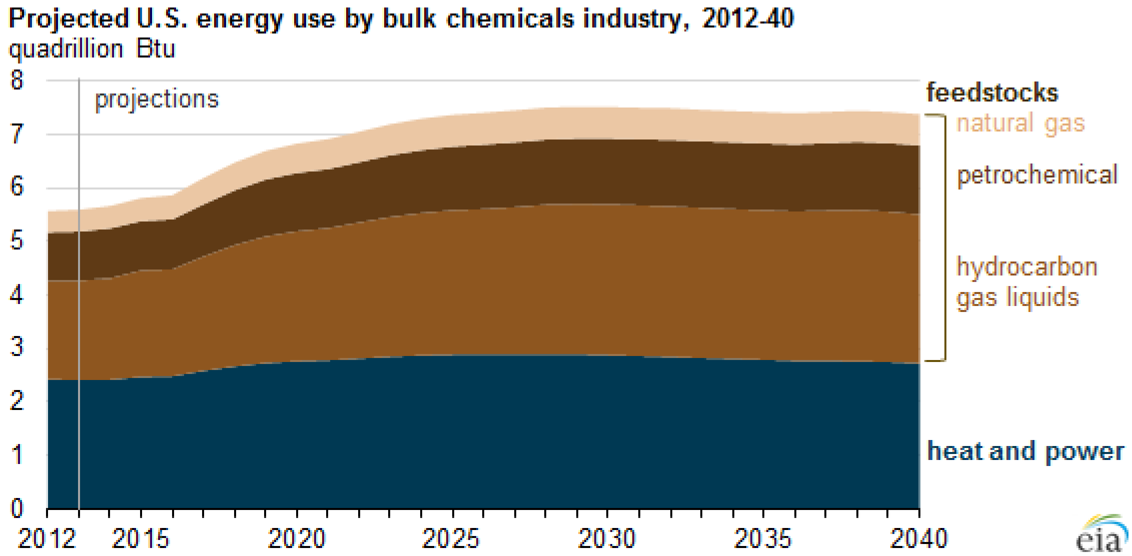
2.2.2 Gas Demand in the Petrochemicals Industrial Processes Sector

The industrial sector accounts for one third (33 percent) of natural consumption in the United States.[39] This sector encompasses the highly-carbon intensive sub-sectors of oil and gas extraction, non-fluorinated chemicals, and refineries,[40] the three most carbon-intensive sectors following power generation, as well as manufacturing.[41]

The petrochemicals industries use natural gas for three main purposes: heating, electricity generation (often employing combined heat and power systems), and as a feedstock to produce chemicals, fertilizers and hydrogen.[42]

Figure 4 below demonstrates the various uses of gas in the petrochemicals industrial processes sector.

Figure 4.



Source: U.S. Energy Information Administration.[43]

Pennsylvania has emerged as the leading state in natural gas production growth in recent years,[44] propelling the expansion of the petrochemical complex in Pennsylvania, Ohio, and West Virginia along the Ohio River Valley. Promoted by the U.S. Department of Energy as a

[39] U.S. ENERGY INFO. ADMIN., *supra* note 31.
[40] *Glossary,* U.S. ENERGY INFORMATION ADMINISTRATION (Accessed Apr. 7 2020) https://www.eia.gov/tools/glossary/index.php?id=Industrial%20sector.
[41] *Greenhouse Gas Reporting Program (GHGRP)*, U.S. E.P.A. (Accessed Apr. 7, 2020) https://www.epa.gov/ghgreporting/ghgrp-reported-data.
[42] U.S. ENERGY INFO. ADMIN., *supra* note 31.
[43] *Bulk chemical feedstock use a key part of increasing industrial energy demand*, U.S. ENERGY INFO. ADMIN. (May 29, 2015), https://www.eia.gov/todayinenergy/detail.php?id=21432.
[44] *Report: Pennsylvania a leader in U.S. natural gas production growth,* MARCELLUS SHALE COAL. (Dec. 6, 2019), https://marcelluscoalition.org/2019/12/report-pennsylvania-a-leader-in-u-s-natural-gas-production-growth/.

future Appalachian petrochemicals “hub,”[45] these new facilities include gas processing plants to separate natural gas from liquids following extraction, fractionators to refine natural gas liquids into fuel products such as ethane and butane, ethane crackers to produce ethylene for feedstock for plastics, and plastics manufacturing plants.[46] These facilities may be supplemented with expanded underground hydrocarbon storage and ethane liquidation plants for export to overseas markets.[47]

Given low natural gas prices, the expansion of natural gas production and processing capacity requires the oil and gas and related petrochemicals industries to promote increasing natural gas consumption by the power, industrial and buildings sector to ensure these investments are successful. By implication, this “build-it-and-they-will-come” business strategy means the natural gas sector, supported by the U.S. Department of Energy, exerts pressure to increase demand for natural gas, particularly in the Northeast United States, the closest market for their product.

2.2.3 Gas Demand in the Buildings Sector

The buildings sector is diverse, encompassing residential buildings, ranging from single-family homes to multifamily apartment buildings; small to large commercial buildings, including individual businesses like restaurants to university campuses, malls, and hospitals; and large industrial buildings, such as factories.

Depending on building type, the building sector may use natural gas, fuel oil, or propane, for heating, cooking, hot water, clothes drying, and on-site energy generation.[48]

Nationally, in residential buildings, heating and cooling together account for 51 percent of gas consumption in homes, followed by water heating (19 percent), lighting (5 percent), refrigeration (3 percent), and various other uses including cooking, clothes washers and dryers, and other appliances (21 percent).[49]

In New York, 57 percent of households use natural gas for space heating, followed by 29 percent using use fuel oil.[50] As New York City and other municipalities mandate reduction of pollution by shifting towards cleaner fuels, natural gas continues to increase its market share of home heating fuel demand by displacing fuel oil. As boilers used for hydronic and steam heating systems also typically heat water for consumption, natural gas also accounts for a large and increasing segment of the water heating fuel demand.

These trends are reflected in the broader Northeast, encompassing New York and neighboring New Jersey and Pennsylvania. In residential buildings, space heating is the leading use of natural gas and propane (69 percent), followed by water heating (26 percent), then cooking (5 percent).[51]

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[45] *Ethane Storage and Distribution Hub in the United States,* U.S. DEPT. OF ENERGY (Nov. 2018), https://www.energy.gov/sites/prod/files/2018/12/f58/Nov%202018%20DOE%20Ethane%20Hub%20Report.pdf.

[46] James Bruggers, *Plastics: The New Coal in Appalachia?* INSIDE CLIMATE NEWS (Feb. 25, 2019) https://insideclimatenews.org/news/25022019/plastics-hub-appalachian-fracking-ethane-cracker-climate-change-health-ohio-river.

[47] *Id*.

[48] *Natural Gas*, CTR. FOR CLIMATE AND ENERGY SOLUTIONS, https://www.c2es.org/content/natural-gas/.

[49] *Use of energy explained: Energy use in homes,* U.S. ENERGY INFORMATION ADMINISTRATION (Updated Apr. 8, 2019) https://www.eia.gov/energyexplained/use-of-energy/homes.php.

[50] *Id*.

[51] Table CE5.4: Detailed household natural gas and propane end-use consumption–averages, 2015, U.S. ENERGY INFO. ADMIN. (May 2018), https://www.eia.gov/consumption/residential/data/2015/c&e/pdf/ce5.4.pdf. Percentages calculated based on caloric value of combined natural gas and propane.

Importantly, electrification is gaining momentum for cooking. In 2017, 35 percent of American households used gas for cooking, compared to 55 percent that used electric stoves. Electrification of cooking varies by region, reflecting variations in fuel costs and energy infrastructure. Northeast households are the greatest users of gas for cooking.[52]

Gas use in commercial buildings is similar to the residential sector—heating, hot water, cooking, and clothes drying—but includes power generation (sometimes employing combined heat and power systems), refrigeration, cooling equipment, and outdoor lighting.[53]

A 2017 study of energy consumption in New York City buildings illustrates differences between residential and commercial buildings, particularly the heavy reliance on gas, shown in the table below.

Table 1.

Energy Source	Multi-family Buildings	Office buildings
Electricity	26%	60%
Natural Gas	50%	29%
District Steam (Con Edison)	6%	7%
Fuel Oil No. 2	8%	2%
Fuel Oil No. 4	8%	1%
Fuel Oil No. 5 and 6	2%	1%

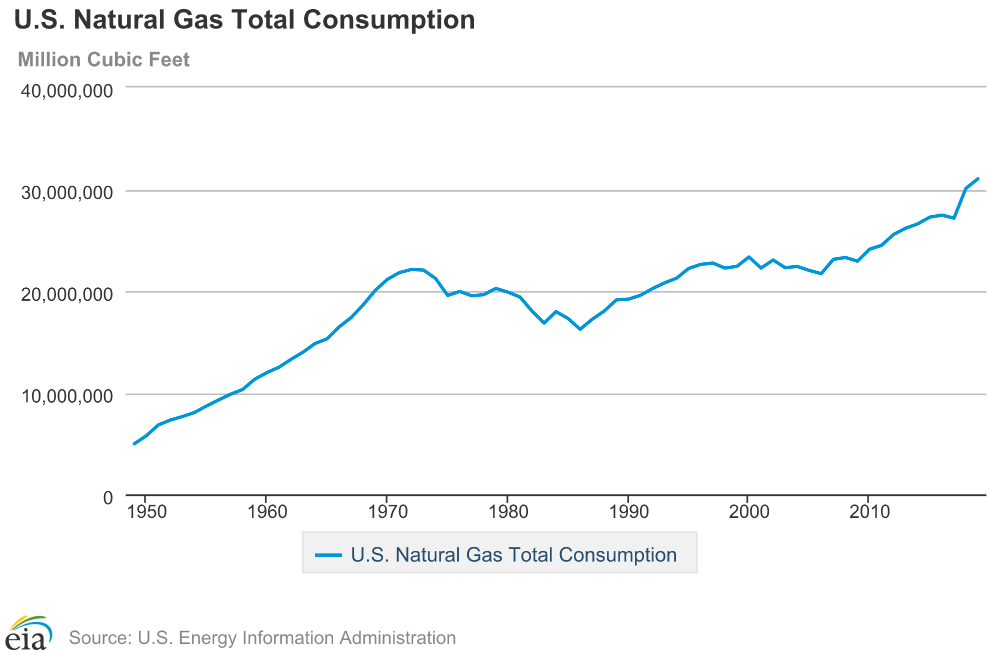
Source: NYC Urban Green Council, 2017 as described in https://www.ny-engineers.com/blog/comparing-energy-use-and-emissions-in-multifamily-and-office-buildings. Note: No. 5 and 6 fuel oil are no longer permitted, and No. 4 fuel oil will be phased out by 2030.

2.2.4 Trends in Gas Demand

Over the past decade, demand for natural gas has grown steadily nationally, increasingly from almost 24.1 million MMCF in 2009 to 31.0 million MMCF in 2019.[54] New York is the 6th largest state by gas consumption.[55] New York's demand for gas has increased slightly from almost 1.2 million MMCF in 2010 to 1.35 million MMCF in 2018 (the last year for which data is available), with year to year fluctuation within this range.[56]

[52] U.S. ENERGY INFO. ADMIN., *supra* note 31. *See also*, *Thanksgiving week: EIA data highlight how energy is used in the kitchen*, U.S. ENERGY INFORMATION ADMINISTRATION (NOV. 19, 2018), HTTPS://WWW.EIA.GOV/TODAYINENERGY/DETAIL.PHP?ID=37552.
[53] *Id*.
[54] *See, See* Natural Gas Consumption by End Use, U.S. ENERGY INFO. ADMIN. (Apr. 30, 2020), https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_nus_a.htm.
[55] *Id*.
[56] *Id.*

Figure 5.



Along with consumption, U.S. gas infrastructure spending has increased steadily over the past five decades for which data is available, with a sharp increase in spending in the 2010s. In the 2000s, annual investment in gas infrastructure averaged $11.3 billion; spending jumped in 2011 to $17.1 billion and reached $34.2 billion in 2018.[57]

The majority of the recent infrastructure spending is transmission and distribution expansion and replacement.[58] Roughly 5,600 miles of gas mains have been replaced each year in the past decade.[59] Given the present scale of our gas infrastructure, it will take over 230 years to replace all pipes at current rates of replacement.[60]

The U.S. Energy Information Administration projects that new gas demand will increase gradually from current levels to around 36 quads by 2050.[61] Thus, spending levels to expand and maintain gas infrastructure will continue to increase steadily as long as we remain dependent on this fuel.

Current practices among municipalities and the building industry prioritize natural gas. In 2018, over 60 percent of the 617,000 new single-family houses sold in the United States relied on

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57 *Annual Construction Expenditures: Gas Utility Construction Expenditures by Type of Facility 1971-2017* AMERICAN GAS ASS'N. (Nov. 28, 2018) https://www.aga.org/research/data/construction-expenditures/.
58 *Id.*
59 ROCKY MOUNTAIN INSTITUTE, THE IMPACT OF FOSSIL FUELS IN BUILDINGS: A FACT BASE 30 (Dec. 2019) https://rmi.org/insight/the-impact-of-fossil-fuels-in-buildings/.
60 *Id.*
61 *Annual Energy Outlook 2019: Total Energy Supply, Disposition, and Price Summary*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/outlooks/aeo/data/browser/#/?id=1-AEO2019&region=0-0&cases=ref2019&start=2017&end=2050&f=A&linechart=ref2019-d111618a.31-1-AEO2019&map=&ctype=linechart&sourcekey=0.

natural gas for heating.[62] Natural gas heating has consistently represented the majority of new single-family home construction since the 1990s, claiming as much as 70 percent share of new construction around the turn of the century.[63]

In the Northeast, the percentage of new single-family homes sold relying on natural gas has increased steadily since 2000, rising from around 76 percent in 2000 to 94 percent in 2018.[64]

Across the U.S. new multifamily building construction continues to rely heavily on natural gas, although electrification now commands a greater share in this sector. Overall, gas's share of new multi-family buildings has declined from its peak of between 40 to 50 percent in the late 1990s and early 2000s,[65] to 32-39 percent in the 2010'.[66]

In the Northeast, gas is much more prevalent in multifamily units. The overwhelming majority of new multi-family units completed rely on gas, remaining between 80 to 97 percent since 1993 to present, with the exception of a dip in the 2012-2014 period (72-77 percent).[67]

Nationwide, only one in four households are all electric, although that number is increasing.[68] In the Northeast, 1.6 million households exclusively use electricity for energy services today.[69] In the multifamily sector, electrification has aggressively picked up market share, accounting for roughly 60 percent of new multifamily building heating service.[70]

Future demand will also be influenced by supply considerations. As previously described, expanding natural gas infrastructure along the Ohio River Valley, promoted by the U.S. Department of Energy as the future Appalachian petrochemicals "hub,"[71] will suppress natural gas prices and exert pressure to increase demand for gas nationally, in the Northeast in particular, and for export.

2.3 Health and Environmental Impacts of Gas Production and Use

The extraction, processing, transport and burning of natural gas impacts human health and the environment in various ways, including through the production of hazardous wastes, the resulting water and soil contamination, and the release of greenhouse gas emissions and other pollutants to the atmosphere.[72]

Hydraulic fracturing and horizontal drilling, commonly used for extraction of unconventional gas resources, consume and pollute enormous amounts of water. Typically, injection water is mixed with various chemicals, each of which serves a specific purpose—drilling fluids to lubricate the well prior to drilling, corrosion and scale inhibitors, additives to control bacteria that might

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[62] *Annual Characteristics of New Housing: Heating Fuel – Type of Heating Fuel Used in New Single-Family Houses Sold*, U.S. CENSUS BUREAU, https://www.census.gov/construction/chars/.
[63] *Id.*
[64] *Id.*
[65] *Id.*; *See also Annual Characteristics of New Housing: Heating Fuel – Number of Multifamily Buildings Completed by Type of Heating Fuel*, U.S. CENSUS BUREAU, https://www.census.gov/construction/chars/.
[66] U.S. CENSUS BUREAU, *supra* note 65; *See also* U.S. CENSUS BUREAU & U.S. DEP'T OF HOUS. & URBAN DEV., H150-19, AMERICAN HOUSING SURVEY REPORT: DIFFERENCES IN FUEL USAGE IN THE UNITED STATES HOUSING STOCK (2019) (reporting trends in residential fuel sources for space heating and cooling, cooking, water heating, and clothes drying).
[67] *Id.*
[68] ROCKY MOUNTAIN INST., *supra* note 59, at 50.
[69] *Id*.
[70] U.S. CENSUS BUREAU, *supra* note 65.
[71] *See* U.S. DEPT. OF ENERGY, *supra* note 45.
[72] *Natural gas explained: Natural gas and the environment*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/natural-gas/natural-gas-and-the-environment.php (Updated Sept. 23, 2019).

contaminate the gas, propellants used to blast sand through shale formations to release the gas contained within them, gelling agents for emergency response, and others.[73] These chemicals include highly toxic, known carcinogens, and heavy metals, which even in small exposures pose serious health risks.[74]

Current federal—and most state—environmental regulations applicable to the fossil fuels extraction industry do not require companies engaged in gas extraction to report the contents of the fracking fluids they use, raising public health concerns.[75] Some fracking water remains in the well, but most is returned with the extracted hydrocarbons, requiring disposal.[76] In some cases, production water is stored in containment ponds lined with plastic or other materials to prevent it seeping into ground water.[77] In other cases, fracking water is trucked to municipal wastewater disposal facilities, which are often not equipped to process the full range of chemicals contaminants, raising further public health concerns.[78] All of these approaches risk contamination of soil and groundwater.[79]

Because wells are commonly located far from accessible freshwater sources, extraction companies typically truck water to the drilling site on a daily basis, and truck the wastewater offsite. Trucking can aggravate local air pollution in production areas.[80]

Where gas displaces coal or fuel oil for power generation, heating, or cooking, gas use generally reduces local air pollution because it produces fewer criteria pollutants when combusted.[81] However, indoor gas use—particularly for cooking—can degrade air quality and result in negative health impacts, to the point that indoor air pollution—including from nitrogen dioxide and carbon monoxide—can exceed outdoor emissions of criteria pollutants and ambient air quality standards.[82] Importantly, adverse health effects of household gas consumption are most likely to impact low income households that lack the means to switch to cleaner renewable alternatives, an issue we address in the policy recommendations in Section 5.6 assisting low- and moderate-income communities in energy transition.

Perhaps the most significant environmental impact related to the production and consumption of gas—whether methane-based or produced from biological material—is climate change. Methane is 30 times more potent a greenhouse gas than carbon dioxide.[83]

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[73] *Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States,* EPA (Dec. 2016), https://www.epa.gov/sites/production/files/2016-12/documents/hfdwa_executive_summary.pdf, at 4 and 16; *See also* JOHANNES KARL FINK, PETROLEUM ENGINEER'S GUIDE TO OIL FIELD CHEMICALS AND FLUIDS (2011), Waltham, MA and Oxford, United Kingdom: Elsevier.

[74] *Fracking's Environmental Impacts: Water,* GREENPEACE, https://www.greenpeace.org/usa/global-warming/issues/fracking/environmental-impacts-water/.

[75] *See generally Hydraulic Fracturing and its Impact on Water Resources,* WATER FOOTPRINT CALCULATOR (Oct. 12, 2018), https://www.watercalculator.org/footprint/fracking-water/.

[76] EPA, *supra* note 73, at 34.

[77] GREENPEACE, *supra* note 74.

[78] *Id*.

[79] *Id*.

[80] *See generally* Tanja Srebotnjak & Miriam Rotkin-Ellman, *Fracking Fumes: Air Pollution from Hydraulic Fracturing Threatens Public Health and Communities,* NRDC (Dec. 2014), http://www.hpaf.co.uk/wp-content/uploads/2018/01/fracking-air-pollution-IB.pdf.

[81] GREENPEACE, *supra* note 74.

[82] Brady Seals and Andee Krasner, *Health Effects from Gas Stove Pollution*, ROCKY MOUNTAIN INSTITUTE (May 2020) https://rmi.org/insight/gas-stoves-pollution-health.

[83] IPCC (2014). Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, eds O. R. Edenhofer, Y. Pichs-Madruga, E. Sokona, S. Farahani, K. Kadner, A. Seyboth, et al. Cambridge: Cambridge University Press. Under New York's

Greenhouse gas emissions along the gas supply chain result from leakage, flaring, and combustion. Fugitive emissions are especially problematic for the distribution system, not only for their climate impacts, but also because they threaten public safety.[84] Leakage is commonplace. The U.S. Environmental Protection Agency estimates that 1.4 percent of gas is leaked to the atmosphere throughout the supply chain before delivery to end-users; however, a more current independent study conducted by over 40 institutions and 50 industry participants puts this number higher, at 2.3 percent.[85] Given methane's global warming potential, these fugitive emissions have enormous consequences for the environment. The amount of methane lost through leakage in the United States alone is equivalent to the greenhouse gas emissions from more than 69 million vehicles.[86]

Methane emissions are generally estimated to account for roughly 16 percent of global greenhouse gas emissions.[87] However, recent research comparing methane levels in ice core samples suggest that traditional estimates based on bottom-up inventories have significantly underestimated methane's actual contribution to global warming, in reality accounting for roughly half of all emissions.[88] Estimates based on ice core comparisons capture a broader set of emissions beyond combustion tracked by national inventories, including releases during the natural gas extraction, transmission and distribution process, such as controlled releases and leaks, as well as other sources of methane released into the atmosphere due to melting permafrost or even subsea hydrate mining.

Climate Leadership and Community Protection Act, the state will apply a 20-year timeframe to evaluating methane emissions. Over a 20-year time frame, methane is more than 80 times more potent than carbon dioxide in terms of its climate warming impact.

[84] Dan Zimmerle, *The U.S. natural gas industry is leaking way more methane than previously thought,* PBS (Jul. 4, 2018) https://www.pbs.org/newshour/science/the-u-s-natural-gas-industry-is-leaking-way-more-methane-than-previously-thought (citing *U.S. Greenhouse Gas Emissions and Sinks: 1990-2016,* EPA (published 2018)).

[85] *Id*. *See also* Ramón A. Alvarez et. al., *Assessment of methane emissions from the U.S. gas supply chain,* 361 Science 186 (2018).

[86] Rebecca Elliott, *The Leaks That Threaten the Clean Image of Natural Gas,* THE WALL STREET JOURNAL (Aug. 8, 2019) https://www.wsj.com/articles/the-leaks-that-threaten-the-clean-image-of-natural-gas-11565280375. *See also* A. Alvarez, *supra* note 85.

[87] *Global Emissions,* CTR. FOR CLIMATE AND ENERGY SOLUTIONS, https://www.c2es.org/content/international-emissions/.

[88] Benjamin Hmiel, V. et al, *Preindustrial* $^{14}CH_4$ *indicates greater anthropogenic fossil* CH_4 *emissions* 578 NATURE 409-412 (2020).

3. The Challenges of Decarbonization

Decarbonizing the gas system requires overcoming several challenges. In broad categories, these include:

- Coordination of policy at federal, state and regional levels;
- Incumbent utility business models that incentivize gas infrastructure expansion, and the economic consequences of ultimately reversing gas infrastructure, especially stranded assets;
- Lack of consumer understanding and acceptance of electrified technologies;
- Financing the transition for households and businesses, in particular for low- and moderate-income communities;
- Municipal codes and permitting practices;
- Insufficient training and standard practices in the building trades; and
- Economic impact and the need for a just transition for fossil-dependent communities.[89]

This chapter describes several of the most pressing challenges that we must address if we are to successfully decarbonize gas infrastructure. The remaining sections of this chapter outline specific issues that a sustained decarbonization program will confront.

3.1. Fragmented Regulatory Frameworks Undermine Comprehensive Planning

Regulatory authority over the electricity and gas industries is divided between the federal government and states. Fragmentation of authority complicates government decision making processes for transitioning energy infrastructure, and undermines the ability to comprehensively plan such a transition.

The Federal Energy Regulatory Commission ("FERC") regulates the interstate transmission of electricity, natural gas, and oil pursuant to the commerce clause of the Constitution, which vests the federal government with regulatory jurisdiction over interstate commerce.[90] As a result, FERC possesses jurisdiction over the interstate sale of electricity, natural gas, and transportation of oil by pipeline.[91]

FERC derives its authority from several federal laws, including the Federal Power Act, the Public Utility Regulatory Policies Act, the Natural Gas Act, Interstate Commerce Act, and the Energy Policy Act.[92]

FERC reviews and approves the siting and abandonment of interstate natural gas pipelines, storage projects, and liquefied natural gas terminals, and reviews siting applications for electric transmission projects under limited circumstances.[93] FERC possesses authority for developing mandatory standards to ensure the reliability of the bulk power system, including cybersecurity. The agency may enforce reliability and other regulatory requirements through the imposition of civil penalties.[94]

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[89] *See A Roadmap to Decarbonize California Buildings,* BUILDING DECARBONIZATION COAL. (February 2019) at 8, *available at* http://www.buildingdecarb.org/resources/a-roadmap-to-decarbonize-californias-buildings.

[90] *FERC's Role in the Electric Power Industry,* BETA ENGINEERING (Accessed March 12, 2020) http://www.betaengineering.com/high-voltage-industry-blog/ferc-s-role-in-the-electric-power-industry.

[91] *What FERC Does,* FERC (Updated Aug. 14, 2018) https://www.ferc.gov/about/ferc-does.asp.

[92] *Strategic Plan FY 2018-2022*, FERC (Sept. 2018), https://www.ferc.gov/about/strat-docs/FY-2018-FY-2022-strat-plan.pdf.

[93] FERC, *supra* note 91.

[94] *Id*.

The states retain jurisdiction for regulating gas and power production facilities and retail natural gas and electricity sales to residential consumers located within their state.[95] Regulation of retail natural gas and electricity sales to consumers is delegated to state regulatory commissions, usually public service or public utility commissions.

Some state regulatory commissions regulate municipal power systems and rural electric cooperatives, while others possess jurisdiction primarily over investor-owned utilities. State commissions may also exercise jurisdiction over pipeline construction within state borders, and the regulation of local distribution, development, operation, and reliability of natural gas and associated facilities within state borders.[96]

Although fragmented, federal and state jurisdiction interact to shape gas infrastructure development and markets. The fragmentation of government authority complicates and reduces the certainty of how government decision-making will affect the gas industry. Specifically, direct gas use in buildings drives demand for upstream transmission pipelines, and transmission pipeline construction justifies the build-out of gas distribution infrastructure. Several states—including New York—have recently denied applications for permits to construct new transmission pipelines, in some cases based on state authority to regulate environmental risks:

- The New York State Department of Environmental Conservation ("NYSDEC") denied Millennium Pipeline Company, LLC's permit application for construction of a pipeline in 2017 "on the grounds that FERC's environmental review of the project was 'inadequate and deficient 'because the FERC's Environmental Assessment failed to consider downstream greenhouse gas (GHG) emissions from Millennium's electric generator shipper."[97]
- The NSYDEC denied the Transcontinental Gas Pipe Line Company ("Transco") a permit to build a twenty-six inch gas pipeline as part of its Northeast Supply Enhancement ("NESE") Project.[98] The pipeline was intended to transport natural gas from Pennsylvania, through New Jersey and ending near the Rockaway Peninsula in Queens, NY.[99] NYSDEC announced the denial of the permit application without prejudice on May 15, 2019.[100] Governor Cuomo issued a final denial on May 15, 2020.[101]

The Millennium permit application case is especially important, in that NYSDEC denied the permit explicitly on the grounds of FERC's failure to consider the project's climate impacts.[102]

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[95] *Id*.
[96] *Id.;* FERC, *supra* note 92, at vii.
[97] Letter from Thomas S. Berkman, Deputy Comm'r and Gen. Counsel, N.Y. State Dep't of Envtl. Conservation, Re: 3-3399-0071/00001 – Valley Lateral Project Notice of Decision, to Georgia Carter, Vice President and Gen. Counsel, Millennium Pipeline Co. (Aug. 30, 2017), *available at* https://www.dec.ny.gov/docs/permits_ej_operations_pdf/valleydecltr.pdf; *See also* S. Scott Gaille, *How Political Risk Associated with Climate Change Is Impacting Pipeline Construction Agreements*, 40 ENERGY L.J. 111, 119 (2019).
[98] *Northeast Supply Enhancement (NESE) Project,* N.Y. ST. DEPT. OF ENVIRO. CONSERVATION (Accessed Mar. 17, 2020) https://www.dec.ny.gov/permits/115980.html.
[99] *Id*.
[100] N.Y.S. DEPT. OF ENV. CONSERVATION, DEC ID 2-9902-00109/00004, NOTICE OF DENIAL OF WATER QUALITY CERTIFICATION TO TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC (May 15, 2019) [hereinafter "DEC DENIAL NOTICE"].
[101] Scott Di Savino *et al*, Reuters, New York Denies PA-NY Williams Northeast Supply Natgas Pipe (May 15, 2020), https://www.reuters.com/article/us-natgas-williams-pipeline/new-york-denies-pa-ny-williams-northeast-supply-natgas-pipe-idUSKBN22R3FT.
[102] "Pipeline projects are likely to meet increasing resistance on the basis that they contribute to climate change. Even when a permit is granted, court challenges may result in the permit being reversed--or at least returned to the regulatory agency for further consideration." Gaille, *supra* note 97, at 120.

However, the decision is grounded on a procedural deficiency, leaving open the possibility that FERC could cure the problem if it considers greenhouse gas emissions more fully in its approval process, without necessarily requiring that those emissions be eliminated. Thus, at present, climate policy remains a weak basis to prevent further expansion of natural gas infrastructure.

In contrast, in the Transco permit application case, NYSDEC relied heavily on its authority under state water law to block the interstate natural gas pipeline. To implement its project in New York, Transco applied to the NYSDEC for a Clean Water Act Section 401 Water Quality Certification Permit, an Article 15 Protection of Waters Permit, an Endangered or Threatened Species Incidental Take Permit, and a State Pollutant Discharge Elimination System Surface Discharge Permit.[103] NYSDEC denied the pipeline construction permits on the ground that they would significantly impact water quality in New York state by disrupting previously settled contaminants such as mercury and copper.[104] Broadly, NYSDEC stated that it did not have "reasonable assurances that construction and operation of the Project would meet all applicable water quality standards,"[105] and expressed concern that Transco had not taken appropriate steps to mitigate negative impacts on water quality, shellfish, and other environmental resources.[106]

The Transco case highlights how conflicts between federal and state law shape gas infrastructure development in the United States. Transco had received approval from FERC subject to conditions to mitigate impacts set forth in FERC's Final Environmental Impact Statement.[107] However, under Section 401 of the Clean Water Act, "no federal license for a project can be granted if a Water Quality Certification is denied."[108] As a result, NYSDEC has effectively blocked progress on the Project, pending a new application for a Water Quality Certification Permit that adequately accounts for adverse water quality and environmental impacts.[109]

The bifurcated federal and state permitting process often produces deadlock, resulting in denial of pipeline permits, constraining natural gas supply to some utilities and their consumers, without providing an alternative solution. The shortcomings of the fragmented regulatory regime are compounded by traditional utility planning processes, which myopically focus on procuring sufficient gas supply, typically through the interstate pipeline supply chain, to meet forecasted gas demand, without considering demand-side solutions. By ignoring demand-side solutions, system planners fail to exploit one of the most cost-effective methods of ensuring system resiliency.

The current gas planning and permitting process thus penalizes consumers and only aligns with decarbonization goals when jurisdictional conflicts paralyze proposed pipeline expansion. Some states, including California and New York, have attempted to solve these problems by launching initiatives to evaluate current utility planning processes and how to better align them with state goals. These initiatives feature integrated gas planning practices that can incorporate demand-side resources, such as energy efficiency, demand response, renewable heating, and non-pipe solutions, alongside traditional supply-side approaches (pipeline infrastructure and capacity expansion). Integrated gas planning will be discussed in greater detail later in this paper.

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[103] N.Y. ST. DEPT. OF ENVIRO. CONSERVATION, *supra* note 98.
[104] DEC DENIAL NOTICE, *supra* note 100 at 4.
[105] *Id*.
[106] *Id*.
[107] *Id.* at 2.
[108] *Id*.
[109] *Id*. at 11.

3.2. Utility Incentives and Operation Misalign with Decarbonization Goals

Current gas utility regulation ensuring universal service and contract incentives are misaligned with the goal of decarbonizing our energy infrastructure. As described in this section, these rules and incentives fix a path towards expanding gas infrastructure triggered by both consumer demand and the economies of scale of expanding gas supply.

Gas distribution utilities provide service to their customers pursuant to tariff and service agreements approved by state public service commissions. Utility tariffs establish the rates and terms of service for the provision of gas to consumers. Terms of service include the procedures and timeframes by which a new customer can request gas service; the grounds on which a utility may deny a customer service; and the types of service classes the utility provides, such as residential, multifamily, small and large commercial, municipal, and industrial, among others. Rates are often indexed to inflation. Tariff schedules are updated periodically through rate cases and interim adjustment mechanisms. Utilities typically offer two broad types of gas service: "firm" service, for customers who receive gas service year-round, without interruptions (in the absence of exigent circumstances), and "interruptible" service, which allows the utility to temporarily turn off gas service and require consumers to switch to an alternate energy source during times of high energy demand.

Utility regulators adopt a universal service principle, requiring a utility to respond to customer requests for access to electricity and gas service in its franchise territory within a short timeframe, typically a matter of days.[110] Triggered by the customer submitting basic identification and payment information, the utility responds within a specified time by providing service, identifying deficiencies in the application, or denying connection, pursuant to statutory criteria.

For buildings that are not yet connected to utility services, the cost and speed of the connection varies based on the customer's geographic location (rural vs. urban), how far the customer is located from the utility gas main, and whether the utility plans to expand gas or electricity service to that area in the absence of a customer request. State laws may require utilities to expand utility service under certain conditions. In New York, for example, utilities must connect buildings located within 100 feet of a gas or electric transmission line upon request for service, and the costs of connection are borne by the utility and amortized across other gas customers through approved tariffs.[111] The "100-foot rule" initially was enacted in the late 1800's to ensure that New Yorkers have access to gas lighting, and was most recently amended as part of New York's Home Energy Fair Practices Act in the early 1980's,[112] when high energy prices raised concern that low-income households would be denied access to essential energy services.

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[110] *See*, e.g., *Schedule for Gas Service, effective Mar. 1, 1999*, CONSOLIDATED EDISON, *available at* https://www.coned.com/_external/cerates/documents/gas_tariff/pdf/schedule-for-gas-service.pdf; *Schedule for Gas Service, effective Aug. 1, 2003*, NIAGARA MOHAWK POWER CORP., *available at* https://www9.nationalgridus.com/niagaramohawk/non_html/rates_psc220.pdf; *Schedule for Gas Service*, *effective Jun. 1, 2003,* ROCHESTER GAS AND ELECTRIC CORP., *available at* https://www.rge.com/wps/wcm/connect/f2818589-b1b3-4a44-bb51-35c22ce41a53/PSC16Sections.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-f2818589-b1b3-4a44-bb51-35c22ce41a53-mFQRLl3.

[111] New York Public Service Law § 31(4); 16 NYCRR Part 230.2 and 230.3. Related statutory requirements are found in the New York Transportation Corporations Law § 12.

[112] *Moore v. Champlain Electric Co*., 85 N.Y.S. 37 (App. Div. 3d Dep't 1903); *see also Home Energy Fair Practices Act: Rules Governing the Provision of Gas, Electric and Steam Service to Residential Customers,* New York Public Serv. Comm'n (Dec. 2008) at 1, *available at* http://www.dps.ny.gov/HEFPA_Brochure_12-08.pdf.

While this system has worked well from the perspective of ensuring universal service to qualifying customers, it conflicts with emerging legislative priorities of shifting toward beneficial electrification and a zero-emissions economy. It effectively automates the extension of natural gas infrastructure triggered by customer request. The utility's obligation to provide service does not include a requirement to inform customers of alternatives to gas. In addition, the requirement that ratepayers share the cost of connecting new customers, designed to ensure equitable access across consumers, runs counter to policy goals to discourage fossil fuel expansion and support renewable alternatives.[113] Perversely, the larger gas infrastructure grows, the lower the cost of connecting additional customers, further growing demand for gas supply in a self-reinforcing cycle of carbon dependency.

3.3. Compensating Capital Investment Drives Expanding Gas Infrastructure

Public service commissions are, first and foremost, economic regulators. The methodology these commissions adopt to regulate returns on investment drive the expansion of natural gas infrastructure and must be reformed in order to decarbonize our gas infrastructure.

Under the "regulatory compact," pursuant to which investor-owned utilities operate, public service commissions grant investor-owned utilities certificates of public convenience and necessity, allowing the utilities a regulated monopoly franchise within their service territories, as well as the opportunity to earn a fair return on capital investments. In exchange, the utilities are obligated to provide safe and reliable gas and/or electric service at just and reasonable rates to all customers in their service territories.[114]

As part of regulating investor-owned utilities in the public interest, the regulator reviews and approves utility proposals for capital and operating expenditures, as well as the rate of return that utilities are permitted to earn on their capital investments. Regulators authorize return on equity levels based on their assessment of the amounts investors expect in order to make their capital available to utilities, an admittedly "psychological concept."[115] During the 2010s, the average authorized return hovered between almost 10.50 to just over 9.50 percent, a healthy return for a relatively stable sector during a period of low interest rates.[116]

The method of compensating shareholders based on a return on the amount of capital investments creates an incentive for investor-owned utilities to invest in capital-intensive infrastructure, such as electric or gas distribution and transmission assets.

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[113] The New York Geothermal Energy Organization has estimated that the 100-foot rule has cost New York ratepayers $960 million in a five-year period. NYPSC Case 20-G-0131, Proceeding on Motion of the Commission in Regard to Gas Planning Procedures, *Filing from NY-GEO Requesting Commission Action Regarding the Cost of the 100-Foot Rule in Proceeding 20-G-0131* (Apr. 27, 2020). Other jurisdictions have recognized the inappropriateness of existing gas customers subsidizing new customer connections. *See*, e.g., *Backgrounder: Generic Proceeding on Community Expansion (Natural Gas),* Ontario Energy Board (Nov. 17, 2016), https://www.oeb.ca/oeb/_Documents/Documents/Backgrounder_Gas_Expansion_20161117.pdf.

[114] William K. Jones, *Origins of the Certificate of Public Convenience and Necessity: Developments in the States*, *1870 – 1920,* 79 COLUM. L. REV. 426 (1979).

[115] Dennis Sperduto, *Utility-earned ROEs exceeded authorized since 2016, but 2019 may not match 2018,* S&P GLOB. MKT. INTELLIGENCE (June 10, 2019), https://www.spglobal.com/marketintelligence/en/news-insights/research/utility-earned-roes-exceeded-authorized-since-2016-but-2019-may-not-match-2018.

[116] *Id*.

The bias towards gas infrastructure expansion is supported by traditional gas demand forecast methods that focus on peak demand and volume requirements,[117] and do not always take climate change meaningfully into account, given that they do not necessarily include state climate mandates in baselines or scenario analyses.

The incentive for utilities to expand infrastructure investments conflicts with various state policy objectives to reduce energy consumption through efficiency and other measures, reduce greenhouse gas emissions, increase distributed energy resources, provide customers with greater control over their energy options, and reduce costs to consumers. A number of states, recognizing this conflict between state energy, climate, and affordability policies and the current investor-owned utility business model, have launched efforts to modernize or reform the utility sector.

New York's Reforming the Energy Vision ("REV") framework was among the earliest and most ambitious grid modernization efforts. It explicitly recognized that, "[f]rom the perspective of the utility investor, the current regulatory system places a premium on capital deployment."[118] As a result, one of the central goals of REV is to align utility shareholder interests with consumer interests and state policy objectives.[119] REV focuses primarily on the electricity sector, yet the same bias toward capital expenditure exists in the gas distribution utility sector.

As proposed in this paper, overcoming the bias towards investment in carbon-intensive infrastructure in order to decarbonize the gas sector will require integrated gas planning that addresses various policy challenges through a systematic, managed, and comprehensive process that provides regulatory and economic certainty while driving toward decarbonization.

3.4. Addressing Stranded Assets

Stranded assets or stranded costs represent "that portion of the net book value of a utility's generation assets not yet recovered through depreciation that has become unrecoverable in a deregulated environment."[120] In lay terms, stranded assets refer to a utility company's investments that are lost, or "those investments which are made but which, at some time prior to the end of their economic life (as assumed at the investment decision point), are no longer able to earn an economic return, as a result of changes in the market and regulatory environment."[121]

Aggressive action on climate change threatens to strand utilities' investments in fossil fuel infrastructure and combustion technologies that, due to decarbonization legislation or other actions, must be retired prematurely, depriving the utility of an economic return on those investments.[122]

Currently, utilities recover the costs of their assets over the expected useful lives of those assets. However, the expected useful lives currently used in ratemaking are significantly longer than the 2050 target decarbonization date set by most state and municipal mandates to achieve

[117] Ronald H. Brown, et al., *Improving Daily Natural Gas Forecasting by Tracking and Combining Models,* 288 ELECTRICAL AND COMPUTER ENGINEERING FAC. RES. AND PUBLICATIONS (2017), *available at* https://epublications.marquette.edu/electric_fac/288.
[118] NYPSC Case 14-M-0101, Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision, *Order Adopting Regulatory Policy Framework and Implementation Plan* (February 26, 2015), p. 19.
[119] *Id*. at p. 2.
[120] 80 A.L.R.6th 1 (2012).
[121] *Redrawing the Energy Climate Map: World Energy Outlook Special Report,* IEA (June 2013), https://www.iea.org/reports/redrawing-the-energy-climate-map.
[122] *Stranded Assets and Thermal Coal, An analysis of environment-related risk exposure*, UNIV. OF OXFORD (Jan. 2016), https://www.smithschool.ox.ac.uk/research/sustainable-finance/publications/satc.pdf.

significant emissions reductions. If gas assets will no longer be used and useful and eligible for cost recovery past 2050, utilities will suffer losses on those investments, unable to recover their investment and regulatory return. The question then becomes who should pay for the costs of that stranded asset—ratepayers, utility shareholders, taxpayers, or a combination shared among some or all of those stakeholders.

The question of stranded asset recovery under current law depends on the circumstances of the particular case, and differs from one jurisdiction to another. In general, utilities are not guaranteed cost recovery for stranded assets. In New York, for example, the determination requires a balancing of equities between ratepayers and shareholders.[123] Public service commissions in states with aggressive decarbonization laws must develop coherent and uniform policy for addressing how to treat stranded assets that may result from the transition away from fossil fuels. Failure to do so could lead to financial instability for utilities and significantly higher rates for customers.

3.5. Consumer Acceptance of Electrification and Affordability

One of the most critical questions related to decarbonization is consumer acceptance of electrification as a substitute for gas appliances in terms of service and cost. Our discussion focuses primarily on cost as a key factor in consumer acceptance.

Whether electrification solutions are cost-effective for a given customer segment depends on a number of factors, including climate and geography, the wholesale cost of energy, retail energy rates, labor costs, and building stock profiles that determine whether upgrades are necessary to accommodate electrification.

Depending on the particular technology, additional factors come into play, notably equipment performance under varying climate and geographic conditions and the age and condition of the building stock, including the integrity of the building envelope. For certain technologies like geothermal heat pumps, soil conditions and resource depth, as well as urban density and the ease of access to sufficient land around a property to install geothermal heat pump equipment, influence both feasibility and cost.[124]

When comparing and selecting energy equipment investments, consumers often favor those with a lower initial capital cost. This is often true even when the larger upfront investment is recouped over time with energy bill savings and lower costs of operation. There are a number of factors that would deter customers from selecting more energy efficient but higher initial cost equipment. These factors include, but are not limited to:

- Lack of full information about the competing investment choices;
- Perceived risk of realizing the future cash savings from the efficiency investment;
- Lack of capital and access to financing;
- Expected tenure in the facility—how long the resident or business occupies the property compared to the time it would take to recoup the investment; and
- Split incentives, where the building owner bears the initial equipment cost and wishes to minimize it, and the tenant pays the future operating costs.

[123] *See*, e.g. Rochester Gas and Elec. Corp. v. Public Service Com'n of State of N.Y., 488 N.Y.S.2d 303 at 306 (1985).

[124] This paper does not address the full range of technological challenges. Additional information is available at *Geo Vision: Harnessing the Heat Beneath Our Feet*, U.S. DEPT. OF ENERGY (May 3, 2019), https://www.energy.gov/sites/prod/files/2019/05/f63/GeoVision-full-report.pdf.

In a study of four U.S. cities with varying climates and market conditions, the Rocky Mountain Institute found that for the new construction market, "electrification reduces costs over the lifetime of the appliance when compared with fossil fuels," and that it also reduces costs for customers who switch from delivered fuels (propane or heating oil) and for a subset of existing gas customers "who would otherwise need to replace both a furnace and air conditioner simultaneously."[125]

Existing gas customers likely face higher up-front investments for switching to electric space and water heaters than replacing an old gas unit with a new gas unit. Further, depending on particular climate and market conditions as well as electric utility rate design, consumers making the switch may also face higher overall energy bills or fail to save enough on their energy bills to recover the investment.[126]

Importantly, however, the Rocky Mountain Institute comparison did not consider the long-term stranded costs associated with gas infrastructure that utilities and ratepayers may be faced with as a result of state decarbonization policies.

The price of gas appliances also tends to be somewhat lower than the price of electric equipment. For example, the cost of a single-oven gas stove typically ranges from around $460 to $2,300, whereas the cost of an electric stove is usually between $450 and $2,800.[127] In terms of heating, the cost of a gas-fired water heater falls between $250-$1,800, whereas the cost of an electric water heater is typically between $200-$2,800.[128] Since electric water heaters do not require make-up air or ventilators, regardless of whether the unit is tank or tankless, electric units are usually a better choice for small apartments and confined spaces.[129]

3.6. Reducing Cost and Administrative Burden

A significant aspect of the capital cost of new infrastructure investments is regulatory and administrative burden. Estimating the incremental cost associated with regulation and the administrative burden associated with a task like decarbonizing the gas system is difficult. However, several analogues exist that may place this unknown cost in context.

The National Association of Manufacturers estimated that federal regulation alone cost the United States economy over $2 trillion dollars in 2014 dollars, or almost 12 percent of GDP.[130]

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[125] Sherri Billimoria et al., *The Economics of Electrifying Buildings: How Electric Space and Water Heating Supports Decarbonization of Residential Buildings,* ROCKY MOUNTAIN INST. (2018) at 6, *available at* https://rmi.org/insight/the-economics-of-electrifying-buildings/.

[126] *Id*. However, it should be noted that part of the discrepancy between the cost of gas and electrification is the result of utility regulations. In some cases, the upfront cost of gas connection (from the customer's premises to the gas main) is socialized across gas customers, whereas the upfront cost of installing heat pumps, for example, generally rests on the individual customer adopting the technology, unless there are robust state incentives sufficient to cover the up-front installation costs.

[127] Donna Boyle Schwartz and Bob Vila, *Gas or Electric? Choose Your Next Stove Wisely,* BOB VILA (Accessed May 19, 2020) https://www.bobvila.com/articles/gas-vs-electric-stove/.

[128] *How Much Does Water Heater Installation or Replacement Cost?,* HOMEADVISOR, https://www.homeadvisor.com/cost/plumbing/install-a-water-heater/.

[129] *Id*.

[130] W. Mark Crain & Nicole V. Crain, *The Cost of Federal Regulation to the U.S. Economy, Manufacturing and Small Business*, NAT'L ASS'N OF MANUFACTURERS (Sept. 10, 2014), https://www.nam.org/wp-content/uploads/2019/05/Federal-Regulation-Full-Study.pdf.

The National Association of Home Builders estimates that on average, over 24 percent of the price a new single-family home is attributable to regulatory costs, during the development and construction phases.[131]

Although not specific to decarbonization measures, the estimate for the cost of homes is particularly relevant because the residential sector represents the majority of natural gas consumption, and the decarbonization of buildings will ultimately be passed on to owners and renters. This estimate also captures federal, state and local regulatory costs, more fully reflecting the regulations decarbonization measures will implicate.

Minimizing regulatory costs frees up capital for directly productive uses, such as investment in decarbonization technologies, and will reduce the overall cost of measures to consumers. Streamlining regulatory requirements can significantly reduce administrative burden.

While regulation plays an important role in ensuring due process and the health and safety of communities, administrative procedures can also hinder progress towards decarbonization. For example, in the electric sector, New York's efforts to expand renewables throughout the state have been hampered by local communities mobilizing municipal administrative procedures to block the development of wind and solar farms. The state has responded by amending its procedures for siting large-scale renewables through the Accelerated Renewable Energy Growth and Community Benefit Act, which attempts to balance the interests of local communities and clean energy development.[132]

In relation to the ZNG framework proposed by this paper, streamlined regulatory design suggests that responsibility for netting out the additional emissions of new customers should be assigned to utilities, without requiring hearings for each new or expanded customer application. Yet, the process must be fair and verifiable. The specific details must be worked out in consultation with interested stakeholders. This should be done at the time the netting framework is adopted, and revisited periodically to ensure that the process accomplished efficiency, fairness and effective netting.

3.7. Ending Gas Conversion Programs

Since as early as the 1950s, successful marketing, supported by public policy and perception, has played an important role in expanding the gas market. Labeling gas as "modern," "natural," "clean," and a "bridge fuel" to renewables promotes gas as a responsible, environmentally-friendly energy source.[133]

More recently, some utility companies have begun marketing natural gas through service options that claim to meet consumers' demand for more environmentally friendly energy

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[131] Paul Emrath, *Government Regulation in the Price of a Home*, NAT'L ASS'N OF HOME BUILDERS (May 2, 2016), https://www.nahbclassic.org/generic.aspx?genericContentID=250611.

[132] See Budget Bill 75023-05-0, submitted 2/20/2020. *available at* https://www.budget.ny.gov/pubs/archive/fy21/exec/30day/ted-artvii-newpart-jjj.pdf (Accessed April 5, 2020). *See also*, *New York State Announces Passage of Accelerated Renewable Energy Growth and Community Benefit Act as Part of 2020-2021 Enacted State Budget*, NEW YORK STATE RESEARCH AND DEVELOPMENT AUTHORITY (April 3, 2020), https://www.nyserda.ny.gov/About/Newsroom/2020-Announcements/2020-04-03-NEW-YORK-STATE-ANNOUNCES-PASSAGE-OF-ACCELERATED-RENEWABLE-ENERGY-GROWTH-AND-COMMUNITY-BENEFIT-ACT-AS-PART-OF-2020-2021-ENACTED-STATE-BUDGET.

[133] Examples of gas marketing can be found on Youtube, such as the American Gas Association's 1950 "Let's Make a Sandwich," the "World of Tomorrow" commercial produced for the Gas Pavilion at the 1964-65 World's Fair or National Fuel Gas Distribution Corporation's 1988 "Rappin' with Gas."

sources,[134] such as by tailoring gas service to meet specific attributes, like the percentage of methane emissions, or gas produced without hydraulic fracturing.[135]

Oil-to-gas conversion programs have also helped promote gas as a fuel. Lawmakers, utilities, and environmental groups once saw oil-to-gas conversion as a necessary step toward moving away from dirty and polluting heating oil—and such programs have had a positive effect in that regard, reducing local air pollution emissions.[136] From the mid 1800s up to the 1970s, oil was widely used for home energy.[137] In the 1970s, rising oil prices triggered a search for alternatives,[138] increasing demand for natural gas. Gas offered advantages over other fossil fuels: it produces less air pollution than oil, and requires little homeowner attention compared to coal stoves and furnaces. Cities around the country adopted policies encouraging natural gas expansion to reduce air pollution.[139] Utilities also marketed gas, promising savings to consumers. Many gas utility companies offered, or continue to offer, conversion incentives to help cover the conversion costs[140] that may dissuade customers from transitioning to natural gas,[141] and provide assistance through energy solution specialists who assess the cost of conversion and educate consumers on the savings they can expect and the permits that the customer needs to obtain for the conversion.[142]

As states enact aggressive energy and climate goals and policymakers become more aware of the climate impacts of methane across the gas supply chain, municipalities and utilities are beginning to move away from these programs. For example, Con Edison has phased out its oil-to-gas conversion programs, which the Public Service Commission found reasonable in light of Con Edison's obligations "in meeting increased peak day demand and [*sic*] State's policies to further reduce reliance on fossil fuels."[143] Yet, other New York utilities continue to promote conversion programs.[144]

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[134] Jim Magill, *'Responsible' gas offers end-users a choice to buy environmentally friendly product,* S&P Global, https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/110619-responsible-gas-offers-end-users-a-choice-to-buy-environmentally-friendly-product (Nov. 6, 2019).
[135] *Id*.
[136] For example, Con Edison's oil-to-gas programs has converted over 4,200 large buildings and 2,600 customer homes, and has avoided over 520 tons of fine particulate matter emissions. *Oil-to-Gas Conversions: Sustainability Report 2017-2018,* CONSOLIDATED EDISON, https://www.conedison.com/ehs/2017-sustainability-report/safety-and-environment/oil-to-gas-conversions/.
[137] Peter A. O'Connor & Cutler J. Cleveland, *U.S. Energy Transitions 1780-2010,* ENERGIES 7956, 7970 (2014).
[138] *Id*.
[139] *Id*.
[140] Converting a home from fuel oil to gas costs from $4,500 to $10,000. *Oil-to-gas conversion in New York,* TRUE ENERGY SOLUTIONS, https://www.trueenergysolutions.com/hvac-systems/oil-to-gas-conversion.html.
[141] NYC Clean Heat, https://www.nyccleanheat.org/content/incentives.
[142] *Natural Gas Conversion Process,* PSE&G, https://nj.pseg.com/saveenergyandmoney/switchingtonaturalgaspage/naturalgasconversionprocess.
[143] NYPSC Cases 19-E-0065, 19-G-0066, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric and Gas Service, *Order Adopting Terms of Joint Proposals and Establishing Electric and Gas Rate Plan* 36-37 (January 16, 2020) [hereinafter, the Order is referred to as the "Con Edison 2020 Order," and the Joint Proposal as the "Con Edison 2019 Joint Proposal"). New York State Electric and Gas and Rochester Gas and Electric also recently agreed to phase out their oil-to-gas conversion programs in a joint settlement agreement that is pending NY PSC decision. *See* NYPSC Cases 19-E-0378, 19-G-0379, 19-E-0380, 19-G-0381 Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of New York State Electric & Gas Corporation and Rochester Gas and Electric Corporation for Electric and Gas Service, *Joint Proposal* M-4 (May 21, 2020) [hereinafter the NYSEG/RGE 2020 Joint Proposal].
[144] *See*, e.g., *Save energy at home – residential natural gas rebate,* NAT'L GRID, https://www.nationalgridus.com/media/pdfs/resi-ways-to-save/national-grid-nyc-residential-gas-rebate-application.pdf (2019); *Convert to Natural Gas,* ORANGE & ROCKLAND, https://www.oru.com/en/save-money/convert-to-natural-gas.

3.8. Accommodating Beneficial Electrification and Deeper Renewables in the Grid

Electrifying the building and transportation sectors while reducing greenhouse gas emissions presents technological challenges that will require upgrading our electrical grid using smart technologies capable of accommodating energy efficiency, demand response, and deeper penetration of intermittent renewable generation accompanied by storage.

The technological challenge presented by beneficial electrification is two-fold. Electrification of buildings and transportation will increase peak and overall electricity loads, and may shift loads from summer to winter months. At the same time, scaling up renewables to meet most, if not all, electricity load requires overcoming the intermittency problem. With national and subnational governments adopting aggressive renewables targets in relatively short time frames—for example, New York's requirement that 70 percent of electricity generation be derived from renewables by 2030 and 100 percent be emissions free by 2040[145]—the complexity of meeting this two-fold challenge in time should not be understated.[146]

Modernizing our electricity grid to meet these challenges presents opportunities for renewed economic development in high technology industries and the traditional trades.[147] The suite of technologies required to solve the challenges of decarbonization and scaling up renewables are rapidly advancing.

The impacts on the grid of electrifying energy uses previously served by gas infrastructure will place a premium on enhancing energy efficiency and improvements in the performance of traditional and new electrification appliances, such as heat pumps. In the absence of strategic and comprehensive power system planning, beneficial electrification could shift load from summer to winter months, as more heat pumps are deployed,[148] or trigger investment in gas-fired power generation to meet a rapid increase in electricity demand that cannot be met with existing renewables resources. Adverse consequences can be avoided with careful planning, the strategic use of DER as grid resources, and a ramp-up of building envelope upgrades and other efficiency measures.

States must also carbon-tune their electric system—transitioning away from dirty generators on the margins.[149] Carbon-tuning the electric system requires both short-term and longer-term planning, and will vary based on a state's generation and demand characteristics.[150] In the near term, states must better integrate and align utility distribution system planning—including energy efficiency and demand-management programs—with upstream transmission and generation

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145 2019 N.Y. Laws 106, 2019 N.Y. SB 6599, § 1(12)(d).

146 Northeastern Regional Assessment of Strategic Electrification: Summary Report, Ne. Energy Efficiency P'ships (Jul. 2017), at 12-14, https://neep.org/sites/default/files/resources/Strategic%20Electrification%20Regional%20Assessment%20-%20Summary.pdf.

147 Craig A. Hart, *Strategy for the Future: Energy Transition, Competitiveness and the Future Midwest*, UNIV. OF NOTRE DAME PULTE INST. FOR GLOB. DEV. (2020), https://pulte.nd.edu/assets/351519/report_strategy_for_the_future_craig_hart.pdf.

148 Ne. Energy Efficiency P'ships, *supra* note 146, at 12-13.

149 *See*, e.g., Nick Martin, *Carbon-Tuning New York's Electricity System: Uncovering New Opportunities for CO2 Emissions Reductions,* PACE ENERGY & CLIMATE CTR.(Nov. 2015), https://digitalcommons.pace.edu/cgi/viewcontent.cgi?article=1005&context=environmental.

150 For an overview of quantifying power sector carbon emissions resulting from electrification, *see* ROCKY MOUNTAIN INST., *supra* note 125.

planning.[151] Doing so would allow utilities and independent system operators to tap into the demand management potential of electrified technologies. For example, electric water heaters and smart air conditioners can be preset to heat or cool at a time of day when electricity prices and demand are at their lowest, thus providing savings to the customer and the grid, without any significant impact on customers' energy services.[152] Certain technologies, such as resistance storage heating, can also serve as a tool for grid operators, whether through ancillary services or providing curtailment relief for large-scale wind resources, and peak demand management.[153]

The New York Public Service Commission launched a proceeding to evaluate the state's resource adequacy at the wholesale market level, factoring in a number of inputs, including the state's ambitious energy and climate policies.[154] Together with the Commission's integrated planning proceeding for natural gas utilities,[155] these planning efforts represent an initial step of preparing the state to tackle the challenges presented by beneficial electrification and scaling up of renewables to achieve its climate and energy goals.

3.9. Business as Usual in the Building Trades

Currently, in New York and other Northeast states, the default energy services option in both new construction and retrofits of existing buildings tends to be gas. Gas's dominance persists due in large part to cost, and also partly to lack of consumer awareness of alternative technologies and a "business as usual" mentality in the building trades, which include the construction, architecture, planning, real estate and other professionals who work with the building sector.

Real estate development and building retrofit processes foster a "business as usual" approach as the exigencies of holding down costs, meeting deadlines, and minimizing liability dictate working with familiar technologies and completing jobs rapidly, leaving little incentive for developers and contractors to consider alternatives to gas. Ready access to utility service enhances the value of undeveloped property, and utilities' capability to rapidly and easily provide connection to the development reduces cost and time on the part of property developers.

As the real estate development process for commercial and residential buildings proceeds from site selection through development, permitting, and ultimately, construction and tenant turnover,[156] developers should consult utility companies early in the process to address any issues with connection—prior to architectural and engineering design plans being submitted to zoning and permitting authorities for approval.[157] However, the focus tends to be on addressing issues related to the application of gas services rather than on consideration of renewable

[151] As they undertake these efforts, states must take into account the impact of federal policies on wholesale markets. *New York State Public Service Commission and New York State Energy Research and Development Authority v. New York Independent System Operator, Inc.,* 170 F.E.R.C. ¶ 61,119 (Feb. 20, 2020), available at https://www.ferc.gov/whats-new/comm-meet/2020/022020/E-9.pdf.
[152] Rocky Mountain Inst., *supra* note 125, at 8.
[153] Jessica Shipley, Jim Lazar, David Farnsworth & Camille Kadoch, *Beneficial Electrification of Space Heating*, Regulatory Assistance Project (Nov. 8, 2018) at 37, https://www.raponline.org/knowledge-center/beneficial-electrification-of-space-heating/.
[154] NYPSC Case 19-E-0530, Proceeding on Motion of the Commission to Consider Resource Adequacy Matters, *Order Instituting Proceeding and Soliciting Comments* (Aug. 8, 2019).
[155] NYPSC Case 20-G-0131, Proceeding on Motion of the Commission in Regard to Gas Planning Procedures, *Order Instituting Proceeding* (Mar. 19, 2020).
[156] *The Commercial Real Estate Development Process,* SimonCRE, http://info.simoncre.com/the-commercial-real-estate-development-process.
[157] *Id*.

alternatives.[158] The same issues exist for retrofits of existing buildings, and particularly within the affordable housing market and smaller commercial customers.

Although New York and other states increasingly promote and offer incentives for renewable heating and cooling systems, developers often reach out to utilities and permitting authorities only after they have solidified their construction plans relying on gas service, leaving little opportunity for the utility to direct the developer to existing clean energy technology and finance programs. Establishing earlier check-in points enabling municipalities, zoning and planning boards, and utilities to encourage developers to consider alternative energy options would help promote alternatives to gas.

Government and utility resources should also be designed to build capacity among developers for adopting non-gas solutions. Large commercial building developers and operators, such as those managing multi-unit housing, hospitals, and universities, increasingly have energy specialists on staff who have the necessary training and knowledge to evaluate non-gas solutions. Yet, smaller building owners or managers often lack resources and dedicated staff focusing on energy management. These smaller building operators represent the vast majority of building stock in New York City,[159] and will need help.

Consumer outreach and education programs are critical to making customers aware of alternatives to gas. The gas industry established its dominance through a concerted marketing campaign aimed at educating consumers on the advantages of gas for over 200 years.[160] Efforts to educate the public and trades professionals on the advantages of beneficial electrification and deeper penetration of renewables are in their infancy.

3.10. Economic and Jobs Impacts on Fossil Industry Dependent Communities

With the shift towards clean energy and sustainable alternatives, fossil-fired power generation is in a state of flux. The transition away from coal- and gas-fired electric generation systems is impacting economic development and jobs in the communities that rely on fossil fuel industries for jobs and tax revenue.[161] While the transition away from gas will cause job losses, clean energy industries have the potential to replace many of these jobs with new opportunities.[162]

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[158] *Id*. *See also*, James H. Burton, *Residential Real Estate Development,* UNIV. OF W. GEORGIA, https://www.westga.edu/~bquest/2000/resident.html.

[159] There are 662,455 residential buildings in NYC with 1 to 3 units. There are 311,743 residential buildings in NYC with 4 or more units, 17,716 of which are covered under Local Laws 84 and 97 for energy benchmarking and carbon emissions limits for buildings over 25,000 sqft. *See* NYC OpenData DOF: Property Charges Balance, https://data.cityofnewyork.us/City-Government/DOF-Property-Charges-Balance/scjx-j6np. *See also*, NYC OpenData Energy and Water Data Disclosure for Local Law 84 2019 (Data for Calendar Year 2018) https://data.cityofnewyork.us/Environment/Energy-and-Water-Data-Disclosure-for-Local-Law-84-/vdzd-yy49.

[160] The first known advertisement for natural gas appeared on June 13, 1816 in the "American and Commercial Daily Advertiser' for the Peale Museum's gas light exhibit: "Gas Lights – Without Oil, Tallow, Wicks or Smoke. It is not necessary to invite attention to the gas lights by which my salon of paintings is now illuminated; those who have seen the ring beset with gems of light are sufficiently disposed to spread their reputation; the purpose of this notice is merely to say that the Museum will be illuminated every evening until the public curiosity be gratified." On June 17, four days later, the first commercial gas light company, the Gas Light Company of Baltimore, was founded. *See* Christopher Castenada, *Manufactured and Natural Gas Industry*, ECON. HISTORY ASS'N, https://eh.net/encyclopedia/manufactured-and-natural-gas-industry/ (Accessed April 23, 2020).

[161] Robert Pollin & Brian Callaci, *The Economics of Just Transition: Framework for Supporting Fossil Fuel-Dependent Workers and Communities in the United States,* POLITICAL ECON. RESEARCH INST. (Oct. 2016), at 1.

[162] *Id*.

As of 2017, the United States had 10.3 million jobs in the fossil fuels industry.[163] Coal and natural gas jobs account for almost a third of those jobs.[164] The transition from fossil fuels to renewable energy can shift jobs to construction and manufacturing positions.[165] The International Institute for Sustainable Development estimates that "the average number of jobs per megawatt of capacity of solar photovoltaic to be between seven and 11 times that of coal and natural gas."[166] As of 2018, 3.36 million jobs been have created in the clean energy industry, which outnumbers the fossil fuel industry job count by almost three to one, and that number is expected to increase.[167] These numbers suggest that the transition from gas to renewables can be net positive in creating new jobs.

Planning for the economic impacts on communities reliant on the gas industry is crucial to the success of transitioning away from gas. Two principles of energy justice, distributive justice and procedural justice, should guide policies.[168] Distributive justice considers who to compensate for losses due to the loss of fossil industry enterprises and jobs, and how to mitigate the loss of any identity or culture often lost with the closure of an industry.[169] Procedural justice aims to ensure that those affected participate in the decision-making process.[170]

An equitable and fair transition approach should prepare workers to build necessary skills for new occupations, prioritize support for disadvantaged communities and individuals, ensure environmental remediation, and provide social support.[171] The need for social support will be urgent. The loss of the steel industry and much of the coal industry during the 1970's and 1980's hollowed out communities, and contributed to physical and mental health problems for affected individuals, leading to an increase in the demand for local social services.[172] The transition away from gas may be no less traumatic.

3.11. Managing Distributive Impacts of Netting Gas Demand

The Zero Net Gas policy framework requires gas demand growth by existing and new customers to be netted against reductions within the utility service territory. To net, ZNG calls for inefficient gas infrastructure to be prioritized for replacement by efficiency measures or even electrification to optimize environmental results at lowest cost.

Netting will inevitably require regulators and utilities to make judgements about who will receive gas service, who will be required to reduce gas use through efficiency or other measures, and who will shift from gas to electricity. These decisions impose direct costs and potentially indirect

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[163] *Natural Gas and Oil: A Critical Contributor to American Prosperity,* AMER. PETROLEUM INST. (July 2017), https://www.api.org/~/media/Files/Policy/Jobs/National-Factsheet.pdf.
[164] Gary Hilberg, *Employment in the US Power Generation Sector – Will there be an employment impact due to transitioning from fossil fuels to renewables?,* ENERGY CENTRAL (Oct. 3, 2019), https://www.energycentral.com/c/gn/employment-us-power-generation-sector-will-there-be-employment-impact-due.
[165] *Id*.
[166] Philip Gass & Daniella Echeverria, *Fossil Fuel Subsidy Reform and the Just Transition: Integrating approaches for complementary outcomes,* INT'L INST. FOR SUSTAINABLE DEV. (Dec. 2017), at 5.
[167] *Clean Jobs America 2019,* E2 (Mar. 13, 2019), https://e2.org/reports/clean-jobs-america-2019/.
[168] *Realizing a just and equitable transition away from fossil fuels,* STOCKHOLM ENVIRO. INST. (Jan. 2019), at 3, *available at* https://www.sei.org/wp-content/uploads/2019/01/realizing-a-just-and-equitable-transition-away-from-fossil-fuels.pdf.
[169] *Id* at 4.
[170] *Id*.
[171] Lisa Anne Hamilton *et al*, *Transition Support Mechanisms for Communities Facing Full or Partial Coal Power Plant Retirement in New York*, PACE ENERGY AND CLIMATE CENTER (2017), *available at* https://peccpubs.pace.edu/viewresource/64922f6e3534abb/Transition+Support+Mechanisms+for+Communities+Facing+Full+or+Partial+Coal+Power+Plant+Retirement+in+New+York.
[172] RICHARD B. MCKENZIE, FUGITIVE INDUSTRY: THE ECONOMICS AND POLITICS OF DEINDUSTRIALIZATION 3 (1984).

costs, through market effects, on utility customers. In particular, low- and moderate-income communities are least able to absorb cost increases due to the transition to electrification.

These issues must be presented to stakeholders, resolved through a methodology that is procedurally and distributionally equitable, and implemented impartially. Chapter 5, presenting the Zero Net Gas policy framework, discusses these issues and explores approaches to ensuring the design of the program achieves environmentally sustainable, cost-effective, and just outcomes.

4. Technologies and Policies for Decarbonizing Gas

States and municipalities continue to be the primary drivers of decarbonization in the United States. A growing number of states and municipalities now require transition to 100 percent decarbonization through renewable energy or other reductions in greenhouse gas emissions.

Legislative mandates typically do not prescribe the precise mechanisms by which targets must be achieved, however, ambitious targets aimed at meaningfully reducing greenhouse emissions can be expected to require at least some decarbonization of the gas utility sector or gas use in buildings.

This chapter explores selected technology and policy solutions to buildings decarbonization. As our experience with gas decarbonization evolves, the universe of possible solutions will expand. The technologies and policies presented here should therefore be considered an early, partial survey.

4.1 Technologies

An array of technologies and measures described in this section are being deployed by gas utilities to reduce gas demand, including energy efficiency, demand response, non-pipe solutions, and renewable alternatives to gas, such as electric heat pumps.

In evaluating the potential for these technologies to successfully displace gas, the replacement technologies must satisfy customer preferences, representing a *true substitute* for the fossil-fired system they displace. Consumers will expect that substitute technologies provide equal or better levels of performance across several criteria, including:

- *Affordability* in energy services;
- *Comfort* in space conditioning and cooking;
- *Reliability* in space conditioning / water heating under all operating conditions (at maximum demand levels, sustained periods of high demand, extended cold weather);
- *Resiliency* in space conditioning / water heating, including mitigation measures to address grid power outages of short (hours) and long term (24 or more hours) duration;
- *Customer satisfaction* across installation, operations and maintenance; and
- *Minimizing disruption to business or household* across equipment installation, operations and maintenance.

If one, and particularly if several, of these criteria for technology substitution are not met, consumers may reject building electrification technologies, slowing adoption at the pace and level required to meet climate and energy goals.

Based on these criteria, the technologies presented in this section possess the potential to successfully displace gas, with appropriate policy support and consumer education.

4.1.1 Energy Efficiency

Energy efficiency is a low-cost and often cost-saving energy resource, and is a cornerstone of effective gas demand reduction. In deploying a ZNG policy framework, states that do not already have robust energy efficiency structures in place should prioritize developing efficiency targets and programs.

To reduce gas consumption, energy efficiency can include both electric and gas programs, and encompasses a wide variety of measures. Common processes and technologies for energy efficiency include weatherizing buildings, high efficiency boilers and heat pumps, and combined heat and power.

In the residential multifamily sector, efficiency programs should cover common areas, whole-building, and in-unit measures, in order to maximize savings. Whole-house weatherization programs reduce gas demand by minimizing the amount of heat lost through building envelopes, and are cost-saving for households.

New York has prioritized energy efficiency in its climate and clean energy framework, both through utility and state investments. As part of New York's Reforming the Energy Vision process, the state transitioned from an Energy Efficiency Portfolio Standard, which focused on resource acquisition, to an all-fuels approach to efficiency that coordinates policies across electricity, natural gas, and oil, and embraces flexibility to meet state greenhouse gas reduction goals.[173] To meet the utility sector's customer-level energy consumption reduction target of 185 trillion BTU by 2025 pursuant to this policy,[174] the Public Service Commission allocated a budget of $1.99 billion through the New Efficiency: New York proceeding, with nearly $500 million allocated to heat pumps.[175] New Efficiency: New York is projected to produce $13 billion in customer savings over the life of the programs.[176]

Energy efficiency is particularly important for the low- and moderate-income ("LMI") customer segment, where inefficient building envelopes, central systems, and appliances can have a significant impact on customer energy affordability, health, and comfort. Under the New Efficiency: New York framework, utilities must allocate 20 percent of incremental investments to LMI customer programs,[177] and 40 percent of that LMI funding specifically to the affordable multifamily segment.[178]

The New York Public Service Commission recognized the synergy between gas and electric efficiency, and authorized Con Edison flexibility in shifting funds between its electric and gas efficiency portfolios for low- and middle-income households, and the same for Con Edison's non-LMI portfolio once it achieves its lifetime savings targets for any specific rate year.[179] Further, New York's utilities, in coordination with the New York State Research and Development Authority ("NYSERDA"), are currently developing LMI Efficiency Portfolios, including initiatives to ease up-front financing barriers and improve customer identification and outreach.

In this section we discuss combined heat and power systems as a best-of-class energy efficiency measure if gas must be used as the system fuel.

Combined Heat and Power

Combined heat and power ("CHP"), also referred to as cogeneration, is defined as "the concurrent production of electricity or mechanical power and useful thermal energy (heating

[173] NYPSC Case 18-M-0084, In the Matter of a Comprehensive Energy Efficiency Initiative, *Order Adopting Accelerated Energy Efficiency Targets*, 5 (Dec. 13, 2018) [hereinafter the "Accelerated Energy Efficiency Targets Order"]. *See also*, NYPSC Case 07-M-0548, Proceeding on Motion of the Commission Regarding an Energy Efficiency Portfolio Standard, *Order Establishing Energy Efficiency Portfolio Standard and Approving Programs* (June 23, 2008).
[174] *Accelerated Energy Efficiency Targets Order*, *supra* note 173 at 1.
[175] NYPSC Case 18-M-0084, In the Matter of a Comprehensive Energy Efficiency Initiative, *Order Authorizing Utility Energy Efficiency and Building Electrification Portfolios Through 2025* 35 (Jan. 16, 2020).
[176] *Id*. at 35.
[177] *Id.* at 20.
[178] *Id*. at 55.
[179] Con Edison 2020 Order, *supra* note 143, at 68.

and/or cooling) from a single source of energy."[180] CHP systems provide highly efficient power, heating and/or cooling generated at or near the user site, providing a residential building or industrial facility with primary energy services or a resilient backup power source.

Whereas conventional fossil-fuel electric power generation operates at about 33 percent efficiency, the remaining 67 percent being lost as waste heat, CHP systems use otherwise wasted heat for heating and cooling, steam production, or other industrial processes. Heat reuse, together with avoided energy loss in transmission due to the close proximity of these systems to consumption, enables these systems to achieve thermal efficiencies from 60 to as high as 80 percent.[181]

Because modern CHP systems are powered by natural gas, they represent a best-of-class energy efficiency measure compared to central-station power, reducing overall gas consumption and emissions, however they are not carbon-free. Importantly, CHP operators that purchase gas on a firm basis contribute to peak gas demand and thus help drive new infrastructure investments. As electric power generation infrastructure transitions to renewable technologies, CHP's contribution to GHG emission reductions diminishes.

Gas CHP systems can also be designed to operate with solar photovoltaic and storage, further enhancing reductions in emissions and resiliency,[182] though fully-renewable CHP systems remain cost prohibitive for most customers. However non-gas CHP technologies are expected to advance and drive costs down.

Finally, CHP can also be powered by biogas or biomass.[183] Both biogas and biomass present certain complexities, including availability and potential impacts on land use, which should be carefully considered. For biogas, capturing fugitive methane emissions from landfill, agriculture, or wastewater treatment plants can reduce emissions, however not all states consider biogas a renewable resource. In New York, biogas is not included in the definition of "renewable energy" in the Climate Leadership and Community Protection Act,[184] and thus is not eligible for certain financial incentives through state programs and does not count towards the state's 2030 goal of 70 percent renewable power generation.

4.1.2 Demand Response

Under demand response programs, participating customers agree to shift or reduce their demand, or to switch to an alternate fuel source during peak periods upon the utility's request in exchange for lower energy rates or other benefits.

Because non-gas fuel sources are often diesel or fuel oil, traditional gas demand response programs are designed to enhance system reliability and avoid costs by reducing peak gas consumption, rather than to achieve long-term emissions reduction or other environmental or social benefit.

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[180] *Combined Heat and Power Basics,* Office of Energy Efficiency & Renewable Energy, ENERGY.GOV (Accessed Mar. 21, 2020) https://www.energy.gov/eere/amo/combined-heat-and-power-basics.
[181] *CHP Benefits,* US EPA (Accessed May 7, 2020) https://www.epa.gov/chp/chp-benefits.
[182] *See,* e.g., *Hybrid Rooftop Solar + CHP + Storage Model Has Potential, Says GE,* CLEAN TECHNICA (May 21, 2015), https://cleantechnica.com/2015/05/21/hybrid-rooftop-solar-chp-storage-model-has-potential-says-ge/; Thomas Bourgeois, et al., *Community Microgrids: Smarter, Cleaner, Greener* PACE ENERGY AND CLIMATE CENTER (2013) 3-5, https://peccpubs.pace.edu/viewresource/aaa4e73b9c11b86/Community+Microgrids%3A+Smarter%2C+Cleaner%2C+Greener.
[183] GE, *GE supplies steam technology for biomass power plant in Japan*. BIOMASS MAGAZINE. (Feb. 19, 2020) http://biomassmagazine.com/articles/16825/ge-supplies-steam-technology-for-biomass-power-plant-in-japan.
[184] Climate Leadership and Community Protection Act, S. 6599, A. 8429, 2019-20 Reg. Sess. (N.Y. 2019), § 66-p.

Interruptible gas service may nevertheless help reduce gas infrastructure expansion. Interruptible customers, which can be large multifamily residential, commercial, or industrial consumers, maintain a backup energy source and agree to allow the utility temporarily suspend their gas service during times of peak demand. To the extent that interruptible service works much like demand-response programs, it can allow utilities to reduce peak demand and associated infrastructure investments.

However, in practice, utilities may ask interruptible customers to switch to their alternative energy source for relatively short periods of time each year, so the impact of interruptible customers on reducing infrastructure needs may vary. In addition, the greenhouse gas emissions profile of interruptible gas service, as compared to standard offer service, is complicated by the fact that interruptible customers typically rely on fuel oil or diesel as their backup energy source when not operating on gas. Thus, gas interruption may actually increase greenhouse gas emissions.

Con Edison has developed an innovative gas demand response program as part of its Smart Solutions for Natural Gas Customer portfolio,[185] and aims to achieve decarbonization. Con Edison's program encompasses both commercial and residential opportunities, including a smart thermostat program for residential customers. Importantly, it precludes fuel switching from gas to fuel oil or liquid fuels as a qualifying demand reduction measure. Customers who are found to have responded to a demand response call by switching to fuel oil or liquid fuels are temporarily banned from participating in the program.[186]

As utilities develop advanced gas demand response programs that integrate non-fossil alternatives, demand response could emerge as a tool to decarbonize gas systems.

4.1.3 Non-Pipe Solutions

Non-pipe solutions programs can assist utilities in reducing gas demand by leveraging innovative demand-reduction mechanisms and technologies, such as energy efficiency, renewable heat, and demand response measures. Instead of investing in expanding traditional gas infrastructure, utilities identify the specific gas supply constraint or demand-reduction need and issue a competitive solicitation for demand- and supply-side products and services.[187]

Non-pipe solutions programs are modeled on electric non-wires alternatives programs, which have proven successful in reducing electric demand through innovative demand-side measures.[188] For example, in response to gas capacity constraints, Con Edison established a $220 million program that solicited proposals for a variety of innovative solutions, such as energy efficiency and weatherization; demand response, including thermal energy storage and

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[185] *See generally*, NYPSC Case 17-G-0606, Petition of Consolidated Edison Company of New York, Inc. for Approval of the Smart Solutions for Natural Gas Customers Program.

[186] Consolidated Edison Company of New York, Inc., *Gas Demand Response Pilot Implementation Plan, 2018-2021* 6 (July 2019), *available at* http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={38B50BE6-E136-4205-A1C0-339F2184EACD}.

[187] "Demand-side" in this context means demand-reduction measures that rely on gas efficiency or alternatives to gas and other fossil-fired resources, in contrast to supply-side programs, such as compressed- or liquefied natural gas trucking, which rely on procuring gas supply through non-traditional (i.e., non-pipeline) means.

[188] *See,* e.g., *Brooklyn Queens Demand Management Demand Response Program*, CONEDISON (Accessed May 20, 2020) https://www.coned.com/en/business-partners/business-opportunities/brooklyn-queens-demand-management-demand-response-program.

other non-fuel oil mechanisms; and beneficial electrification technologies and electric end-use appliances.[189]

4.1.4 District Geothermal, Ground Source and Air Source Heat Pumps

Alternatives to gas use for building energy services often involve beneficial electrification. Examples of beneficial electrification include electric cooking and heating appliances. Electric heat pumps in particular represent a promising renewable, on-site alternative to gas as an energy source in buildings. Heat pumps include both air source and ground source variants, and come in various configurations, including reverse cycle chillers and variable refrigerant flow systems. Heat pumps can be deployed in individual buildings, or they can serve as part of district energy systems, which provide heating and/or cooling to a group of buildings through a shared energy source, such as geothermal heat pumps or steam.

District Geothermal

Several jurisdictions are exploring the replacement of gas distribution infrastructure with geothermal district energy services as a way to defer or avoid the mounting cost of maintaining gas infrastructure. In New York, Con Edison is undertaking a District Energy Initiative to "examine the feasibility of deploying geothermal district energy systems in [its] service territory as an alternative to replacing leak prone pipe." As part of the initiative, Con Edison will assess and identify a portfolio of 10-15 potential sites, giving preference to low- and middle-income communities.[190]

In Massachusetts, the Home Energy Efficiency Team ("HEET") has produced a GeoMicroDistrict Feasibility Study that explores the feasibility of replacing aging gas infrastructure with ground-source heat pump systems shared by buildings along a single street segment. HEET undertook the GeoMicroDistrict Study in recognition of the fact that "more than a quarter of the gas pipes under Massachusetts streets are aging, and must be replaced over the next 20 years," which is expected to cost more than $9 billion.[191]

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[189] NYPSC Case 17-G-0606, Petition of Consolidated Edison Company of New York, Inc. for Approval of the Smart Solutions for Natural Gas Customers Program (February 7, 2019). *See also*, Consolidated Edison Company of New York, Inc., *Request for Information: Non-Pipeline Solutions to Provide Peak Period Natural Gas System Relief* (2020) (Accessed Mar. 17, 2020), https://www.coned.com/-/media/files/coned/documents/business-partners/business-opportunities/non-pipes/non-pipeline-solutions-to-provide-peak-period-natural-gas-system-relief-rfi.pdf?la=en.

[190] Con Edison 2019 Joint Proposal, *supra* note 143, Attachment A, p. 115-116. Two additional New York utilities, New York State Electric and Gas and Rochester Gas and Electric, agreed in their most recent rate case to (1) retain a consultant to assist in developing a study to examine the feasibility of geothermal district energy systems in four upstate New York counties, (2) develop plans for pilot projects where feasible, including in areas with leak prone pipe, and (3) at the conclusion of the study, file recommendations with the Commission to advance the plans. NYSEG/RGE 2020 Joint Proposal, *supra* note 143, Appendix M, p.4.

[191] HOME ENERGY EFFICIENCY TEAM AND BUROHAPPOLD ENGINEERING, GEOMIRCODISTRICT FEASIBILITY Study 1 (2019), *available at* https://heetma.org/feasibility-study/. Massachusetts has gone even further in addressing renewable heating and cooling. In response to a series of gas line explosions and fires that occurred in Massachusetts' Merrimack Valley in 2018, the Massachusetts Legislature introduced the "FUTURE Act" (An Act for a Utility Transition to Using Renewable Energy, H.2849, S.1940 (2019)) to accelerate the repair of gas leaks and encourage a conversion to piping renewably-sourced hot and cold water instead of natural gas. The Applied Economics Clinic studied the economic effect of the FUTURE Act and concluded that it would reduce the cost of gas system repair from $17.1 billion to $6.3 billion, a savings of roughly $10.8 billion over the next 30 years. Joshua R. Castigliego and Liz Stanton, PhD, *Planning for the Future: Massachusetts Cleans Up its Heating*, Policy Brief 1 (June 2020), found at https://aeclinic.org/publicationpages/2020/6/17/planning-for-the-future-massachusetts-cleans-up-its-heating (July 1, 2020).

Ground Source Heat Pumps

Ground source heat pumps, also referred to as geothermal heat pumps, couple an indoor heat pump and an external ground loop for thermal exchange buried underground or underwater. Heat is transferred between the building and the ground or water source. Relatively consistent sub-surface temperatures enable ground source heat pumps to supply space heating in cold weather climates, year-around hot water heating, and space cooling in summers. Water heating is significantly more efficient during summer when these systems can utilize excess heat within the building being served.

Ground source heat pump systems are typically closed loop, but may also be open loop design. Closed loop systems circulate the working fluid—usually water or anti-freeze[192]—in a closed system of pipes. Open loop systems source water directly from nearby groundwater sources, and either return the water back to that groundwater source or otherwise dispose of it.

Ground source heat pumps can be drilled horizontally or vertically. Buildings with adequate space can employ horizontal drilling, typically to depths of 6 to 10 feet.[193] For building sites where land is scarce, vertical drilling systems are utilized. Several bore holes or "wells" are drilled typically to depths of 100 to 400 feet. Pipes are fitted vertically into the bore hole to extract heat or cold from the subsurface.

In indirect heat exchange systems, fluid circulating through the system is piped to a heat exchanger supplying the building's HVAC system. In direct exchange systems, the heat or cooling is supplied directly to the building without an intermediate heat exchanger. Direct exchange systems are significantly more efficient at heat extraction and rejection than indirect systems.

Air Source Heat Pumps

Air source heat pumps provide heating and cooling by exploiting the difference between inside and outside air temperature. Like ground source heat pumps, working fluid running through coils transfers heat or cooling between the building interior and outside depending on the season.

Air source heat pumps vary in design, differentiated by distribution system (ductless, ducted, or short-run ducted systems), division of the building into one or more zones for different space conditioning requirements, and the placement of coils and fan. Split systems have one coil placed outside and one coil placed inside, with supply and return ducts connected to an interior central fan. Packaged systems place both coils and fan outdoors.[194]

Because air source heat pumps are more compact than geothermal systems, they are ideal for dense urban environments, where land constraints and sub-surface infrastructure may render ground systems infeasible. Placement of exterior components in protected areas, such as below-grade parking garages, can enhance performance of these systems due to modest swings in ambient air temperatures in such locations.

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[192] In regard to decarbonization, one important consideration in regard to heat pumps is the climate impact of the working fluid. *See*, Steven Winter Associates, Inc. for Natural Resources Defense Council, *Heat Pump Retrofit Strategies for Multifamily Buildings* 7 (Apr. 2019), *available at* https://www.nrdc.org/sites/default/files/heat-pump-retrofit-strategies-report-05082019.pdf. Installer training is critical to ensuring that refrigerant leakage is minimized.

[193] Home Energy Community of Practice, Geothermal Heat Pumps (July 30, 2019), https://home-energy.extension.org/geothermal-heat-pumps/.

[194] Air Source Heat Pumps, U.S. DEP'T OF ENERGY, (Accessed May 20, 2020) https://www.energy.gov/energysaver/heat-pump-systems/air-source-heat-pumps.

A reverse cycle chiller that runs on electricity can be added to a heat pump system in order to provide additional heating or cooling to boost the system for producing hot water for domestic uses and/or for floor radiant heating. The addition of an insulated water tank to store hot water will further increase the efficiency of the system.

Variable Refrigerant Flow Systems

Variable Refrigerant Flow ("VRF") systems employ a refrigerant as both the heat-transfer fluid as well as the working fluid. A centralized outdoor condensing unit is typically connected to multiple indoor units, or can be connected to a ground loop. The ability to connect to multiple indoor units makes VRF technologies well suited to "zoning" in larger commercial or institutional buildings and multifamily buildings. The capability to control and modulate the delivery of heating or cooling into multiple spaces within the building significantly enhances the attractiveness, as it allows for targeted levels of comfort and achieves efficiency by avoiding the blunt approach of serving the entire building space with the same level of thermal service.

These systems can be designed to provide heat and cooling, or to provide heating, cooling, and—when operating as a heat recovery system—*simultaneous* heating and cooling. Sites can select VRF systems that operate in heat pump mode (providing heating or cooling at any given time), or heating, cooling, and real-time heating/cooling when operating with heat recovery technology.

The systems work either with ground loops or air-coupled heat exchangers. The DC invertors enable the delivery of variable refrigerant flow to all the connected (multi-port) indoor units. Unlike traditional air source heat pumps, the DC invertor-based compressors, coupled with communications and controls, can modulate the amount of refrigerant sent to all interior zones, or, in communication with each internal zone, can send each zone the level of refrigerant that it requires based on user settings on a real-time basis.

The capability to target the refrigeration flow facilitates both efficiency (far better part load operation) and comfort. The key to providing comfort is to supply heating or cooling when and where it is required without swings in room temperature.[195]

The DC invertor compressor speed can be varied, unlike many other heat pump technologies that are either on or off. In practice, this means much longer periods of continuous operation. Specific zonal demands are met by individual setpoints. Once that setpoint is reached, refrigerant flow can be adjusted to maintain the room temperature smoothly without fluctuation.[196] Each zone can further adjust comfort levels by varying fan speed and louver position within a particular zone.

VRF technologies are well suited to meeting the high instantaneous thermal delivery demands of larger buildings. They may be particularly appropriate in settings that have widely varying internal building space conditioning demands or multiple separate tenants sharing the building space. In the United States, VRF technologies are being installed in hotels, multifamily buildings, schools, commercial office buildings, and hospitals.

4.2 Policies for Transitioning to Non-Gas Solutions

This section presents objectives and criteria to evaluate the various policy options for transitioning away from natural gas and its associated infrastructure. Although an exhaustive

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[195] CARRIER CORPORATION SYRACUSE, NEW YORK, VARIABLE REFRIGERANT FLOW (VRF) SYSTEMS: FLEXIBLE SOLUTIONS FOR COMFORT 3 (Jan. 2013), *available at* http://www.utcccs-cdn.com/hvac/docs/1001/Public/0B/04-581067-01.pdf.
[196] *Id*.

treatment of potential criteria is beyond the scope of this study, several basic principles are adequate to support objective evaluation.

The end-goal can be summarized as the transition away from natural gas on a timeframe to avoid dangerous climate change, at least-cost to society, in a manner equitable and affordable to all. Accordingly, the criteria for evaluating potential policies and measures for transition can be distilled as follows:

- Transparent in operation, thereby enabling easy understanding in concept and impact;
- Efficient in use of resources, both private and public;
- Affordable and equitable for all groups within society;
- Measurable and verifiably effective in achieving decarbonization; and
- Sustainable politically and economically over the time period required to decarbonize.

The sections that follow evaluate various policy approaches based on these criteria.

4.2.1 Gas Moratoriums

States, municipalities, and utilities have imposed moratoriums on expanding gas service for both regulatory and supply-constraint reasons in several instances. Whether permanently prohibiting new hookups or new gas-fired technologies, or temporarily suspending expanding gas service due to inability to procure adequate gas supply to serve projected customer demand, moratoriums are disruptive to customers and utilities. Their design and implementation should be carefully considered to mitigate potential adverse consequences.

While no states have imposed near-term prohibitions on gas or other fossil fuel use in buildings, several municipalities have set zero-emissions goals or have imposed moratoriums on fossil fuel use in new construction. Starting in 2020, the city of Berkeley, California prohibited natural gas piping in new buildings, unless the permit applicant proves that no other feasible alternative to natural gas exists.[197] The cities of San Jose, California and Brookline, Massachusetts have imposed similar bans.

Such municipal ordinances are a promising pathway to decarbonization, given that municipalities have jurisdiction to enforce building codes, giving them real "teeth." Yet, municipal moratoriums are likely not politically practicable in all jurisdictions, and municipalities in states that exercise pre-emptive authority on this issue may lack authority to take such action.[198]

More commonly, utilities have enacted moratoriums due to limited natural gas supply, as has occurred in Massachusetts and New York.[199]

Supply-based moratoriums appear to be especially disruptive to consumers and the economy because they are often imposed on an emergency basis and with little to no notice.[200]

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[197] Emilie Raguso, *Berkeley first city in California to ban natural gas in new buildings,* BERKELEYSIDE (Jul. 17, 2019), https://www.berkeleyside.com/2019/07/17/natural-gas-pipes-now-banned-in-new-berkeley-buildings-with-some-exceptions.
[198] Danielle Muoio and Marie French, *New York Slow to Curb Natural Gas in New Construction,* POLITICO (Feb. 26, 2020), https://www.politico.com/states/new-york/albany/story/2020/02/25/new-york-slow-to-curb-natural-gas-in-new-construction-1263585.
[199] New York alone experienced two major moratoriums in the past year, first by Consolidated Edison Company of New York, Inc. (*see* Case 19-G-0080, In re Staff Investigation into a Moratorium on New Natural Gas Services in the Consolidated Edison Company of New York, Inc. Service Territory), followed by affiliates of National Grid USA (the Brooklyn Union Gas Company d/b/a National Grid NY and KeySpan Gas East Corporation d/b/a National Grid).
[200] Kavia Balaraman, *National Grid lifts gas moratorium following deal with New York*, UTILITY DIVE, (Nov. 25, 2019), https://www.utilitydive.com/news/national-grid-lifts-gas-moratorium-following-deal-with-new-york/568044/.

Regulatory moratoriums, in contrast, can phase in requirements over time, allowing a compliance period that gives the buildings industry time to prepare to meet the mandates.

Both New York and California's public utilities commissions have recognized the challenges associated with phasing out gas to meet state decarbonization goals, and in early 2020 launched comprehensive gas planning proceedings to consider these issues. New York's proceeding will address the development of standards for utility moratoriums, including best practices for how utilities declare moratoriums, customer impacts, and other matters.[201] California's proceeding will implement the state's phase out of natural gas, addressing reliability standards, operational coordination between gas utilities and gas-fired generators, and stranded assets issues related to decarbonization of the gas sector.[202]

4.2.2 Carbon Markets

Carbon markets have been proposed as a means to assign a price for emitting carbon with the goal of internalizing these costs to emitters. Carbon markets as a policy instrument has proven to be complex and their effectiveness a matter of debate. Although carbon markets can help mobilize financial resources for a broader set of policies to decarbonize gas infrastructure, we caution in relying upon them as the primary policy tool for the reasons described in greater detail in this section.

Cap and trade schemes limit the greenhouse gas emissions of regulated emitters, while allowing market participants to determine how and by whom the emissions reductions will be accomplished. A regulator defines who is subject to emissions limits and sets those limits, granting a quantity of emissions allowances equal to the permitted amount. In each compliance period, each emitter must submit allowances for its emissions. Emitters who reduce emissions below their limits will have a surplus of allowances, which they can sell to those emitters that fail to meet their targets. The price of those emissions allowances becomes the cost of carbon pollution.

If the carbon price is adequately high and stable, it incents polluters to invest in carbon-reduction technologies. If the government regulator auctions allowances, rather than distributing them freely, the carbon price acts as a tax, the proceeds of which may be re-invested in carbon reducing policies and measures, strengthening its impact. Depending on the rules established by the regulator, emitters may also be permitted to develop or purchase offset credits from other non-regulated entities that can demonstrate they have reduced their emissions.

At the end of each compliance period, regulated emitters must submit allowances for each tonne of CO_2 equivalent they emit or face a monetary penalty.

While attractive in theory, carbon markets have experienced difficulties in actual practice. As noted, for the price signal to influence reductions, it must be adequately high and stable over time. Experience in actual markets has shown that price levels are often lower than expected and highly volatile. Political will on the part of the regulator is also often too weak to set stringent emissions limits that will translate into heavy costs for emitters.

Historically, the implementation the European Union Emissions Trading Scheme and the Northeast United States Regional Greenhouse Gas Initiative have both resulted in replacement

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[201] NYPSC Case 20-G-0131, Proceeding on Motion of the Commission in Regard to Gas Planning Procedures, *Order Instituting Proceeding* (Mar. 19, 2020).
[202] PUCCA Rulemaking 20-01-007, *Order Instituting Rulemaking to Establish Policies, Processes, and Rules to Ensure Safe and Reliable Gas Systems in California and Perform Long-Term Gas System Planning* (Jan. 16, 2020).

of coal consumption in the power sector with natural gas, because gas was an inexpensive and readily available fuel with lower carbon intensity, taking into account potential penalties for exceeding emissions limits. Natural gas was the common response of utilities to the coal problem.[203]

Unfortunately, unlike the case of coal, natural gas does not have an affordable replacement fuel in ample supply at present. Carbon trading can only be effective in transitioning out of gas if the cost of continuing to use gas is higher than the cost of lower-carbon energy alternatives, taking into account potential penalties under the regulation.

As a practical matter, for carbon markets to be effective, carbon prices must be high enough for sustained periods of time to enable beneficial electrification technologies supplied by wind and solar generation to be less expensive than gas coupled with carbon price penalties.

As a result of the need for sustained high carbon prices, a pure carbon markets approach places a premium on political will to set ambitious emissions limits and maintain strict carbon caps, and would be regressive, adversely impacting low-income households in particular. The potential unpopularity and inequity could undermine support for these methods, which would render them politically unsustainable. Experience to date with carbon markets suggest that carbon prices have not been adequately high or stable to sustain the transformation required without other supporting policies.[204]

Importantly, more direct policies and measures discussed in this report are available to influence transition away from gas infrastructure, which offer the potential to share the cost of the transition among different stakeholders more predictably and transparently. Notwithstanding the challenges associated with carbon markets, they can play a role in supporting the transition away from natural gas. To the extent carbon markets are deployed, caps should be set to force transition away from natural gas, and the proceeds of carbon trading should be deployed to support that transition.

4.2.3 Aligning Building Codes and Standards with Decarbonization Goals

Building codes offer one of the most direct and powerful methods for state and municipal governments to drive decarbonization in the buildings sector.

Massachusetts was the first state to supplement their basic building codes with alternative code standards that promote energy efficiency, otherwise known as a stretch code, in 2009.[205] The stretch code is unique because it emphasizes energy performance instead of prescriptive requirements, thus enabling already built buildings to meet the code if original construction meets the energy efficiency guidelines. Massachusetts follows a voluntary adoption model for most municipalities, but makes adoption of the stretch code mandatory for municipalities which have been designated as Green Communities. Green Communities make up more than half of the Commonwealth's cities and towns and promote a 20 percent municipal energy reduction as

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[203] Jackson Salovaara, MOSSAVAR-RAHMANI CENTER FOR BUSINESS & GOVERNMENT, COAL TO NATURAL GAS FUEL SWITCHING AND CO2 EMISSIONS REDUCTION (2011), https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/files/Salovaara_2011.pdf.

[204] *See* E Narassimhan et al., C*arbon pricing in practice: a review of existing emissions trading systems,* 18:8 CLIMATE POLICY (2018).

[205] *Building Energy Code,* MASS.GOV (Apr. 3, 2019), *available at* https://www.mass.gov/info-details/building-energy-code.

well as three other criteria having to do with favorable zoning and permitting for renewables, as well as the prioritization of fuel-efficient vehicle purchases.[206]

In New York, the baseline building energy efficiency codes under the Energy Conservation Construction Code of New York State ("ECCNYS") can be voluntarily supplemented by local jurisdictions through NYStretch Codes. NYSERDA's stretch codes offer an opportunity for localities to adopt more stringent energy efficiency building codes, which have been shown to be 10-12 percent more efficient than ECCNYS.[207] As in Massachusetts, New York allows municipalities to voluntarily adopt stretch codes under the New York Municipal Home Rule Law. This can be replicated in most states with comparable delegations of municipal authority.

In California, the California Green Building Standards Code ("CALGreen") is a mandatory stretch code requiring residential and nonresidential new construction to meet greenhouse gas reductions to 1990 levels by 2020.[208] CALGreen has two tiers; tier one aims for a 15 percent energy efficiency increase over the standard California building code, and tier 2 aims for a 30 percent energy efficiency increase.[209]

States that do not already have advanced building codes that require high energy efficiency and electrification readiness should adopt such codes, including a requirement that new construction include the necessary electrical and wiring conditions for full electrification of end-use energy services, including transportation.[210]

Local governments in most states have been delegated the primary responsibility for determining how private land is developed and conserved. As previously noted, in New York, such powers are delegated through the Municipal Home Rule Law, which allows municipalities to adopt laws relating to their property, affairs, or government and for the protection and enhancement of their physical and visual environment.[211] It is a source of local authority to regulate land use in addition to zoning and planning enabling statutes.

Many states have similar delegations and localities are allowed to prioritize the new construction and retrofit markets. Comprehensive plans could be amended at the local level to inform best energy efficiency practices as well as to provide an emphasis on renewables in traditional plan topics such as existing conditions, goals and objectives, implementation strategies, and future land-use maps.[212] Such goal-oriented comprehensive plans can serve as the basis upon which to adjust zoning codes.

State and municipal codes can promote or be based on private voluntary standards aimed at encouraging manufacturers and developers to adopt cutting-edge clean energy measures. Examples include national manufacturers' efficiency efforts through programs like the US Green

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[206] *Becoming a Designated Green Community* MASS.GOV (Apr. 4, 2020), *available at* https://www.mass.gov/guides/becoming-a-designated-green-community.

[207] *NYStretch Adoption Guide*, NYSERDA (Mar. 13, 2020) 2, *available at* https://www.nyserda.ny.gov/All-Programs/Programs/Energy-Code-Training/NYStretch-Energy-Code-2020.

[208] *CALGreen*, CA.GOV (Apr. 4, 2020), *available at* https://www.dgs.ca.gov/BSC/Resources/Page-Content/Building-Standards-Commission-Resources-List-Folder/CALGreen#@ViewBag.JumpTo.

[209] *Stretch-Reach Codes*, US DEP'T OF ENERGY (Apr. 4, 2020), *available at* https://www.energy.gov/eere/wipo/stretch-reach-codes-text-version.

[210] Jessica Shipley, et al., *Beneficial Electrification of Space Heating,* REGULATORY ASSISTANCE PROJECT 39 (2018) *available at* https://www.raponline.org/knowledge-center/beneficial-electrification-of-space-heating/.

[211] New York State Senate, *Municipal Home Rule Law* (Mar. 13, 2020), *available at* https://www.nysenate.gov/legislation/laws/MHR.

[212] Community Planning and Zoning, *Elements of a Comprehensive Plan* (Mar. 13, 2020), *available at* https://community-planning.extension.org/elements-of-a-comprehensive-plan/.

Building Council's Leadership in Energy and Environmental Design ("LEED") certification and the US EPA's and the US DOE's Energy Star program.

More recently, regional voluntary standards establishing more stringent baselines for recognition of decarbonization measures have been introduced. One such regional effort is the Northeast Energy Efficiency Partnership ("NEEP"). NEEP's goal is to accelerate regional collaboration in the Northeast to reduce building sector energy consumption three percent per year and carbon emission 40 percent by 2030.[213] It aims to achieve such reductions by adopting a three-pronged approach of maintaining an efficiency and decarbonization leadership network, expanding community initiatives for efficient buildings, and engaging stakeholders to catalyze market transformation. Regional partnerships such as NEEP can supplement existing stringent carbon reduction commonalities among the Northeastern states into a single, easily digestible carbon reduction recognition program.

In addition to LEED, the Building Research Establishment Environmental Assessment Method ("BREEAM") provides independent third-party certification for new construction encompassing individual buildings, communities and infrastructure.[214] Green Globes Certification allows the option for certifying new construction, existing buildings, and building interiors.[215] More ambitious certifiers who aim to have very little or net-zero impact include the Living Building Challenge and the Zero Energy Building Certification.

As part of any stretch code, state and municipal building and zoning codes should facilitate the adoption of renewable energy systems. If a zoning code lacks specific provision for renewable systems and such amendments to code are not feasible, installing renewable energy systems may require developers to obtain variances from the local zoning authorities. Variances are required when a proposed change does not meet use, setback, height, or area requirements of the zoning ordinance.[216] Obtaining variances is time-consuming, costly, and leaves municipal authorities and developers without firm guidance.

To facilitate renewables adoption, municipalities should specify in their codes the zoning districts that allow specific renewable systems as defined in the code, provide specific procedures and guidance for obtaining permits, and expand code restrictions to permit greater system, size, area or capacity in order to enhance their adoption.[217]

4.2.4 Performance-Based Ratemaking and Rate of Return-Based Incentives

Performance-based ratemaking ("PBR") and rate of return-based incentives seek to change the utility business model. They incentivize utilities to achieve policy goals, such as increasing efficiency and reducing emissions. Performance-based ratemaking has been used since the 1980's, and has proliferated in recent years, with 36 states having implemented some degree of tariff reform to decouple electric and/or gas utility revenue from sales, and several states having

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[213] NEEP, NEEP 2019 PROGRAM PORTFOLIO, (Mar. 13, 2020), *available at* https://neep.org/sites/default/files/reports/2019%20Full%20Program%20Portfolio%20-%20Summary%20and%20Briefs.pdf.

[214] BREEAM, *How BREEAM Certification Works,* (Mar. 13, 2020), *available at* https://www.breeam.com/discover/how-breeam-certification-works/.

[215] The Green Building Initiative, *Green Globes Certification,* (Mar. 13, 2020), *available at https://thegbi.org/green-globes-certification/*.

[216] The Land Use Law Center at The Elisabeth Haub School of Law at Pace University, *Zoning for Solar Energy: Resource Guide* 24 (Mar. 13, 2020) *available at* https://www.yatescounty.org/DocumentCenter/View/314/Zoning-for-Solar-Energy-Resource-Guide-PDF?bidId=.

[217] *Id.* at 12-13.

successfully implemented performance-based ratemaking incentives, including New York, California, Massachusetts, and Rhode Island.[218]

Traditional utility regulation in the United States is based on the cost of providing service, including the transmission, distribution, and other infrastructure, plus a specified return on the utility's investment. The downside of this approach is that it maximizes gas utility profit based on the amount of investment and sales, incentivizing utilities to invest in as much infrastructure and sell as much gas as possible. The role of the regulator is to ensure safe and reliable service at just and reasonable rates to consumers.

Performance-based ratemaking shifts the utility business model from focusing solely on infrastructure, sales, and reliability to include other outcomes deemed beneficial by policy makers and society at large, such as reducing greenhouse gas emissions. These outcomes can be accomplished through introducing narrowly-targeted metrics to traditional regulation, or comprehensive reform of regulations to incentivize desired policy outcomes rather than merely utility investment and sales.

Performance-based ratemaking has been used to shift utility business objectives to decreasing costs to ratepayers, increasing efficiency, and achieving environmental outcomes. It is typically implemented through multi-year rate plans that set the amounts recoverable from ratepayers each year based on load projections, projected costs of capital and operating expenses, and inflation. Utility revenue is decoupled from sold kWh or therms, allowing recovery for utility investment in energy efficiency and capital cost-avoidance projects without the disincentive of lost revenue.[219] Further decrease in sales can then be incented through efficiency programs. This approach to ratemaking, pioneered for electricity, can be used to reduce gas consumption under a ZNG policy framework.

Performance-based ratemaking uses various metrics to achieve policy goals. In New York, for example, Con Edison is subject to electricity performance metrics for system efficiency and peak reduction, an energy efficiency program metric, a greenhouse gas reduction and beneficial electrification metric, and a distributed energy resources utilization metric. It also has gas performance metrics for peak reduction and energy efficiency. [220]

Utility metrics can be enforced by various means, ranging from benchmarking and scorecards to monetary incentives and penalties for the utility. Benchmarking requires utilities to simply report their performance without setting targets. This is especially useful when the metric in question has not historically been tracked to establish a baseline of performance. A scorecard sets targets for metrics, but does not assign any financial consequences for performance. Incentives and penalties introduce financial benefits or costs for meeting targets or failing to meet metric minimums.

Incentives are awarded either by awarding a fraction of utility revenues expressed as basis points for meeting target outcomes, or through a shared savings model. The basis points method assigns low, medium and high targets for a metric beyond a calculated baseline, with a higher number of basis points awarded for meeting or exceeding each target. The shared savings method sets a target that the utility must meet within a specified budget. If the utility

[218] David Littel, et al., *Next-Generation Performance-Based Regulation*, 21ST CENTURY POWER PARTNERSHIP - REGULATORY ASSISTANCE PROJECT AND NATIONAL RENEWABLE ENERGY LABORATORY 1-9 (Sept. 2017) *available at* http://www.nrel.gov/docs/fy17osti/68512.pdf.
[219] *Id.* at 13-17, 23-28.
[220] Con Edison 2019 Joint Proposal, *supra* note 143 at 80.

meets the target without spending the full budget, it retains a portion of the unused budget as profit, with the remainder passed to ratepayers. Typically, the utility retains 50 percent of the savings, but it can be as little as 30 percent.[221]

New York, one of the leaders in performance-based ratemaking, has implemented scorecards during the development of metrics, and incentives for certain utility targets, while not going as far as setting penalties for underperformance.[222]

Developing an accurate historical baseline and rigorous forecast for incentivized metrics is critical for ensuring targets are set beyond business-as-usual operation. If incentives are too low, they will not spur additional action by the utility beyond their regulatory mandate and existing business practices. Targets should not be set beyond what realistically can be achieved, which could incent the utility to simply ignore the target.[223]

Several metrics currently used for gas and others used for electricity can be adapted to help achieve Zero Net Gas. In New York, gas utilities employ a system efficiency metric to decrease annual peak load, and an energy efficiency metric to reduce end-use thermal units consumed. The system efficiency metric is implemented through a basis point and multi-level target approach. Setting these targets sufficiently low can provide a carrot for the utility to reduce or avoid the need to add gas infrastructure to meet peak day needs and help offset reduced revenue from lower sales. For energy efficiency, New York utilities must achieve a certain target expressed as a reduction in million BTU of end-use efficiency savings, and receive a percentage of the funds left over for reaching those targets under budget.[224]

In California, gas utilities are incentivized to decrease gas supply costs. Like New York's energy efficiency metric, California's gas supply incentives are also a shared-savings metric. The gas distribution utilities retain a portion of savings by effectively hedging and managing their gas supply on behalf of ratepayers.[225]

System peak reduction must also be coupled with end-use efficiency programs and a greenhouse gas reduction metric to prevent incentivizing the utility to decrease its peak load by shifting customers to carbon-intensive delivered fuels on peak days instead of reducing demand through efficiency measures and beneficial electrification. New York implemented carbon reduction incentives for electric utilities to promote heat pumps and electric vehicles. Extending heat pump incentives to gas utilities could help counter the inherent disincentive for gas and combined gas-electric utilities to promote beneficial electrification to existing gas customers.[226] Requiring gas utilities to electrify through carbon targets can also incentivize them to prioritize their least efficient customers for conversion.

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[221] *Id.*

[222] Case 16-E-0060, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric Service, *2018 Outcome-Based EAM Collaborative Report,* 25 (Oct. 17, 2018); Case 14-M-0101 Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision, *Order Adopting a Ratemaking and Utility Revenue Model Policy Framework*, 53-96 (May 19, 2016).

[223] David Littel, et al., *Next-Generation Performance-Based Regulation*, 21ST CENTURY POWER PARTNERSHIP - REGULATORY ASSISTANCE PROJECT AND NATIONAL RENEWABLE ENERGY LABORATORY 20-21 (Sept. 2017), *available at* http://www.nrel.gov/docs/fy17osti/68512.pdf.

[224] Con Edison 2019 Joint Proposal, *supra* note 143 at Appendix 23.

[225] REGULATORY ASSISTANCE PROJECT AND NATIONAL RENEWABLE ENERGY LABORATORY, *supra* note 218 at 6.

[226] *See,* e.g., Con Edison 2019 Joint Proposal, *supra* note 143 at 80.; *see also*, NYPSC Case 17-E-0459, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Central Hudson Gas and Electric Corporation for Electric Service, *Joint Proposal* 70-71 (Apr. 18, 2018).

New York electric utilities also earn basis-point incentives for reducing load in designated networks that face congestion but are not yet eligible for non-wires alternatives.[227] Implementing similar incentives for gas-constrained areas that are not eligible for non-pipe solutions can similarly reduce gas system investment and locational congestion.

Gas utilities should also receive incentives for implementing thermal storage. Electric utilities in New York are currently incentivized for distributed energy resources implementation that includes batteries and thermal ice storage.[228] Effectively managed hot and cold thermal storage projects can decrease gas demand for heating or on-site electric generation, and potentially enable sites to electrify where it otherwise would not be feasible.[229]

Performance-based metrics must be simple, transparent, and verifiable for successful implementation. Complex or overly broad metrics, or poorly calculated baselines and targets invite utilities to game incentives, or ineffectively implement measures.[230] The transparency of the incentive must extend to the gas utility, the public, and the regulator, as well as the electric utilities that operate in the gas utility's service territory. Electric utility incentives for load reduction may overlap with constrained gas distribution areas and create conflicting programs for electric reduction through gas-fired distributed energy resources, and for gas efficiency or load reduction.

Regulators must also strike a balance between simplicity, transparency, and verification in determining whether to adopt outcome-based or programmatic incentives. Programmatic incentives assign a reference factor for specified technologies or activities and award incentives based on technologies or activities deployed by the utility. This streamlines administration and reduces verification costs but precludes the use of technologies or measures that have not been accepted into the program. Outcome-based incentives, in contrast, rely on utilities fostering market activity, indirectly leading to increased investment. The measurement and verification of program impacts can be complex, and results often lag measures. The New York Public Service Commission issued guidance in 2018 that recommends using programmatic incentives for short-term measures, and outcome-based incentives for long-term market measures.[231]

Performance-based ratemaking can also be designed to promote solutions for low- and moderate-income communities. For example, in 2018 New York directed that 20 percent of all incremental gas and electric efficiency program spending must be dedicated to LMI programs, and exempted those programs from societal cost test requirements and shared-savings incentives, recognizing that these requirements increase the expense of reaching those customers.[232]

Performance-based ratemaking has proven an effective and durable policy tool. Current performance rate formats have withstood challenge in multiple rounds of rate cases in New York

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[227] Con Edison 2019 Joint Proposal, *supra* note 143 at Appendix 23.
[228] *Id*.
[229] Stanford University Department of Sustainability & Energy Management, *Stanford Energy System Innovations: Central Plant Optimization Model,* STANFORD.EDU (Jan. 17, 2013) *available at* https://sustainable.stanford.edu/sites/default/files/documents/Stanford_CEPOM.pdf.
[230] REGULATORY ASSISTANCE PROJECT AND NATIONAL RENEWABLE ENERGY LABORATORY, *supra* note 218 at 35-45.
[231] *Accelerated Energy Efficiency Targets Order*, *supra* note 173 at 67-68.
[232] Case 18-M-0084 In the Matter of a Comprehensive Energy Efficiency Initiative, *NY Utilities Report Regarding Energy Efficiency Budgets and Targets, Collaboration, Heat Pump Technology, and Low- and Moderate-Income Customers and Requests for Approval* 42 (Apr. 1, 2019), *available* at http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={9CD3BC73-BFAE-46B1-B0E7-BBC7DFF249FF}.

and California. In New York, for example, utilities have challenged outcome-based metrics, and regulators and large energy users have questioned program costs. As public policy has evolved to prioritize decarbonization, utilities have embraced performance-based rates that provide revenue certainty for decoupling and efficiency measures. Performance-based ratemaking has been successful in the majority of states where it has been adopted, with refinement over time.[233]

4.2.5 Managed Decapitalization as a Regulatory and Economic Pathway

Managed decapitalization describes a long-term plan and process for winding down financial investments in gas infrastructure and supply, and establishing a stable, managed pathway to a renewable energy services system.

The key elements of managed decapitalization involve:

- Eliminating all existing direct and indirect subsidies to gas end-use expansion;
- Revising depreciation policy to allow for earlier retirement of gas assets;
- Aggressively investing in gas demand-reduction;
- Revaluating all new infrastructure proposals using a comprehensive benefit-cost analysis framework;
- Establishing a clear timeline and pathway to a date certain, past which no new gas system investments are permitted and existing gas assets will be taken out of service;
- Developing a new business model for gas utilities as they move away from gas—"recapitalizing" the system with alternative technologies and potentially transitioning gas utilities to renewable sources; and
- Establishing protections for low- and moderate-income customers and other gas customers who are unable to transition away from gas, to ensure they are not stranded with the costs of the legacy system.

Managed decapitalization enables states to effectively plan for a transition away from gas while providing a regulatory framework within which to wind down the gas business, promote continued economic development, and transition the gas utility sector to a new source of revenue. Compared to other decarbonization pathways, such as carbon trading or immediate moratoriums on gas service, managed decapitalization offers greater certainty that emissions reductions will be achieved.

However, managed decapitalization presents technical, financial and legal complexities. Given that a managed decapitalization process would require winding down and decommissioning portions of existing infrastructure, it would strand all incumbent gas assets that cannot be repurposed to support clean energy infrastructure. The framework requires rethinking the way in which gas utilities do business in the age of beneficial electrification. Gas utilities would no longer first and foremost provide gas service, but would focus on providing *energy services*—cooking, heating, hot water, cooling, which could be met through a variety of zero-emissions, non-gas investments. Finally, the framework presents legal issues requiring re-evaluation of state public service laws and utility service obligations.

[233] Regulatory Assistance Project and National Renewable Energy Laboratory, *supra* note 218 at 6-9.

Under a managed decapitalization framework, gas infrastructure could potentially be adapted to deliver zero-emissions resources.[234] Using existing gas infrastructure to deliver hydrogen is a leading example of re-use currently being researched.[235] Proposals to re-use existing gas infrastructure to deliver "zero-emissions" energy should be evaluated on a full life cycle basis, carefully determining whether the re-use would involve greenhouse gas emissions. Such re-use should also be economically sustainable. While biogas and biomethane (the pure, pipeline-quality form of biogas) could potentially reduce emissions by capturing fugitive methane that would otherwise escape to the environment,[236] whether biogas is appropriate in a particular system will depend on its design and source. Economic sustainability also requires evaluating whether biogas or other solutions can be scaled to replace fossil gas in buildings in order to justify repurposing and maintaining the necessary gas infrastructure.[237]

Managed decapitalization would require comprehensive planning, financial mechanisms, and a stable policy environment to support a transition that will require decades to implement.

A Zero Net Gas policy framework can be the first step in a managed decapitalization process—it is designed to begin by stopping gas growth, and begin the process of incrementally reducing dependence on gas, while states, municipalities, and distribution utilities develop longer-term frameworks for decapitalization and decarbonization of the gas system.

4.2.6 Tax Policy and Securitization

Decapitalizing gas infrastructure will ultimately require productive assets to be retired early, resulting in potential losses to utilities—the stranded assets problem described in Section 3.4 of this paper. Two related policies help manage stranded assets: tax policy that allows utilities to take an immediate deduction for scrapped assets, and securitization. We treat them together in this section because they are closely related, albeit distinct.

Tax Losses

Under federal tax law, businesses that sell, scrap, or otherwise dispose of an asset trigger a taxable event, which can result in either reportable income or loss, both of which have tax consequences. Gains result in tax liabilities and losses provide deductions that reduce tax liabilities. The amount of gain or loss depends on the asset's "basis"—the original cost plus any capital improvements, less amounts depreciated annually. Losses can be deducted against income in the year incurred, and unused losses may be carried over to future years.[238]

When utilities scrap or abandon infrastructure that has a positive basis, without receiving anything for scrapping the asset, the amount of loss deduction will be the remaining basis in the asset. By taking losses against operating income in the year an asset is scrapped (and later

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234 Ronald H. Brown, et al., *Improving Daily Natural Gas Forecasting by Tracking and Combining Models,* 288 ELECTRICAL AND COMPUTER ENGINEERING FACULTY RESEARCH AND PUBLICATIONS (2017) https://epublications.marquette.edu/electric_fac/288/.

235 Office of Energy Efficiency and Renewable Energy, Hydrogen Pipelines, U.S. DEP'T OF ENERGY, (Accessed May 19, 2020) https://www.energy.gov/eere/fuelcells/hydrogen-pipelines.

236 *See, e.g.*, AMERICAN GAS FOUNDATION, OPPORTUNITIES FOR REDUCING GREENHOUSE GAS EMISSIONS THROUGH EMERGING NATURAL GAS DIRECT-USE TECHNOLOGIES (Dec. 2019), *available at* https://www.gasfoundation.org/wp-content/uploads/2019/12/AGF-2019-Direct-Use-Study-Full-Report-Final-12-18-19-V2.pdf.

237 Some states have also evaluated its potential. *See*, CALIFORNIA ENERGY COMMISSION, DEEP DECARBONIZATION IN A HIGH RENEWABLES FUTURE: UPDATED RESULTS FROM THE CALIFORNIA PATHWAYS MODEL (June 2018) 33, *available at* https://www.ethree.com/wp-content/uploads/2018/06/Deep_Decarbonization_in_a_High_Renewables_Future_CEC-500-2018-012-1.pdf.

238 *See* INTERNAL REVENUE CODE PUBLICATION NO. 544, SALES AND OTHER DISPOSITIONS OF ASSETS, *available at* https://www.irs.gov/publications/p544#en_US_2019_publink100072287 (Accessed Apr. 28, 2020).

years for unused losses that are carried over), the utility reduces its taxes, thereby effectively reducing the adverse economic impact on the utility.

Securitization

Securitization offers utilities an alternative to claiming a loss on taxes. In response to the transition away from coal-fired power generation, roughly half the states have passed laws allowing utilities to securitize scrapped coal-fired power generation assets as a means to manage stranded assets. Under securitization, the utility transfers the retired plant to a newly created special purpose corporation in return for a payment by the state, which is financed by the state issuing a bond. Along with the asset, the special purpose vehicle will receive the cost recovery tariff proceeds permitted by the state utility regulator. In order for the economics to work, the payment by the state for the asset is generally lower than what the utility would have received from tariff proceeds, but it enables the utility to recover value for the scrapped assets. In addition, if the payment is lower than the remaining basis of the asset, the utility may be able to also claim a loss deduction.[239]

[239] Herman Trabish, *Securitization fever: Renewables advocates seize Wall Street's innovative way to end coal*, UTILITY DIVE, May 28, 2019, *available at* https://www.utilitydive.com/news/securitization-fever-renewables-advocates-seize-wall-streets-innovative-w/555089/.

5 The Zero Net Gas Policy Framework

This chapter presents the Zero Net Gas policy framework. The Zero Net Gas proposal is designed to halt the continuing expansion of gas infrastructure and consumption, and establish an orderly pathway for phasing out gas infrastructure and use altogether, in a managed process aimed at achieving decarbonization goals while minimizing adverse impact on utilities, consumers, and communities.

The Zero Net Gas Framework is the first step toward deep decarbonization: by providing a mechanism for states to halt the growth of gas, regulators and stakeholders establish a pathway to achieving mid-century climate and energy mandates.

At its heart, the Zero Net Gas Framework requires that any proposed increase in gas demand is netted with a corresponding reduction in demand elsewhere within the system. Decarbonization of the gas system will require action across the gas system by various stakeholders. The Zero Net Gas Framework proposes a multi-faceted program designed to halt the growth of new gas demand and infrastructure, including:

- Comprehensive integrated planning for gas infrastructure and consumption to provide as the regulatory framework to design and implement the Zero Net Gas Framework;
- Adopting a robust evaluation, monitoring, and verification process to provide a foundation for effective netting of gas use;
- Changing the gas service application process to require developers and consumers to adopt alternatives to gas wherever feasible;
- Requiring that any new gas use be as efficient as possible;
- Enabling large-scale deployment of non-gas, renewable resources and energy efficiency, including through cost-effective incentives to reduce financing barriers;
- Increasing access for low- and moderate-income communities to non-gas alternatives; and
- Changing the current business-as-usual approach favoring gas in the building trades for new construction and retrofits to embrace non-gas heating and cooking technologies.

Adopting the framework is only the initial step towards retiring the gas system. Further work is needed to effectuate that objective, ultimately requiring a managed process of gas infrastructure decapitalization.

5.1 Establishing ZNG Proceedings Under Existing Regulatory Authority

States with ambitious decarbonization goals need a mechanism to halt gas growth in the near-term, while regulators develop a longer-term and complete gas system decarbonization policy framework to achieve mid-century emissions reductions targets, such as New York’s 85 percent emissions reduction by 2050 mandate.

The Zero Net Gas framework is a policy and regulatory pathway to start reversing gas dependence in buildings, towards deep decarbonization. The ZNG strategy posits that gas consumption must be capped in the near-term—and incrementally reduced where possible—by pairing new gas demand with reductions in existing inefficient gas use through demand-side measures, such as energy efficiency, renewable heating technologies, non-pipe solutions, and demand response programs.

The ZNG framework’s goals are twofold: first and most importantly, stopping new gas infrastructure expansion, and secondly, reducing greenhouse gas emissions.

The ZNG strategy differs from crude tools like moratoriums in that it allows for new gas uses, so long as they are paired with demand reductions within the particular gas system. Any new gas uses should be as small, modular, and efficient as possible, in order to facilitate accelerated retirement.

The ZNG strategy will not only halt the growth of gas infrastructure and emissions at the distribution level, but it will cap and eventually reduce demand for upstream gas supply and its infrastructure, thereby reducing the overall cost, environmental damage, and adverse health effects of our gas system. Applied strictly, the ZNG strategy requires that reductions occur within the gas distribution system, not through crediting of reductions achieved outside the system (commonly known as “offset credits,” or simply “offsets”). By prohibiting external offsets and instead relying on internal netting, the ZNG framework forces the decarbonization of gas infrastructure.

The elements of the framework are described below. Where applicable, a range of implementation scenarios are suggested, with varying degrees of stringency. Unless otherwise noted, and where New York is offered as an example, the recommendations assume the existing authority of the New York Public Service Commission. Specific analysis of other state’s public utility commission’s jurisdiction must be undertaken to apply these recommendations to other states.

The first step in establishing a ZNG framework is for the state public utility commission, in coordination with the state’s gas utilities and interested stakeholders, to establish a procedural mechanism for the ZNG program. This should be done through a rulemaking proceeding applicable to all regulated gas utilities in the state, in order to ensure uniformity of application and to maximize demand reduction across the state.

The regulatory proceeding should then establish performance targets for the program; procedures to guide utility programming and expenditures; comprehensive planning process requirements; and evaluation, measurement, and verification mechanisms.

Performance targets should require that utilities at a minimum net out gas demand in their service territories. A “net-plus” target would further require incrementally reducing gas consumption by a specified percentage or portion.

To meet the target, utilities must establish a baseline or business-as-usual gas demand forecast. The public utility commission should review and approve the baseline, which would then become the cap under the ZNG framework for that utility. The baseline may vary by season, and be further adjusted based on weather-related variations in demand, taking into account anticipated climate change-related weather impacts that may change “design day” forecasts and associated infrastructure planning. In New York’s comprehensive gas planning proceeding, launched in early 2020, the Public Service Commission required that utilities file supply and demand analyses as an initial step to the comprehensive gas planning process.[240]

Process-based requirements include changes to the customer application review and approval process, both discussed immediately below; and require developing netting methodologies supported by robust evaluation, monitoring, and verification rules, discussed in Section 5.3 of this report.

[240] NYPSC Case 20-G-0131, Proceeding on Motion of the Commission in Regard to Gas Planning Procedures, *Order Instituting Proceeding* (Mar. 19, 2020), p. 11.

5.1.1 Integrated Resource Planning and Benefit-Cost Analysis

Comprehensive integrated resource planning for gas distribution utilities is an essential element of the ZNG framework to align utility operations and investments with state and local climate policy. Netting will require utilities to achieve reductions beyond those possible through traditional supply planning, necessitating demand-reduction programs and new technologies to be deployed with and replace traditional gas supply approaches.

Public utility commissions should establish two complementary planning pathways: general integrated planning proceedings governing all utilities, and individual planning processes for each gas utility.

The statewide integrated planning proceeding would evaluate procedural and substantive requirements with which all gas utilities must comply. This proceeding would take up issues of general application in establishing the NZG framework, including: developing a statewide benefit-cost analysis framework to guide utility investments in gas infrastructure and non-gas alternatives; developing the accounting guidance and methodology for implementing netting; aligning utility depreciation practices and methodologies with state and municipal energy and climate policies to reduce the future impact of stranded assets; and developing safeguards for low- and moderate-income consumers to avoid significant bill impacts and to ensure near- and long-term affordability.

Second, public utility commissions should establish utility-specific gas distribution planning processes to ensure that each utility's investments are aligned with state and local energy and climate policy. Electric utility planning processes, such as New York's Distributed System Implementation Plans ("DSIP"),[241] may offer useful lessons learned on the challenges and opportunities associated with developing a robust planning mechanism to reduce greenhouse gas emissions. The DSIP process required each investor-owned utility to prepare a self-assessment of its ability to integrate distributed resources and establish a five-year roadmap for implementing those resources in line with state climate and energy goals. While useful, the DSIP process may not represent best practices as to openness. To be credible and effective, planning processes must be transparent and inclusive of all stakeholders.

Two jurisdictions—New York and California—launched general statewide comprehensive gas planning proceedings in 2020, which will provide lessons for others. The New York Public Service Commission's proceeding evaluates several broad issues: (1) standards governing utility moratoriums; (2) data access and transparency in the gas planning process; (3) aligning gas utility planning, including supply and distribution planning, with New York's climate and energy goals; and (4) related issues, including Non-Pipe Solutions, rate design, and reliance on gas-fired plants for meeting peak loads.[242] An overall goal of the proceeding is to "establish planning and operational practices that best support customer needs and emissions objectives while minimizing infrastructure investments and ensuring the continuation of reliable, safe, and adequate service to existing customers."[243]

The California Public Utilities Commission launched its proceeding to "implement a long-term planning strategy to manage the state's transition away from natural gas-fueled technologies to

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[241] *See*, NYPSC Case 14-M-0101, Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision, *Order Adopting Distributed System Implementation Plan Guidance* (Apr. 20, 2016).
[242] NYPSC Case 20-G-0131, Proceeding on Motion of the Commission in Regard to Gas Planning Procedures, *Order Instituting Proceeding* (Mar. 19, 2020).
[243] *Id.* at 4.

meet California's decarbonization goals."[244] The proceeding will also address reliability standards and operational coordination between gas utilities and gas-fired generators in light of the planned transition,[245] and issues related to decarbonization of the gas sector, such as policy changes to minimize potential future stranded assets.[246]

As part of the comprehensive planning process, regulators should perform statewide benefit-cost analysis to quantitatively evaluate gas infrastructure investments against a range of non-pipe / demand-based alternatives, accounting for social and environmental impacts. The quantitative analysis should be supplemented by qualitative analysis where appropriate. Data and assumptions should be disclosed to the public, and modelling algorithms should be disclosed and fully explained with supporting documentation.[247]

Cost-benefit analysis has been applied in the electric sector, including as part of grid modernization and variations of integrated resource planning. New York, for example, established an electric benefit-cost analysis framework to support its Reforming the Energy Vision process, which although not comprehensive (it does not fully include non-energy benefits, such as health-related impacts), could serve as a useful example. New York utilities have developed their own gas benefit-cost analysis pursuant to rate cases. However, these frameworks have typically been developed as part of confidential settlement negotiations, or using proprietary third-party software or data that is subject to restrictions on disclosure. Proprietary studies developed by individual utilities do not substitute for an open, comprehensive, statewide process in which all stakeholders can participate.

A comprehensive benefit-cost analysis framework should include several features: (1) a time horizon that appropriately accounts for the useful lives of gas infrastructure investments, taking into account the deadline for meeting state climate goals; (2) the projected costs of maintaining and ensuring the safe operation of existing gas infrastructure; (3) the environmental impacts of proposed gas investments, including the net costs of greenhouse gas emissions based on the full life-cycle of the gas system, from extraction well to burner tip to the retirement of infrastructure; (4) public health and social impacts; and (5) near- and longer-term price and supply volatility typically associated with gas.

Within the comprehensive planning process, the ZNG mandate presents both challenges and opportunities to ensure the safe operation of the incumbent gas system while halting the expansion of gas infrastructure. Utilities in the United States collectively spend tens of billions of dollars each year replacing leak-prone pipes and repairing the damage caused by gas leaks. These investments must continue so long as gas distribution infrastructure remains in place, to ensure public health and safety and system reliability, even as we decarbonize the gas system. However, decarbonization potentially offers the opportunity to reduce system maintenance costs.

Maintenance costs will be reduced by stopping the expansion of gas infrastructure. Further, the costs of replacing damaged or leak-prone pipe and other infrastructure can potentially be avoided if gas alternatives can be deployed and obsolete gas infrastructure abandoned rather

[244] California Public Utilities Commission, Order Instituting Rulemaking to Establish Policies, Processes, and Rules to Ensure Safe and Reliable Gas Systems in California and Perform Long-Term Gas System Planning (Jan. 27, 2020), http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=325641802.
[245] *Id.*
[246] *Id.* at 17.
[247] Where proprietary models are contracted through consulting firms, the algorithms may be subject to constraints on disclosure. Such constraints should be minimized if they cannot be eliminated to ensure transparency.

than upgraded. As described in Section 4.1.4, some utilities are evaluating geothermal district energy systems as possible replacements to ageing gas infrastructure in portions of their service territories.[248] Where such approaches are technologically feasible and economic, they have the potential to make decarbonization profitable for utilities and consumers.

5.2 Encouraging Developers and Customers to Adopt Feasible Gas Alternatives

One of the barriers to buildings decarbonization is reaching customers early enough in the development or retrofit process to provide a meaningful opportunity for them to consider alternatives to gas.

Public service law generally requires utilities to provide universal, non-discriminatory service—if a customer requests electric or gas service, meets the necessary application requirements, and the utility has the capacity to provide the requested service, it must generally do so within a reasonable timeframe. The majority of customers reach out to the utility a relatively short time before they need the gas service to go into effect, leaving little opportunity for the consideration of alternatives.

In order to reach customers earlier in the process, public utility commissions could revise utility gas service tariffs to require customers to submit applications at an earlier point in the development or retrofit process. A more aggressive approach would require customers to evaluate alternatives prior to the utility acting on the service request. Under this process, the customer would be required to demonstrate, as part of the application criteria, that it has undertaken an evaluation and that no economically feasible alternatives to gas are available.

Success in implementing a ZNG strategy also necessitates that utilities and local and state government take a proactive approach in reaching developers and existing property owners early in the planning or retrofit process to ensure a comprehensive and thorough evaluation of energy options.

An entry point at the local level is the city or town planning board. Local planning boards typically receive, review and approve subdivision and site plan applications. Utilities are consulted in the development process. Applications for gas and utility service trigger an assessment of whether system upgrades are required to accommodate the application.

State and local economic development agencies also offer potential points of entry to influence developers. For example, in New York's institutional sector, the Dormitory of the State of New York finances hospitals, colleges and universities, assisted living, and other not-for-profit clients, and the Empire State Development Corporation runs numerous programs to support investment and economic development within the State. At the county level, industrial development authorities promote and finance local economic development initiatives. Government housing agencies, in particular, are well positioned to require developers to meet "green" building criteria through the procurement process.

Conditioning access to public finance support—tax exempt, tax advantaged, or otherwise advantageous financing—from public economic development agencies could further enhance leverage over developer behavior.

The impact of additional requirements on the development process can be minimized by ensuring that utilities, local and state government economic development agencies, and

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[248] For additional considerations as part of a district energy study, *see* NYPSC Cases 19-E-0065, 19-G-0066, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric and Gas Service, *Prepared Direct Testimony of New York City Policy Panel*, p. 20, line 12 through p. 21, line 11 (May 2019).

financing stakeholders coordinate and streamline requirements to the greatest degree possible, and share information amongst themselves and with developers. Utilities and government stakeholders should develop a joint action plan for implementing new requirements for gas connection. The plan should be developed with private stakeholder input—the development community as well as service providers such as architects, engineers, and non-gas equipment providers who will be central to a non-gas development or retrofit process.

5.3 Netting Incremental Gas Demand from Existing Gas Customers

The netting function is the most complex—and critical—component of the ZNG framework. In order to net and, where possible, incrementally reduce gas demand and the need for new infrastructure, utilities must employ comprehensive gas planning that includes both traditional supply and large-scale deployment of non-traditional alternatives, such as gas efficiency, renewable heat, demand-response, and non-pipe solutions. Such planning must be supported by a robust benefit-cost analysis framework that accounts for the full life cycle of gas emissions and the social and environmental impacts of gas and non-gas investments.

Netting's primary goal should be reducing gas peak and particularly the gas design day, which drives infrastructure planning and investments. Netting can also target volumetric usage and overall greenhouse gas emissions.

In the netting process, utilities must prioritize replacing gas load with beneficial electrification and long-lasting building envelope efficiency and weatherization measures, and, as described in greater detail in Section 5.5, provide targeted support for low- and moderate-income communities to adopt these resources.

Netting requires a deep understanding of the gas distribution system and the unique characteristics of each utility service territory. Determining how to measure and net new consumption against future reductions relative to baseline consumption requires accounting guidelines and assessment standards for comparing future against past trends, performance of different technologies and distribution system designs, changing consumer behavior, and variations across geographic/demographic segments of the system.

Netting protocols and accounting guidelines must be developed to address these technical issues and to also provide for procedural and distributive fairness in determining how to net for new gas consumption. These decisions inevitably require judging amongst competing consumers, imposing costs on some and conferring benefits on other stakeholders, influencing broader impacts on economic development, and navigating principles of universal service. A methodology must be developed that balances these considerations, ensures environmental outcomes, and accounts for financing and deployment barriers in the LMI consumer segment.

Although the methodology operationalizing netting is beyond the scope of this paper and would have to be tailored to meet the needs and conditions of each jurisdiction, we offer preliminary suggestions how these issues might be balanced:

- Target commercial and residential multifamily utility customers for the largest, most cost-effective demand-reduction opportunities. These include malls, hospitals, universities, mixed-use developments, and multifamily residential buildings.

- Specific guidelines for industrial customers should be developed. Manufacturers and processing plants that rely on gas for process heat or steam generation may face significant costs to electrify, forcing premature retirement of equipment long before the end of its useful life.[249]

- In the absence of legally binding state or municipal prohibitions against gas use, ZNG netting must rely on markets and financial incentives to drive customer adoption of alternatives to gas.

- Where a public utilities commission has authority to direct utilities to provide gas service in a manner that maximizes the most beneficial uses of gas, explore how the commission can leverage its authority to implement the ZNG policy framework.[250]

5.3.1 Evaluation, Monitoring, and Verification

The regulatory framework must provide a compliance mechanism to verify that the utility is netting new customer demand by matching increased consumption with reductions within the system of equal or greater magnitude on a regular basis. The net effect should be to reduce or prevent any increase in peak demand, and, depending on regulatory objectives, total volumetric consumption and greenhouse and emissions. The design of an evaluation, monitoring, and verification ("EM&V") mechanism may range from a high degree of oversight and continuous monitoring, to requiring that utilities pair new demand against reductions on an aggregate basis for each compliance period.

Environmental integrity, technological feasibility, accuracy, cost, economic impact, and legal and administrative considerations, will influence design of the EM&V mechanism.

At one end of the spectrum, regulators could mandate netting: they can disallow new gas demand unless the utility demonstrates new demand will be netted by reductions elsewhere in the utility's service territory.

While this approach imposes certainty of the environmental outcome, it is likely costly and burdensome administratively. Pairing each application for new or increased service with specific demand reductions would increase transaction costs and delays. Also, from a regulatory perspective, existing public service law is likely to prohibit such an approach, given that utilities may be legally obligated to provide service to customers within a specified time from the date of request.

Alternately, utilities can net new customer connections and increased service against peak gas day demand reductions on a periodic basis, such as quarterly or annually. An appropriate compliance period should give utilities flexibility to achieve reductions against new peak demand and ensure that environmental objectives are verified in a timely manner to preclude delays in netting. As utilities have extensive experience forecasting peak gas demand, existing methodologies could be adapted to verify peak demand reductions as part of the netting process.

For measuring greenhouse gas reductions, verification of netting can be accomplished by measuring the volume of gas flowing through each city gate during the compliance period, weather-normalized and benchmarked against comparable time periods before the ZNG program was implemented, taking into account lost and unaccounted for gas. Lost and

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[249] NORTHEAST ENERGY EFFICIENCY PARTNERSHIPS, NORTHEASTERN REGIONAL ASSESSMENT OF STRATEGIC ELECTRIFICATION: SUMMARY REPORT 5 (2017), *available at* https://neep.org/strategic-electrification-regional-assessment.

[250] *See,* e.g., N.Y. P.S.L. § 66-a. (2020).

unaccounted for gas is generally defined as "the difference between the total amount of gas purchased by [a local distribution company] and the amount delivered to customers,"[251] typically due to theft, methane release, meter malfunction or intentional tampering, and other causes.[252]

To measure consumption against baseline and verify netting, utilities must measure against a comparable time period, normalized for variations in weather. The verification methodology will therefore involve a baseline algorithm that must be approved by the regulator. The certification of compliance with the netting requirement will also require the development of guidelines in the adjustment and normalization assumptions used in the compliance calculations.

EM&V results would be publicly reported. The results should inform the ZNG proceedings, enabling the regulator, utilities, and other stakeholders to assess the EM&V methodologies and the ZNG framework, and to plan and budget future changes to gas infrastructure. The EM&V procedures should evolve based on real-world feedback, enabling the regulator and program administrators to adapt EM&V methodologies as we gain experience.[253]

An effective EM&V framework has long been recognized as a necessary component of effective integrated resource planning and will play a key role in a ZNG program as well.

5.3.2 Changes to the Customer Application Review Process

In addition to the netting obligation, applications for new or increased gas service should be subject to a rigorous review process that includes requiring the consumer to demonstrate that alternatives to gas were considered but are infeasible at present. Specifically, the process should require:

- The customer be informed of alternatives to gas, as well as gas efficiency, demand response, and other demand-reduction programs;
- Demonstration by the customer that no economically feasible alternatives to gas are presently available; and
- Evaluation of whether the application would require infrastructure investments beyond the customer's service line extension or reinforcement, and whether those infrastructure investments can be avoided through non-gas alternatives.

Given statutory service requirements, meeting the additional requirements imposed by the ZNG framework would require that the customer prepare these new elements of their application in advance, and that the utility be given additional time to review and approve the application.

5.4 If Unavoidable, Small, Efficient, and Modular as Possible

Where new gas use is unavoidable in new developments and retrofits, the ZNG framework requires that new gas infrastructure be as small, efficient, and modular as possible. Small, efficient, and modular expansion reduces the risk of locking customers into technologies with useful lives that extend beyond zero-carbon mandates, and facilitates the netting process by minimizing incremental gas system expansion.

[251] NATIONAL ASSOCIATION OF REGULATORY UTILITY COMMISSIONERS, NATURAL GAS DISTRIBUTION INFRASTRUCTURE REPLACEMENT AND MODERNIZATION: A REVIEW OF STATE PROGRAMS 5 (Jan. 2020), *available at* https://pubs.naruc.org/pub/45E90C1E-155D-0A36-31FE-A68E6BF430EE.

[252] *Id.* at 10.

[253] NEW YORK DEP'T OF PUBLIC SERVICE, EVALUATION, MEASUREMENT, AND VERIFICATION GUIDANCE 2 (Nov. 1, 2016), *available at* http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/255ea3546df802b585257e38005460f9/$FILE/CE-05-EMV%20Guidance%20Final%20%2011-1-2016.pdf.

Small, efficient, and modular gas technologies include highly efficient gas-fired furnaces and boilers, and combined heat and power generating units, especially when paired with solar and/or storage. Interruptible gas service may also help limit gas infrastructure. These technologies are described in greater detail in Section 4.1 of this paper.

5.5 Scaling Up Energy Efficiency and Demand-Reduction Programs

ZNG netting methodologies should prioritize long-term demand-side solutions over temporary or emergency supply-side measures.

Ensuring that demand-side programs, including energy efficiency, demand response, renewable heating and cooling technologies, and non-pipe solutions reach the maximum number of customers as efficiently as possible in terms of cost and administration, states should evaluate the performance of their delivery of these programs and seek to remove any barriers that limit customer identification, enrollment, and participation. States should also evaluate demand-side program targets and budgets to determine whether they are sufficient to achieve netting or net-plus outcomes in individual utility service territories.

In evaluating barriers to clean energy program implementation, regulators should consider several factors. First, utility efficiency programs should support comprehensive whole-house measures or technologies such as insulation combined with electric heat pumps, which can eliminate gas consumption. New York's Technical Resource Manual,[254] for example, which serves as the framework for evaluating utility efficiency investments, currently requires that measures such as whole-house efficiency be packaged and approved through a rather complex and lengthy process, rather than the more streamlined cost-effectiveness evaluation process available for more traditional (and simpler) energy efficiency measures. This places load reduction envelope measures, combined with the impacts of heat pump installations, at a disadvantage.

Other resources include the National Efficiency Screening Project's National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources.[255] The manual provides guidance for jurisdictions seeking to evaluate the cost-effectiveness of programs and policies, taking into account costs and benefits as well as non-utility impacts as they relate to the overall policy goals of the respective jurisdiction.[256]

Second, programs should be evaluated for whether incentives available to customers are adequate to reduce up-front costs to incentivize widespread adoption of more complex solutions, such as heat pumps.[257]

To improve the economics of demand-side measures, regulators should direct resources towards funding demand-side netting solutions. Under one approach, a portion of the up-front costs of demand-side measures could be shared by all gas customers, in addition to any existing ratepayer-funded efficiency and clean energy programs. Such a funding mechanism already exists for gas: qualifying new gas customers are connected at no charge, the costs being shared by other ratepayers. Applying the same treatment to demand-side solutions would improve their economics and enable them to compete with supply-side measures. Another

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[254] NEW YORK DEP'T OF PUBLIC SERVICE TECHNICAL, RESOURCE MANUAL (TRM) (Accessed May 8, 2020) http://www3.dps.ny.gov/W/PSCWeb.nsf/All/72C23DECFF52920A85257F1100671BDD.

[255] NESP, NATIONAL STANDARD PRACTICE MANUAL I (Mar. 26, 2020), *available at* https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf.

[256] *Id.* at vii.

[257] *See, e.g.* NYSERDA, NEW EFFICIENCY, NEW YORK: ANALYSIS OF RESIDENTIAL HEAT PUMP POTENTIAL AND ECONOMICS (Jan. 2019) *available at* file:///Users/sarenamalsin/Downloads/18-44-HeatPump.pdf.

approach would be to require customers requesting new gas service to pay for a portion of the costs of demand-side reduction investments required to net that customer's incremental gas demand.

These approaches should be evaluated based on their economic impacts. Robust benefit-cost analysis based on specific state and regional data can guide decision-making, as well as long-term capacity planning designed to achieve state energy and climate mandates. In addition, long-term planning must forecast peak demand as accurately as possible, to ensure that estimates accurately reflect the cost comparison between traditional infrastructure options and demand-reduction measures.

Third, states should reevaluate their existing whole-house, weatherization, and gas efficiency programs to determine how they can be ramped up to achieve state climate and energy goals. As an example, in its New Efficiency: New York program, the Public Service Commission expanded the state's efficiency programs—particularly gas efficiency and building envelope measures—to achieve its climate and energy goals. The Commission recognized the state cannot achieve these goals without ramping up efficiency deployment, that the state had previously failed to tap the full potential for cost-effective gas efficiency, and that building envelope measures that are critical to decarbonization efforts had not been adequately deployed.[258]

5.6 Assisting LMI Communities to Adopt Efficiency and Renewables

New York's Climate Leadership and Community Protection Act calls for all New Yorkers—particularly disadvantaged communities—to benefit from the transition from fossil fuels to clean energy. Solutions for LMI communities will be critical for achieving state climate goals.

The CLCPA requires multi-agency, cross-sector coordination to build on and expand efforts to address energy affordability, equity, and resilience. New York mandates increased affordability[259] and efficiency programs[260] for low-income New Yorkers and sponsors initiatives to reduce barriers to community distributed generation.[261] Even with this progress, clean energy deployment remains a challenge for LMI communities.

Challenges include: financing barriers to energy efficiency and distributed energy resources, particularly for affordable multifamily housing, and especially for 2-4 unit multifamily buildings; the problem of "split incentives," which can reduce building owners' incentives to invest in efficiency measures and/or increase tenant bills rather than contribute to savings; technical barriers, such as outdated wiring that requires significant upgrades before a building can be electrified; and strain on building owners and operators, both financial and technical, as a result of limited budgets and staff to address existing tenant, environmental, and health and safety needs.[262]

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[258] NYPSC Case 18-M-0084, In the Matter of a Comprehensive Energy Efficiency Initiative, *Order Authorizing Utility Energy Efficiency and Building Electrification Portfolios Through 2025*, 43-45 (Jan. 16, 2020).
[259] NYPSC Case 14-M-0565, Proceeding on Motion of the Commission to Examine Programs to Address Energy Affordability for Low Income Utility Customers, *Order Instituting Proceeding* (filed Jan. 9, 2015).
[260] *Accelerated Energy Efficiency Targets Order*, *supra* note 173.
[261] NYPSC Case 15-E-0751, In the Matter of the Value of Distributed Energy Resources, *Order Adopting Low-Income Community Distributed Generation Initiatives* (filed July 12, 2018).
[262] For a more in-depth look at barriers and opportunities in New York, *see* NYPSC Case 18-M-0084, In the Matter of a Comprehensive Energy Efficiency Initiative, *Assessment of Input Received at 2018 LMI Stakeholder Forums* (Jan. 31, 2019).

While New York City has prohibited the dirtiest fuel oils for home heating, many buildings continue to rely on fuel oil, particularly among LMI households.[263] Overall, the Northeast is by far the region most reliant on heating oil in the United States.[264] Around 20 percent of Northeast households use heating oil as their primary space heating fuel and the region accounts for nearly 82 percent of the country's households using heating oil for space heating.[265] A study of New York City confirms that lower income neighborhoods are slower to transition from fuel oil to clean energy.[266] Understanding the systemic inequalities and technical and financial obstacles that LMI customers face in adopting clean energy resources may help regulators and utilities develop better solutions.[267]

Under a Zero Net Gas framework, regulators and utilities should prioritize assisting LMI communities and the affordable multifamily sector, particularly those reliant on fuel oil, to adopt more aggressive energy efficiency deployment and switching to zero-emissions and renewable alternatives. Renewable generation can also support microgrids,[268] providing resiliency in energy services.

To address barriers to clean energy adoption, states should consider several issues:

- Broadening clean energy program eligibility criteria and the identification process to reach as many customers as possible—including tenants, homeowners, and multifamily building owners and operators. Outreach and identification efforts should include geolocation-based eligibility, community blitzes, and targeted engagement of community groups and local organizations.

- Offering predevelopment support for new construction and especially retrofits. Predevelopment planning, design and permitting costs pose significant barriers to efficiency and weatherization adoption. Providing building owners/operators and developers with predevelopment support for financing, site assessments, engineering studies, and permitting and compliance assistance can spur clean energy adoption.

- Coordinating among agencies responsible for clean energy, buildings, public housing, and health, in order to simplify the permitting and financing of clean energy upgrades.

- Increasing the deployment of efficiency and weatherization measures alongside ordinary building safety compliance inspections.

- Providing funds for addressing health and safety or infrastructure issues that can prevent energy efficiency work (e.g., mold or structural issues may prevent participation in weatherization programs).

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[263] *See* Daniel Carrión et al., *Residual Inequality: Assessing the Unintended Consequences of New York City's Clean Heat Transition,* 15 INT'L J. ENVIRO. RES. & PUB. HEALTH 117 (2018).
[264] *Heating oil explained,* EIA, (Updated Feb. 26, 2020) https://www.eia.gov/energyexplained/heating-oil/use-of-heating-oil.php.
[265] *Id.*
[266] Carrión, *supra* note 263.
[267] *Id.*
[268] In Kodiak, Alaska, a 75,000 kW microgrid powered by 99% renewable energy provides low-cost electric service to over 13,000 people. Likewise, El Hierro, in the Canary Islands of Spain, utilizes a 35,000 kW microgrid served by 100% renewable energy to provide low-cost electric service to over 11,000 people. *See*, Kaitlyn Bunker et. al., *Renewable Microgrids: Profiles from Islands and Remote Communities Across the Globe*, Rocky Mountain Institute and Carbon War Room 14-15 (Nov. 2015).

- Prioritizing a whole-building approach to efficiency and weatherization programs, providing support and incentives for common areas, central systems, and building envelope measures, as well as in-unit programs.

- Incorporating the health and safety benefits of efficiency, electrification, and renewable alternatives to gas as part of benefit-cost analysis frameworks.

In addition to addressing program design and financing challenges, states can impose fossil-fuel surcharges and offer clean energy generation incentives to incentivize adopting clean energy sources. Utility regulators since the 1990s have imposed fossil surcharges to internalize environmental costs of energy and identify least-cost investments.[269]

Clean energy incentives can specifically assist LMI communities. For example, New York's Multifamily Affordable Housing Adder provides developers an incentive payment, the amount of which varies based on New York region, for installation of an approved, grid-connected photovoltaic (PV) system supporting an affordable housing property, in addition to other program incentives that may be available.[270]

5.7 Educating the Supply Chain and Developing Financing Solutions

Educating developers, building owners/operators, the construction trades and equipment suppliers, and tenants of alternatives to gas is essential to implementing the ZNG framework. Education and training of the trades and equipment suppliers can also help drive down the cost of alternatives to gas as the market for these options expands.

Education should inform the supply chain and consumers of available technologies and build consumer confidence in those technologies by furnishing objective and reliable information. Consumer education programs must be designed to reach customers. Direct customer engagement—such as contractors meeting building owners or operators, developers, or community groups—are more likely to be effective than direct mail programs, for example.

Programs that establish standards, test and report equipment performance, certify installers, and help match prospective buyers with equipment and service providers, such as through a catalog, can help build robust, competitive markets for non-gas technologies. NYSERDA's Renewable Heating & Cooling program, for example, promotes ground source heat pumps by preparing case studies, developing design and installation best practices guidance, and furnishing installation checklists.[271] NYSERDA also funds air source heat pump demonstration

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[269] RFF, *Lessons from Integrated Resource Planning and Carbon Trading for Integrating Carbon Adders into Wholesale Electricity Markets* 1 (Mar. 26, 2020), *available at* https://media.rff.org/documents/RFF-Rpt-Carbon20Adders.pdf.

[270] ENTERPRISE COMMUNITY PARTNERS, GREEN FUNDING AND RESOURCES FOR NEW YORK CITY AFFORDABLE MULTIFAMILY HOUSING: IMPROVING THE RESILIENCE OF NYC'S MULTIFAMILY HOUSING 14 (Jan. 2020), *available at* https://www.enterprisecommunity.org/download?fid=13144&nid=3923.

[271] NYSERDA, Clean Energy Fund Quarterly Performance Report through December 31, 2019, A-16 (Mar. 2020) [hereinafter *NYSERDA Q4 2019 Report*], *available at* file:///Users/sarenamalsin/Downloads/CEF-2019-Q4.pdf. NYPSC Case Number 16-00681, In the Matter of the Clean Energy Fund Investment Plan, NYSERDA CEF, *Clean Energy Fund: Clean Heating and Cooling Chapter, Portfolio: Market Development* 4, 5, 7, 8, 18 (June 15, 2020) [hereinafter *NYSERDA CEF CHC Chapter June 2020*].

projects.[272] NYSERDA has developed a customer targeting tool to assist contractors in their efforts to market both air and ground source heat pumps to potential customers.[273]

Municipalities can design clean energy resources that deliver location-specific assessment, education, and financing services. For example, New York City developed a geothermal pre-feasibility tool specific to the city's geography and infrastructure to help identify specific areas appropriate for ground source or geothermal heat pump systems.[274] The New York City Retrofit Accelerator provides a "one-stop shop" where consumers can learn about energy efficiency programs and financing options, connect to local contractors, and receive guidance on the steps for implementing efficiency in the city.[275] Tompkins County created a Building Energy Advisors Program that matches energy advisors knowledgeable about county requirements with local real estate developers early in the development process to evaluate energy options.

Financial incentives will also deepen market penetration of non-gas alternatives.[276] Several state initiatives in the Northeast provide examples of program designs to address decarbonization and social policy goals:

- New York allocated more than $450 million in incentives through its New Efficiency: New York initiative to support heat pump technologies, including for space heating and cooling, water heating, and process heating and cooling.[277] The program aims to expand heat pump deployment beyond single-family to multifamily properties, particularly existing buildings.

- Connecticut offers rebates for installations of ductless heat pumps: $300 for a single indoor unit per home and $500 for a multi-indoor unit. [278]

- Massachusetts offers rebates of $250 per ton through its Mass Save initiative for central heat pumps.[279] Massachusetts also provides incentives to install air source heat pumps based on household income on a sliding scale, with a rebate of up to $5,500 per residence that makes less than 80 percent of the state median income, down to $3,000 per residence that makes more than 120 percent of the state median income.[280]

- New Jersey's COOLAdvantage Program offers rebates for central air source heat pump installations based on a 16 Seasonal Energy Efficiency Ratio ("SEER") rating eligible for $600, and an18 SEER rating eligible for $1,000. Mini-split cold climate air source heat pump single units are eligible for $1,000, and multi-units eligible for $2,000. The program

[272] NYSERDA, Clean Energy Fund Quarterly Performance Report Through March 31, 2020, at A-6.
[273] NYSERDA Q4 2019 Report at A-21; NYSERDA CEF CHC Chapter June 2020, supra note 271, at 3, 4, 29.
[274] *Geothermal Tool,* City of New York Dep't of Design and Construction (Accessed May 8, 2020), https://www1.nyc.gov/assets/ddc/geothermal/index.html.
[275] New York City Retrofit Accelerator, (Accessed May 8, 2020), https://retrofitaccelerator.cityofnewyork.us.
[276] *See* BUILDING DECARBONIZATION COALITION, A ROADMAP TO DECARBONIZE CALIFORNIA BUILDINGS 11 (Feb. 2019), *available at* http://www.buildingdecarb.org/resources/a-roadmap-to-decarbonize-californias-buildings.
[277] NYPSC Case 18-M-0084, In re A Comprehensive Energy Efficiency Initiative, *Order Authorizing Utility Energy Efficiency and Building Electrification Portfolios Through 2025*, 4, 22 (Jan. 16, 2020).
[278] *Ductless Split Heat Pump Rebates,* ENERGIZE CONNECTICUT (Mar. 19, 2020), *available at* https://www.energizect.com/your-home/solutions-list/ductless-split-heat-pump-rebates.
[279] *Electric Heating and Cooling Equipment,* MASS SAVE, (March 19, 2020), *available at* https://www.masssave.com/saving/residential-rebates/electric-heating-and-cooling.
[280] *Air Source Heat Pumps,* MASSACHUSETTS CLEAN ENERGY CENTER, (Mar. 19, 2020), *available at* https://www.masscec.com/air-source-heat-pump-pilot.

also offers rebates for air-to-water heat pumps with integrated domestic hot water for $2,000.[281]

Turnover in building or unit ownership before the owner has recovered the cost of upgrades is a major barrier to investment in non-gas alternatives. Commercial and residential Property Assessed Clean Energy ("C-PACE" and "PACE") programs attempt to solve this challenge by creating a long-term obligation to pay for energy capital equipment that is collected via the property tax bill and thus transfers with building ownership. Utility on-bill financing is an alternative method that leverages the creditworthiness of the utility, allowing the cost of equipment to be recovered over years via the building's energy bill rather than being attached to the individual customer. NYSERDA offers an on-bill financing to customers purchasing qualifying air source or ground source heat pumps and heat pump water heaters.

[281] New Jersey's Clean Energy Program, *COOLAdvantage,* (Mar. 19, 2020), *available at* https://www.njcleanenergy.com/residential/programs/cooladvantage/heat-pumps#COOLAdvantage_rebate_table.

6. Next Steps

The Zero Net Gas policy framework represents the first steps toward decarbonizing the gas distribution utility and buildings sectors. To achieve deep decarbonization to advance climate and energy goals, states must further develop pathways to significantly reduce carbon emissions and scale up clean energy deployment. Ultimately, managed decapitalization of the gas system will be essential to providing regulatory and economic stability and assuring environmental outcomes in a transition away from gas infrastructure.

In establishing a managed decapitalization process, states must consider several factors. First, in integrating decarbonization within the operations and investments of regulated distribution utilities, states with competitive retail energy markets should consider how best to align utility business models and product offerings with gas policy aimed at achieving energy and climate objectives. Several states have expressed concerns in recent years regarding whether retail market competition has produced meaningful benefits to customers in terms of cost savings or environmental benefits.[282] New York, for example, is evaluating how its licensed energy service providers (known as "energy service companies" or "ESCOs") can provide value-added services to their customers, beyond the procurement of retail electricity or gas, such as energy efficiency or demand-response programs. As distribution utilities align their operations, investments, and business model with decarbonization policies, the retail energy markets must do the same.

Second, long-term decarbonization can build upon the processes and mechanisms established under the Zero Net Gas framework. States developing a pathway to managed decapitalization should consider the following elements of such a pathway:

- Reform rate design to incentivize customers and utilities to embrace alternatives to gas;
- Revise utility depreciation and amortization practices and acceleration schedules to align cost recovery with state decarbonization timelines;
- Amend regulatory barriers to reducing demand for gas, and ensure that utility service obligations continue to prioritize safe and reliable service at just and reasonable rates throughout the decarbonization transition;
- Reform utility resource planning to prioritize demand-side resources and fuel-neutrality among gas and electric utility efficiency and clean energy programs; and
- Support meaningful stakeholder engagement throughout the process, to ensure that all impacted parties—utilities, industry, commercial and residential customers, consumer advocates, environmental groups, frontline communities, and the clean energy trades—have the opportunity to contribute to the process.

As part of robust stakeholder participation, states should establish stakeholder intervenor funds, which can promote fairness in representation at public utility commission proceedings. Environmental justice, disadvantaged, and frontline communities are the most vulnerable to the impacts of fossil fuel use, yet the least likely or able to participate in regulatory proceedings, which require resources, time, and technical expertise. Intervenor funding can enable participation and provide greater input by impacted communities. In addition, capacity-building

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[282] *See,* e.g., Massachusetts Attorney General's Office, *Are Consumers Benefiting from Competition? An Analysis of the Individual Residential Electric Supply Market in Massachusetts* (March 2018), *available at* https://www.mass.gov/doc/comp-supply-report-final/download. *See also*, NYPSC Case 15-M-0127, In the Matter of Eligibility Criteria for Energy Service Companies, *Order Adopting Changes to the Retail Access Energy Market and Establishing Further Process* (Dec. 12, 2019).

resources, such as training on regulatory procedure and substance, would further enhance participation for these stakeholders.

Finally, states aiming to decarbonize their gas systems must consider the financial costs and benefits of meeting those goals over time, as well as the broader economic impacts of the transition. Regulators must consider the economic impacts on communities dependent upon fossil fuels industries. In this context, regulators should look to energy and climate policy as a mechanism and tool for economic development. In developing transition mechanisms, states should prioritize workforce training, job creation, and incentives to spur jobs growth in the clean energy industry. In the buildings sector, renewables, efficiency and weatherization, beneficial electrification, and smart energy management technologies offer not just a pathway to decarbonization, but opportunities for jobs and prosperity.